# Lincoln Eastern Bypass

**Environmental Statement**

**Volume 1 – Environmental Statement**

December 2012

*Produced by*

Lincolnshire COUNTY COUNCIL
HIGHWAYS ALLIANCE

## Preface

Lincolnshire County Council, in partnership with City of Lincoln, North Kesteven District and West Lindsey District Councils is proposing to build a Bypass Road to the east of the City to alleviate potential congestion problems. This Environmental Statement (ES) reports the findings of detailed environmental assessments undertaken during the development of the proposed scheme.

Information relating to the Environmental Statement and supporting documentation is available in one Non Techincal Summary (also available as a separate stand alone document) and three Volumes:

**Non Technical Summary**

**Volume 1 - Environmental Statement**

**Volume 2 – Supporting Information**

**Volume 3 – Technical Appendices**

The Environmental Statement will be available to view at the Highway Alliance's offices:

Witham Park House, Waterside South. Lincoln, LN5 7JN

Please contact John Pollard at john.pollard@mouchel.com to organise viewing or request a copy.

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# ACRONYMS

| | |
|---|---|
| AADT | Annual Average Daily Traffic |
| A&E | Accident and Emergency |
| AQMA | Air Quality Management Area |
| AQS | Air Quality Strategy |
| AW | Anglian Water Services |
| BAP | Biodiversity Action Plan (habitats and species) |
| BCT | Bat Conservation Trust |
| bgl | below ground level |
| BGS | British Geological Survey |
| BS | British Standard |
| CA | Conservation Area |
| $CaCO_3$ | Calcium Carbonate |
| CAMS | Catchment and Abstraction Management Strategies |
| CCMP | City Centre Master Plan |
| CEMP | Construction Environmental Management Plan |
| CIRIA | Construction Industry Research and Information Association |
| CLC | City of Lincoln Council |
| CO | Carbon Monoxide |
| CRoW | Countryside and Rights of Way Acts |
| CRTN | Calculation of Road Traffic Noise |
| dB | Decibels |
| Defra | Department for Environment, Food and Rural Affairs |
| DM | Do Minimum |
| DMRB | Design Manual for Roads and Bridges |
| DS | Do Something |
| EA | Environment Agency |
| EC | European Commission |
| EHO | Environmental Health Officer |
| EIA | Environmental Impact Assessment |
| EMDA | East Midlands Development Agency |
| EPA | Environmental Protection Act |

| | |
|---|---|
| EPS | European Protected Species |
| EPUK | Environmental Protection UK |
| ES | Environmental Statement |
| EU | European Union |
| EWL | Lincoln Eastern Bypass |
| FEH | Flood Estimation Handbook |
| FRA | Flood Risk Assessment |
| GI | Ground Investigation |
| GLVIA | Guidelines for Landscape and Visual Impact Assessment |
| ha | Hectare |
| HA | Highways Agency |
| HAWRAT | Highways Agency Water Risk Assessment Tool |
| HDV | Heavy Duty Vehicle |
| HER | Historic Environment Record |
| HGV | Heavy Goods Vehicle |
| IEEM | Institute of Ecology and Environmental Management |
| IEMA | Institute of Environmental Management and Assessment |
| IfA | Institute for Archaeologists |
| IoA | Institute of Acoustics |
| JNCC | Joint Nature Conservation Committee |
| LCC | Lincolnshire County Council |
| LCCHA | Lincolnshire County Council Highways Alliance |
| LGV | Light Goods Vehicle |
| LNR | Local Nature Reserve |
| LTS | Lincoln Transport Strategy |
| LWS | Local Wildlife Site |
| km | Kilometres |
| kph | Kilometres per hour |
| l/s | litres per second |
| LCC | Lincolnshire County Council |
| LDF | Local Development Framework |
| LHD | Lincoln Heritage Database |
| m | Metres |
| MAGIC | Multi-Agency Geographic Information for the Countryside |

| | |
|---|---|
| MfS | Manual for Streets |
| µg | micrograms |
| NERC | Natural Environment and Rural Communities |
| NCA | National Character Area |
| NIR | Noise Insulation Regulations |
| NMR | National Monuments Record |
| NNR | National Nature Reserve |
| $NO_2$ | Nitrogen Dioxide |
| NPPF | National Planning Policy Framework |
| ODPM | Office of the Deputy Prime Minister |
| OS | Ordnance Survey |
| PAHs | Polyaromatic hydrocvarbons |
| Pb | Lead |
| PCBs | Polychlorinated biphenyls |
| PM | Particulate Matter |
| PM10s | Particulate Matter less than 10mm in diameter |
| PPG | Planning Policy Guidance |
| PPS | Planning Policy Statement |
| PVC | Polyvinyl cholride |
| RE | River Ecosystem |
| RSS | Regional Spatial Strategy |
| SAAR | Standard Average Annual Rainfall |
| SAC | Special Area of Conservation |
| SBI | Site of Biological Importance |
| SINC | Site of Importance for Nature Conservation |
| SLC | Saved Lincoln City Local Plan |
| SLINC | Site of Local Importance for Nature Conservation |
| s/n | Serial number |
| SPA | Special Protection Area |
| SPR | Standard Percentage Runoff |
| SPZ | Source Protection Zone |
| SSSI | Site of Special Scientific Interest |
| SUDS | Sustainable Urban Drainage System |
| SWMP | Site Waste Management Plan |

| | |
|---|---|
| TCA | Townscape Character Area |
| TPHs | Total petroleum hydrocarbons |
| TTM | Temporary Traffic Management |
| TRRL | Transport and Road Research Laboratory |
| UK | United Kingdom |
| WFD | Water Framework Directive |
| ZVI | Zone of Visual Influence |

# 1 Introduction

## 1.1 The Proposed Scheme

1.1.1 Lincolnshire County Council (LCC) is working in partnership with the City of Lincoln, North Kesteven District and West Lindsey District Councils to deliver a major project called the Lincoln Eastern Bypass Road. The Lincoln Eastern Bypass (LEB) is part of the joint vision to make Lincoln and the surrounding communities better places in which to work and live, and is an essential component of the Council's strategy to encourage growth and regeneration.

1.1.2 The Proposed Scheme will be a single carriageway road through an area of predominantly arable farmland. The Proposed Scheme will provide a new road linking the existing Northern Relief Road to the A15 in the south of Lincoln. It will also provide a crossing of the River Witham, Lincoln to Market Rasen railway line and the Lincoln to Spalding railway Line. The scheme will be located to the east of the city of Lincoln and the villages of Canwick and Bracebridge Heath, and to the west of the outlying villages of North Greetwell, Cherry Willingham, Washingborough and Branston (see Figure 1-1).

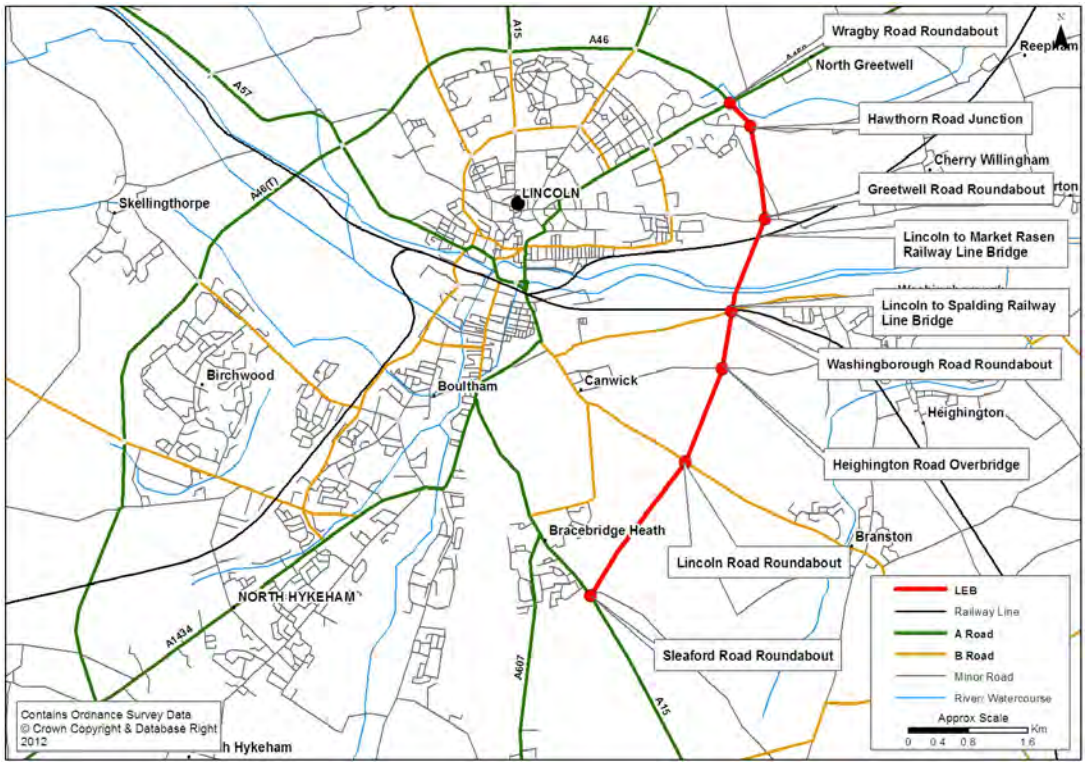


*Figure 1-1 Location Plan*

1.1.3 The *Red Line Plan* is available in Volume 2 – Supporting Information.

#### *The Preferred Option*

1.1.4 The Proposed Scheme will provide a new 7.5km single carriageway relief road that will link the junction of the A15 and A158 Wragby Road to the A15 Sleaford Road. The new route will have a design speed of 100kph and a separate 3m wide combined cycle and pedestrian right of way (located on the western side of the carriageway) provided along the full length of the scheme to link up with existing Public Rights of Way. The Proposed Scheme is described in full in Chapter 4.

## 1.2 The Environmental Impact Assessment

1.2.1 The Proposed Scheme has been subject to a process of Environmental Impact Assessment (EIA) in accordance with European Directives as transposed into Town and Country Planning (EIA) Regulations 2011. This Environmental Statement (ES) reports the findings of the EIA.

#### *Assessment Guidelines*

1.2.2 The scope of this EIA was based on that undertaken to accompany the planning application for the previous dual carriageway version of the LEB, approved in August 2009. Whilst the current proposal is now for a smaller single carriageway it was agreed with the LCC Planning Officer Neil McBride in August 2012 that the scope of the EIA should remain the same, as the significant impacts were likely to be of a similar magnitude and nature.

1.2.3 Individual assessment chapters stipulate whether the baseline data and/or the assessment findings from the 2009 EIA, have been used as primary material. The Environmental Statement produced in 2009 is available in Volume 3 – Technical Appendices.

1.2.4 This EIA has been conducted following the guidelines detailed in the Design Manual for Roads & Bridges (DMRB), as it outlines a set of standardised and comprehensive processes for identifying and assessing environmental impacts associated with significant road schemes (Volume 11 provides a framework for assessing and reporting on environmental effects and their resultant impacts).

## 1.3 Structure of the Environmental Statement

1.3.1 The Environmental Statement is presented in three volumes:

- Volume 1: Environmental Statement
- Volume 2: Supporting Information (figures, tables, correspondence, etc)
- Volume 3: Technical Appendices (freestanding documents)

1.3.2 A Non-Technical Summary is provided at the front of Volume 1 and is also available as a separate stand alone document.

### *Volume 1 – Environmental Statement*

1.3.3 There are 17 chapters in Volume 1 covering an introduction to the proposed development, outlining the consultation process, providing an overview of the existing environment, reporting the findings of the detailed environmental assessments and identifying predicted residual environmental effects and describing the interactions of predicted impacts on receptors and any cumulative impacts. Finally, the last chapter provides a schedule of the Environmental Commitments, comprising the design and mitigation measures proposed in relation to the various environmental impacts, and to be implemented through the scheme construction and operation.

### *Volume 2 – Supporting Information*

1.3.4 Volume 2 includes figures, tables and data, referred to in Volume 1, in support or explanation of the description of the existing environment and the Proposed Scheme and the evaluation and assessment of the predicted impacts. It also includes additional detail which supports the information provided in the main text.

### *Volume 3 – Technical Appendices*

1.3.5 Volume 3 comprises appendices containing relevant detailed reports of the assessments and supporting detail and documentation relevant to the individual assessments.

### *Non-Technical Summary*

1.3.6 The Non-Technical Summary describes the above mentioned project in general and outlines the summary of the respective Environmental Impacts and means of mitigation.

## 1.4 Format of the Assessment Chapters

1.4.1 A common format has been adopted for the reporting of the assessments undertaken for each of the environmental aspects investigated, which is as follows.

### *Scope of the Assessment*

1.4.2 This section describes the potential impacts identified during scoping. It explains the nature of the potential impacts, the specific assessments considered appropriate, the extent of the study area and the timescales considered.

### *Statutory and Planning Context and Guidance*

1.4.3 This section outlines statutes, guidance, policies and plans relevant to the assessment reported in the chapter

### *Method of Assessment*

1.4.4 This section details the method of assessment adopted. It reflects good practice and guidelines on assessment published by professional organisations.

### *Baseline Environment*

1.4.5 This section includes a description of the key components (resources and receptors) and characteristics of the baseline environment and the status of the environment.

1.4.6 Environmental resources are defined as those aspects of the environment that support and are essential to natural or human systems. These include ecosystems, soil, water, air and climatic factors, material assets, landscape, watercourses, community facilities etc.

1.4.7 Environmental receptors are defined as people (occupiers of dwellings and users of recreational areas, places of employment and community or other facilities), plants and animals, that rely on resources.

### *Predicted Impacts*

1.4.8 Impacts comprise identifiable changes in the baseline environment which would occur or be likely to occur as a consequence of the construction and use of the Proposed Scheme. Impacts may be referred to either prior to or following mitigation.

1.4.9 The assessment evaluates and describes the nature of impacts predicted.

1.4.10 Impacts may be direct (the loss of habitat to accommodate the scheme), or indirect (reduced connectivity as a result habitat loss). They may be short-term/temporary (eg dust associated with construction) medium-term (eg cutting back of planting subsequently allowed to regenerate) or long-term/permanent (eg removal of contamination). They may be beneficial (eg screening of an existing eyesore), neutral; or adverse (eg loss of an attractive landscape component).

### *Proposed Mitigation*

1.4.11 This section describes the mitigation measures identified in order to reduce a significant impact to an acceptable level. The principles adopted during the identification of mitigation measures is one of avoidance if possible, reduction

where avoidance cannot be achieved, or compensation where practical and acceptable reduction cannot be achieved.

### *Residual Effects / Summary and Conclusions*

1.4.12 This section provides a summary of the potential impacts and resulting significance of the residual effects, after mitigation, from the construction and operation of the Proposed Scheme.

1.4.13 It summarises the Chapter's main points and the predicted environmental impacts remaining after any mitigation measures have been implemented.

# 2 Need for the Scheme

## 2.1 Introduction

2.1.1 This chapter identifies the Lincoln Eastern Bypass (LEB) scheme as essential to the delivery of the local policy and strategy objectives. It also highlights the current transport related problems and issues within Lincoln and the role of the Proposed Scheme in addressing these problems.

## 2.2 Policy and Strategy

2.2.1 This section sets out the central role of the Proposed Scheme as identified within the Lincoln Transport Strategy (LTS) and the Central Lincolnshire Core Strategy.

### *Lincoln Transport Strategy*

2.2.2 In 2004, Lincolnshire County Council and its partners (City of Lincoln, North Kesteven and West Lindsay District Councils) commissioned the Lincoln Transport Strategy to build a framework for the prioritisation of transport improvements in and around the Lincoln Policy Area up to 2026. The development of the strategy involved identifying the key transport issues affecting the Lincoln area, generating a number of strategic objectives, and identifying a range of transport interventions that would address the problems identified.

2.2.3 The existing transport issues and forecast problems were formulated through a combination of extensive consultation and from technical outputs from the Lincoln Traffic Model. The process highlighted that the majority of issues and problems identified, centred on congestion, lack of route choice, high volumes of through traffic and poor air quality.

2.2.4 The strategy identified 18 potential transport interventions. These were further refined through evaluating each against the strategic objectives, their ability to address the identified transport challenges, cost and public acceptability. This resulted in a prioritised list of potential options. The Proposed Scheme was identified as the priority scheme that will help achieve the overall aims and objectives that are set out within the LTS.

### *Central Lincolnshire Core Strategy*

2.2.5 The City of Lincoln, North Kesteven District and West Lindsay District in partnership with Lincolnshire County Council, have joined together to prepare a joint development plan (Core Strategy) for their area which is collectively known as Central Lincolnshire.

2.2.6 The Draft Core Strategy will guide all new development and future planning applications in Central Lincolnshire up to 2031. The strategy sets out a clear vision for Central Lincolnshire and contains planning policies to be applied to new development. The Draft Core Strategy identifies a target of 42,800 dwellings and 210 ha of employment land to be built in Central Lincolnshire by 2031, of this 18,800 dwellings and 140ha is identified to be built in and adjacent to the Lincoln Policy Area

## 2.3 Transport Issues and Problems

### *Existing Situation*

2.3.1 Lincoln suffers from a number of transport related problems and issues that have a significant impact on journey times throughout the city. These, in turn, have a negative impact on the wider Lincoln economy and act as a restraint to regeneration and the city's development aspirations. A number of the problems are long-standing and, as discussed, these were identified and investigated as part of the development of the LTS.

2.3.2 Lincoln's city centre currently suffers from high levels of congestion, from local and strategic traffic movements, which impacts on the quality of life for local residents, acts as a constraint to the economy and reduces the attractiveness of the city for visitors and investors.

2.3.3 A lack of route choice has long been identified as a problem for north-south movements through the city. A number of key strategic north-south routes converge on the city centre, with no viable alternative routes. This results in significant levels of traffic being channelled through the centre of Lincoln.

2.3.4 The predicted increase in traffic flows would have a detrimental impact on all users of the network. Public Transport would experience the same increase in journey times as private car users, impacting on the efficiency and reliability of services. It is also likely that pedestrians and cyclists would also suffer through increased levels of severance impacting on the attractiveness of cycling and walking within and around Lincoln.

2.3.5 The primary transport problems and challenges that were identified within the LTS are detailed within Table 2-1.

*Table 2-1 Key Transport Problems and Issues Identified in the Lincoln Transport Strategy*

| Area | Identified Transport Problems and Issues |
|---|---|
| Highways and Infrastructure | Lack of suitable route choice for transport to the south & east of the study area<br>High volumes of HGVs and through traffic in the City Centre because of lack of alternative routes<br>Congestion in the City Centre and on radial routes leads to unreliable journey times and delays<br>Over-dependence on the private car across Lincoln<br>Waterways form a natural constraint with few crossing points<br>Railways create a constraint, particularly the two level crossings in the City Centre<br>Buildings and developments create a built constraint to infrastructure improvements throughout the City. |
| Walking & Cycling | Lack of provision of cycling paths<br>Security concerns associated with cycle routes<br>Inadequate and unsafe cycle parking<br>Hills make cycling in some areas difficult<br>Busy roads with narrow footways make pedestrian routes unattractive<br>Pedestrian severance between residential areas and the City Centre. |
| Environment | The historic 'uphill' area of the City Centre has many historic buildings and narrow streets<br>High noise levels on some strategic routes<br>Poor air quality in the City Centre and Air Quality Management Areas. |
| Safety | High accident occurrence in several areas over recent years due to unsuitable traffic levels<br>Susceptibility of cyclists and pedestrians to accidents in the City Centre. |
| Parking | Parking mainly centred in the lower part of the City Centre. |
| Public Transport | Railway capacity underused, especially by commuters<br>Limited local railway stations in Lincoln<br>Poor quality trains<br>No direct trains to London<br>Congestion leads to reduced levels of bus service<br>Low frequency of bus services on Sunday and in the evenings<br>Poor quality bus station<br>Low proportion of low-floor buses<br>Lack of cross-city services<br>Low and declining bus patronage. |

### *Future Situation*

2.3.6 A number of the transport problems and challenges facing Lincoln are expected to increase over the mid to long term which will place further stress on the highway network and likely have a significant impact on the local economy and Lincoln's development aspirations. Traffic levels are forecast to continue to grow within the Lincoln Area and this will lead to increased problems and pressure on the highway network. It is important to stress that much of the network already

operates above capacity during peak periods, resulting in little scope for increased demand to be accommodated on the existing network. A continued lack of route choice will also exacerbate the problems on existing routes.

## 2.4 Lincoln Eastern Bypass Statement of Need

2.4.1 As described, the Proposed Scheme forms an intrinsic part of the LTS and is a key intervention that will help achieve the transport aims and objectives identified in the Strategy as well as the development aspirations of LCC. The Proposed Scheme is considered to be necessary to help alleviate the problems caused by congestion and support the delivery of national and local policy agendas identified for Lincoln up to 2031. Without the addition of the Proposed Scheme, the existing problems are forecast to increase and the challenges currently facing Lincoln will be exacerbated.

2.4.2 It is important to note that the LTS includes a large number of sustainable transport measures designed to improve conditions in the city and to assist businesses with their economic growth strategies. The Proposed Scheme will be fundamental in the successful delivery of the other measures outlined by the LTS by removing the extraneous traffic from the centre and creating the conditions necessary for their implementation.

2.4.3 It is also important to note that significant housing and economic development is targeted for the Lincoln area, having gained Growth Point status from the Government in 2008. Regional and Local targets are for an additional 42,800 dwellings and 210ha of employment land within the Central Lincolnshire area by 2031 of which the North East and South East Quadrant development sites and the Western Gateway Corridor are key to the delivery of these growth aspirations. These urban extensions have the potential to accommodate a significant level of development within the Lincoln area and the implementation of the LTS (including LEB) will be necessary to facilitate and support their delivery without exacerbating the current problems identified in the current network.

2.4.4 The forecasted future conditions would also have a detrimental impact on the growth strategy for Lincoln and specifically for the Growth Point agenda in the Lincoln Policy Area. The Proposed Scheme is a key infrastructure development that will facilitate the growth aspirations and the economic development of Lincoln and the Lincoln Policy area.

2.4.5 It is important to stress that any deterioration of conditions in the City Centre would have a detrimental impact on local businesses and the public realm. This would reduce Lincoln's ability to attract investment from the business community and detract from Lincoln's setting as a tourist destination. Any impact on this would have serious implications for the local and regional economy.

## 2.5 Summary

2.5.1 The Proposed Scheme forms an intrinsic part of the LTS which is fundamental in facilitating Lincoln's continued economic development. The scheme will act as a catalyst for the further development and implementation of a number of wider initiatives and schemes (as detailed within the LTS) as well as providing the necessary infrastructure to help deal with the transport problems detailed above. As a result the Proposed Scheme has three clear objectives:

- **Objective 1:** To support the delivery of sustainable economic growth and the Growth Point agenda within the Lincoln Policy Area through the provision of reliable and efficient transport infrastructure.
- **Objective 2:** To improve the attractiveness and liveability of central Lincoln for residents, workers and visitors by creating a safe, attractive and accessible environment through the removal of strategic through traffic (particularly HGVs).
- **Objective 3:** To reduce congestion, carbon emissions, improve air and noise quality within the Lincoln Policy Area, especially in the Air Quality Management Area in central Lincoln, by the removal of strategic through traffic (particularly HGVs).

# 3 Consideration of Alternatives

## 3.1 Introduction

3.1.1 The aim of this chapter is to highlight how environmental resources and receptors have been taken into consideration throughout the scheme options, development and design phases completed to date.

3.1.2 Avoidance and mitigation of potential environmental impacts were key considerations in the iterative design process of the Lincoln Eastern Bypass.

## 3.2 Consideration of Alternatives – Stages 1 and 2

3.2.1 The two-stage consideration of Alternatives was undertaken over the course of 2007 and 2008 and summarised in the Environmental Statement produced in 2009.

### *Route Corridors Considered at Stage 1*

3.2.2 During the Stage 1 assessment, carried out in 2007, five potentially feasible corridors were assessed. To the north of Washingborough Road, the corridors were constrained by Greetwell Quarry, Greetwell Hall, Scheduled Ancient Monuments and the Conservation Area of Washingborough. Hence the corridors in this area all followed the same line. To the south of Washingborough Road, the five corridors diverged.

3.2.3 The results of the Stage 1 assessment were presented in the Lincoln Eastern Bypass Stage 1 Assessment Report (Jacobs and Lincolnshire County Council, February 2008).

3.2.4 The corridors were identified as follows:

- Blue Corridor – 7.4km long, terminating north of Waddington Airfield;
- Orange Corridor – 7.8km long, terminating north of Waddington Airfield;
- Green Corridor – 9.2km long, terminating south of Waddington Airfield;
- Brown A Corridor – 7.4km long, terminating north of Waddington Airfield; and
- Brown B Corridor – 9.5km long, terminating south of Waddington Airfield.

3.2.5 The Stage 1 assessment found that all five corridors would have similar environmental impacts, although the impacts of the Blue and Brown A Corridors would be slightly less adverse than the impacts of the other corridors. These corridors were used as the basis for the route options considered at Stage 2.

3.2.6 Table 3-1 is taken from the Stage 1 Assessment Report, and provides an overview of the impacts of the five corridors.

*Table 3-1 Summary of Environmental Impacts identified at Stage 1*

| Impact Area | Effects | Units | Blue Corridor | Orange Corridor | Green Corridor | Brown A Corridor | Brown B Corridor |
|---|---|---|---|---|---|---|---|
| Air Quality | Sensitive properties | Number | None | None | None | None | None |
| | Total properties | Number | 7 | c.32 | c.30 | 5 | 5 |
| | Change in air quality within AQMAs | - | Positive | Positive | Positive | Positive | Positive |
| | In terms of air quality, the two brown corridors would be the preferred options | | | | | | |
| Cultural Heritage | Legally Designated Sites | Number | 2 | 3 | 3 | 2 | 2 |
| | Non-Legally Designated Sites | Number | 67 | 65 | 57 | 58 | 61 |
| | Total | Number | 69 | 68 | 60 | 60 | 63 |
| | At this stage, there is no preferred corridor based on cultural heritage | | | | | | |
| Disruption due to Construction | Residential properties affected | Number of properties within corridor | 7 | c.32 | c.30 | 5 | 5 |
| | Public Rights of Way affected | Numbers and types | See section on Pedestrians, Cyclists, Equestrians and Community Effects | | | | |
| | Existing roads affected by the corridors | Number | 9 | 9 | 11 | 9 | 10 |
| | At this stage, the Brown A corridor is the preferred option in terms of disruption due to construction | | | | | | |
| Ecology and Nature Conservation | Designated sites | Number | 2 | 2 | 2 | 2 | 2 |
| | At this stage, there is no preferred corridor in terms of ecology | | | | | | |
| Landscape and Visual Effects | Landscape Impact | Summary | Minimal cuttings and embankments required. Minimal intrusion into wider countryside. | Disruption of a Relatively tranquil and remote area around Ashfield. | Long route, Hence increased landscape impacts. Disruption to local road and track network | Isolates small areas of farmland | Isolates small areas of farmland. Long route, hence increased landscape impacts. |

| Impact Area | Effects | Units | Blue Corridor | Orange Corridor | Green Corridor | Brown A Corridor | Brown B Corridor |
|---|---|---|---|---|---|---|---|
| | Visual impact | Significance | Slight adverse over the blue section, with moderate adverse over the purple section | Moderate Adverse | Severe Adverse (with moderate adverse along purple section) | Moderate Adverse | Moderate Adverse |
| | At this stage, the Blue corridor is the preferred option in terms of landscape and visual amenity | | | | | | |
| Land Use | Properties affected | Number | 7 | c.32 | c.30 | 5 | 5 |
| | Listed buildings | Number | 3 | 2 | 4 | 2 | 2 |
| | Agricultural land affected | Land classification | 2 | 2 | 2 and 3 | 2 | 2 and 3 |
| | At this stage, there is no preferred corridor in terms of land use | | | | | | |
| Traffic Noise and Vibration | Noise reduction | Locations | Existing A15 and other routes within Lincoln | Existing A15 and other routes within Lincoln | Existing A15 and other routes within Lincoln | Existing A15 and other routes within Lincoln | Existing A15 and other routes within Lincoln |
| | Noise increase within corridor | Number of properties within corridor | 7 | c.32 | c.30 | 5 | 5 |
| | Noise increase on roads leading to and from the corridor | Number of access roads | 5 | 5 | 5 | 5 | 5 |
| | At this stage, the Brown A and B corridors are preferred, based upon traffic noise and vibration | | | | | | |

| Impact Area | Effects | Units | Blue Corridor | Orange Corridor | Green Corridor | Brown A Corridor | Brown B Corridor |
|---|---|---|---|---|---|---|---|
| Pedestrians, Cyclists, Equestrians and Community Effects | Public Rights of Way affected | Public Rights of Way within corridor | 6 footpaths<br>2 bridleways<br>1 equestrian route<br>3 cycle routes<br>3 quiet lanes | 5 footpaths<br>2 bridleways<br>1 equestrian route<br>3 cycle routes<br>3 quiet lanes | 6 footpaths<br>3 bridleways<br>1 equestrian route<br>3 cycle routes<br>3 quiet lanes | 5 footpaths<br>2 bridleways<br>1 equestrian route<br>3 cycle routes<br>3 quiet lanes | 5 footpaths<br>3 bridleways<br>1 equestrian route<br>3 cycle routes<br>3 quiet lanes |
| | At this stage, there is only a slight difference between the options | | | | | | |

### *Route Options Considered at Stage 2*

3.2.7 Three potential routes were identified based on the Blue and Brown A Corridors identified during Stage 1, and were subject to a comparative assessment at Stage 2.

3.2.8 The results of the Stage 2 Environmental Assessment were presented in the Lincoln Eastern Bypass Stage 2 Environmental Assessment Report (Jacobs and Lincolnshire County Council, January 2008)

3.2.9 The three routes were known as X, Y and Z. The northern sections of all three routes, between Wragby Road and Washingborough Road, were identical. Further south, the routes varied in alignment, although all three routes joined the A15 at the same proposed junction, to the north of Waddington Airfield.

3.2.10 Route X was the most westerly route, Route Z was the most easterly route, and Route Y was between them. All routes were to the east of the villages of Canwick and Bracebridge Heath and to the west of Branston.

3.2.11 The Stage 2 Environmental Assessment found that, as the three routes were in close proximity to each other and were of similar lengths, they would have similar beneficial and adverse environmental impacts. Route Z would be marginally preferred in terms of soils and geology, air quality and water quality, while Route X would be marginally preferred in terms of land take, landscape and visual amenity.

3.2.12 Table 3-2 summarises the environmental effects of the route options assessed at Stage 2.

3.2.13 At the end of the Stage 2 Assessment, the findings were used for a public consultation exercise, leading to the identification of the preferred route option to be the subject of a full Environmental Impact Assessment (EIA) at Stage 3.

*Table 3-2 Summary of Environmental Effects from Stage 2*

| | Measure | Route Option X | Route Option Y | Route Option Z |
|---|---|---|---|---|
| Air Quality | Properties with an improvement in air quality | 3079 | 2800 | 3079 |
| | Properties with no change | 198 | 562 | 323 |
| | Properties with a deterioration in air quality | 1034 | 947 | 902 |
| | Air Quality assessment score | -517.00 | -496.14 | -537.74 |
| | **Rank** | **3** | **2** | **1** |
| Noise and Vibration | Properties within 100m of route | 34 | 32 | 31 |
| | **Rank** | **3** | **2** | **1** |
| Cultural Heritage | Known cultural heritage sites affected | 88 | 87 | 80 |
| | Risk of unknown archaeological sites being discovered | Least Risk | - | Greatest Risk |
| | **Rank** | No preferred option based on cultural heritage at this stage | | |
| Landscape and Visual Impacts | Effects arising from northern section | Major effects would arise, particularly in the Witham Valley. The route options are identical along this section. | | |
| | Effect on southern slope | Cutting is at an angle to the slope and may be screened | Cutting is at an angle to the slope and may be screened | Cutting is direct and difficult to screen. Impact on open countryside to west of Branston. |
| | **Rank** | **1** | **2** | **3** |
| Ecology and Nature Conservation | **Rank** | No preferred option based on ecology at this stage, as the effects are broadly similar between options, and all effects are of moderate significance. This is unlikely to change following additional survey and assessment. | | |
| Road Drainage and the Water Environment | Impacts on surface water | Low significance | Low significance | Low significance |
| | Impacts on flood risk | No change | No change | No change |
| | **Rank** (with mitigation in place) | **2** | **3** | **1** |
| Soils and Geology | Significant constraints | Greetwell Quarry Geological SSSI, Lincoln | Greetwell Quarry Geological SSSI, Lincoln | Greetwell Quarry Geological SSSI, Lincoln |

| | Measure | Route Option X | Route Option Y | Route Option Z |
|---|---|---|---|---|
| | | Edge escarpment, and superficial deposits associated with surface watercourses. | Edge escarpment, and superficial deposits associated with surface watercourses. | Edge escarpment, and superficial deposits associated with surface watercourses. |
| | **Rank** | **2** | **2** | **1** |
| Land Use | Impact on private property, land used by the community and development land | Neutral | Neutral | Neutral |
| | Land take | 38.4 hectares | 40.4 hectares | 39.5 hectares |
| | **Rank** | **1** | **3** | **2** |
| Pedestrians, Equestrians, Cyclists and Community Effects | Severance | No significant severance caused. Reduced severance in city centre, new crossing of River Witham and links to rights of way | No significant severance caused. Reduced severance in city centre, new crossing of River Witham and links to rights of way | No significant severance caused. Reduced severance in city centre, new crossing of River Witham and links to rights of way |
| | **Rank** | **1** | **2** | **2** |
| Vehicle Travellers | **Rank** | **1** | **2** | **2** |
| Disruption due to Construction | Number of residential properties within 100m | 34 | 32 | 31 |
| | **Rank** | **3** | **2** | **1** |
| Policies and Plans | Net effect | Positive | Positive | Positive |
| | Land take (links to environmental protection policies) | 38.4 hectares | 40.4 hectares | 39.5 hectares |
| | **Rank** | **1** | **3** | **2** |

### *Preferred Option*

3.2.14 Route Z was identified by Lincolnshire County Council as the preferred option for the Lincoln Eastern Bypass, following the Stage 2 assessment and public consultation.

3.2.15 Following the announcement of the preferred route, the design development process began, and the proposals submitted in 2009 were developed from Route Z. The Environmental Impact Assessment has been carried out alongside the design development, with close liaison with the design team to ensure that environmental considerations have been addressed where possible in the design of the road.

## 3.3 Consideration of Alternatives – Programme Entry

3.3.1 The 2010 Coalition Spending Review meant that the dual carriageway LEB was not taken forward to programme entry. However, the Department for Transport (DfT) announced that funding would be available through the development pool process for schemes that looked to revise the total cost required from DfT. As a result a value engineering process was undertaken to look for opportunities to reduce the overall scheme cost of the LEB.

3.3.2 The exercise looked to assess all possible changes in scope and all potential value engineering options in order to develop the most effective solution. Specifically, the exercise looked at changes to highway design, earthworks, structures, drainage, lighting, construction and environmental measures. It evaluated each option in relation to the impact on overall scheme objectives, the wider aims of the LTS, the value for money objectives and whether it was achievable. The exercise resulted in considering the following options:

i. A partial dual carriageway;

ii. Removing the proposed NMU route;

iii. Reducing/removing lighting across the length of the route;

iv. Reducing the length of the route,

v. Single carriageway with future proofed structures; and

vi. Single carriageway with single carriageway structures.

3.3.3 An assessment was undertaken for these options but all except ‘v’ were discarded on the basis of feasibility, value for money, or contribution to scheme objectives. Option ‘v’ was taken forward as the revised LEB scheme proposal.

# 4 Site Context and Proposed Scheme

## 4.1 Site Context

4.1.1 The Proposed Scheme will involve the construction of a single carriageway road linking the existing Northern Relief Road to the A15 south of Lincoln. It will run east of the city of Lincoln and the villages of Canwick and Bracebridge Heath, and to the west of the outlying villages of North Greetwell, Cherry Willingham, Washingborough and Branston (see Figure 4-1). It also provides a crossing of the River Witham, Lincoln to Market Rasen railway line and the Lincoln to Spalding railway Line.

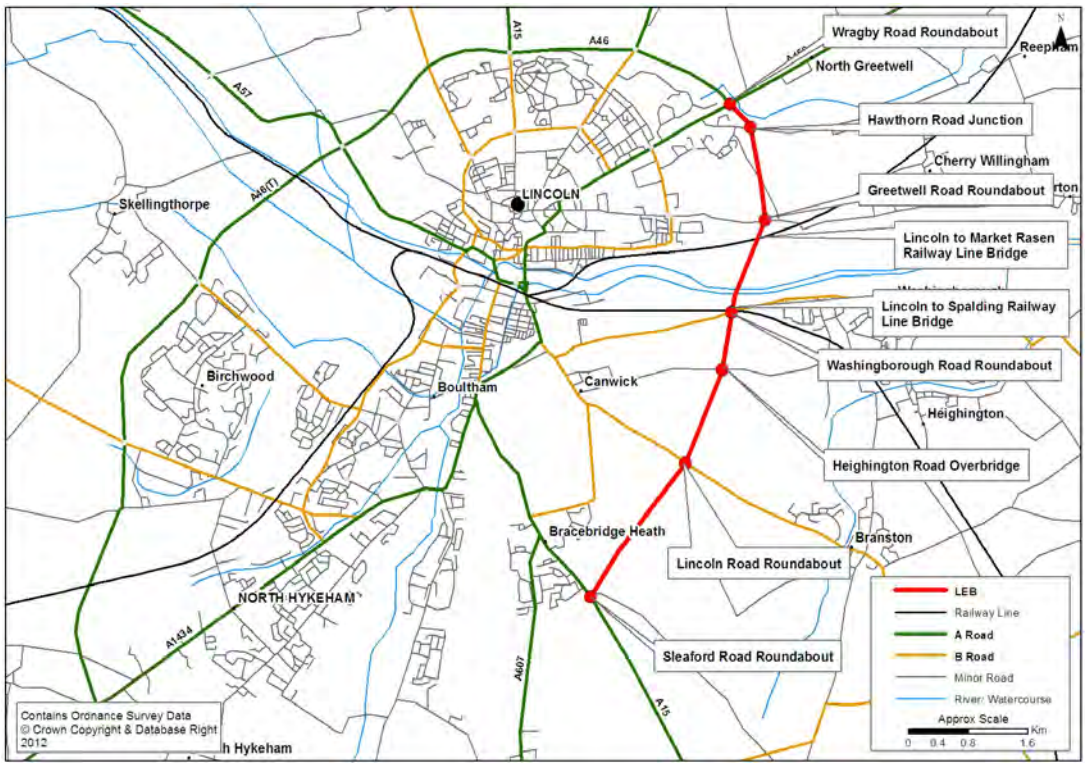


*Figure 4-1 – Lincoln Eastern Bypass Route*

4.1.2 Topography of the land along the northern and southern extents of the scheme is raised on plateau, with land slopping and dropping into a valley for the River Witham along the central portion of the proposed bypass.

4.1.3 Land use in the immediate vicinity of the Proposed Scheme is predominantly arable farmland with various habitats sparsely represented including: improved and semi improved grassland, broadleaved woodland and plantation, and hedgerows. An area of farmland along the River Witham is classified as Flood Plain Grazing Marsh.

4.1.4 The principle watercourses in the study area (from north to south) comprise of the Reeham Beck, Wragby Road Ditch, Greetwell Fields Drain, North Delph, River Witham (EA designated 'Main River'), South Delph (EA designated 'Main River'), Canwick Fen Drain, Branston Brook Tributary and the Ashfield Beck. Additionally there is a network of smaller streams, drains and ditches throughout and within close proximity to the study corridor. One notable flood plain and flood risk area has been identified in the study area. This is associated with the River Witham/ Delph System/ Canwick Fen drain corridor.

4.1.5 The bedrock geology in the northern and southern sections of the study area is dominated by the Lincolnshire Limestone, designated as a Principal Aquifer of High Vulnerability. The older strata located in the Witham Valley and the younger strata located in the north and to the east of the study area are a succession of aquifers and aquitards grouped together and classified as Secondary Aquifers.

4.1.6 A single Site of Special Scientific Interest (SSSI), Greetwell Hollow Quarry, abuts the western edge of the proposed Greetwell Road roundabout and is designated for its geological interest and is in favourable condition.

4.1.7 There are five non statutory designated sites, but no statutory sites, for ecology and nature conservation within the study area. These include three Sites of Nature Conservation Interest (SNCIs) - Greetwell Wood, Washingborough Junction Canwick Hall Woods - plus two Local Wildlife Sites (LWS) - Witham Corridor, and Greetwell Junction Railway Embankment.

4.1.8 A single Scheduled Monument - Greetwell Medieval Village, Cultivation and Post Medieval Garden Remains - has been identified in proximity to the Proposed Scheme, to the east of the proposed Greetwell Road roundabout. Archaeological remains have been found in the study area as far back as the Mesolithic period. Additionally, Lincoln was an important town in Roman Britain with the study area containing settlements and likely artefacts and findspots.

4.1.9 There are a number of Public Rights of Way that are within, cross or close to the proposed bypass boundary.

4.1.10 The Proposed Scheme lies within an Air Quality Management Area (AQMA) declared for $PM_{10}$ in 2008 where it crosses Lincoln City Council Boundaries.

## 4.2 The Proposed Scheme

4.2.1 The following section provides an overview of the Proposed Scheme as shown in Volume 2 Supporting Information (1030171-100-023 to 1030171-100-027).

### *Lincoln Eastern Bypass – Overview*

4.2.2 The proposed LEB will provide a new 7.5km single carriageway relief road that will link the junction of the A15 and A158 Wragby Road to the A15 Sleaford Road. The new route will have a design speed of 100kph and a separate 3m wide combined cycle and pedestrian route (located on the western side of the carriageway) provided along the full length of the scheme to link up with existing Public Rights of Way. The scheme will comprise of the following elements (north to south starting from the Wragby Road Roundabout):

*Wragby Road Roundabout to Greetwell Road (0-1,500m):*

- *Wragby Road Roundabout:* From A158 Wragby Road the single carriageway layout follows the horizontal alignment of the northbound side of the A158 which allows the Proposed Scheme to tie into the existing roundabout as a fourth arm. The diameter of the existing roundabout remains unaltered.
- *Hawthorn Road Junction:* The western side (residential side) of Hawthorn Road will be stopped up and a turning head provided. A left/in left out only priority junction on the eastern side of the Proposed Scheme will be provided and a segregation island included to block right turns.
- The existing footpath located to the north of Hawthorn Road will be stopped up and access provided to the Proposed Scheme pedestrian/cycle way on the western side of the Proposed Scheme.
- *Greetwell Road Footbridge:* A footbridge on the north side of the Greetwell Road Roundabout over the Proposed Scheme will provide access to the Proposed Scheme pedestrian/cycle way and maintain the current provision for non motorised users along Greetwell Road.

*Greetwell Road Roundabout to Washingborough Road Roundabout (1,500m–3,000m):*

- *Greetwell Road Roundabout*: A new four arm roundabout will provide a link from the Proposed Scheme to Greetwell Road.
- *Lincoln to Market Rasen Railway Bridge:* The structure will carry the Proposed Scheme over the Lincoln to Market Rasen railway line and the Viking Way footpath. A link will be provided to the Viking Way from the Proposed Scheme pedestrian/cycle way.
- Northbound overtaking lane provided between the River Witham Bridge and Greetwell Road Roundabout.
- *River Witham Bridge:* The River Witham Bridge is the largest structure on the scheme and will cross the River Witham floodplain on an embankment, with a bridge travelling over the North Delph, River Witham, and South Delph.
- *Lincoln to Spalding Railway Bridge:* To the south of the river, the bypass will cross under the Lincoln to Spalding railway line.

- *South Delph Footbridge:* The footbridge will cross the South Delph watercourse away from the northbound carriageway and provide access to the existing Sustrans cycleway/footway that runs parallel to the River Witham.

*Washingborough Road Roundabout to 1500m south of Heighington Bridge (3,000m–4,500m):*

- *Washingborough Road Roundabout:* The Proposed Scheme joins the B1190 Washingborough Road at a new four arm roundabout.
- A climbing lane has been provided on the southbound exit from Washingborough Road roundabout with an 8% gradient.
- *Heighington Road Bridge:* The Proposed Scheme will pass under Heighington Road through a new bridge, with only NMU access to Heighington Road.

*4,500m–6,000m:*

- *Lincoln Road Roundabout:* A new four arm roundabout will be constructed where the Proposed Scheme crosses the B1188 Lincoln Road.
- *Lincoln Road Subway:* An underpass is proposed for non-motorised users to cross the Proposed Scheme at Lincoln Road.

*6,000m–7,500m (Ref B/1030171/100/027):*

- *Bloxholm Lane Footbridge*: A new footbridge will be provided over the Proposed Scheme at Bloxholm Lane.
- *Sleaford Road Roundabout:* A new four arm roundabout will be constructed to join the Proposed Scheme with the A15 Sleaford Road and the realigned Bloxholm Lane.

4.2.3 The Proposed Scheme provides for lighting at the junctions with local roads and includes lighting across the Witham Valley between Greetwell Road and Washingborough Road. The lighting will comprise modern lighting design, including cut offs to reduce light spill, with lighting columns approximately 12m in height.

4.2.4 Areas for temporary topsoil storage, estimated compound areas, attenuation ponds, hard landscaping features and other areas likely to be effected by the construction works have been included within the Proposed Scheme.

4.2.5 LCC aims to ensure that, if required, the Proposed Scheme can be upgraded to a dual carriageway at some point in the future, in the most cost effective manner with minimum disruption. As a result the Proposed Scheme has been designed to incorporate a number of future proofing design elements that offer best value for the single carriageway scheme design and minimises disruption for any future upgrades or scheme changes. These features include twin tunnels under the railway line and oversized roundabouts.

# 5 Stakeholder Consultation

## 5.1 Introduction

5.1.1 A wide range of stakeholders were consulted as part of the EIA process. Liaison with both statutory consultees and other stakeholder organisations was undertaken in order to gather environmental data and agree the scope of the assessments, adopted methods of assessment and mitigation measures.

5.1.2 This recent consultation is in addition to the consultation undertaken during the production of the Environmental Statement produced in 2009.

## 5.2 Statutory Consultees

5.2.1 Consultation with the following statutory consultees has been undertaken.

*Table 5-1 Consultees that informed specialist chapters within the ES*

| Consultee | Contact and / or Position | Date | Method of Consultation | Issues Considered |
|---|---|---|---|---|
| **Flood Risk and Drainage** | | | | |
| Environment Agency – External Relations Team | Vicky Ellison – External Relations Officer | 18/09/2012 | Email | Issue of data request for FRA and ES Water chapter |
| Environment Agency – Development and Flood Risk team | Ian Dreary – Development and Flood Risk Officer | 17/10/2012 | Telephone | Use of defended flood zones in terms of any floodplain compensation requirement |
| Environment Agency – External Relations Team | Katie Bonnett – External Relations Officer | 17/10/2012 | Telephone | Issue of missing historical flood map and no reply regarding fluvial channel geomorphology |
| LCC | Lee Rowley – Senior Project Lead | 18/10/2012 | Telephone and Email | Contact regarding access of EA data via Geostore for GIS Flood Zone data |
| Environment Agency – Mapping Team | Elizabeth Bowlt – Mapping Officer | 22/10/2012 | Telephone | To seek confirmation on level of defences as EA letter indicates 1:20yr RP but Jacobs modelling/FRA indicated 1:100yr RP |
| Environment Agency – Planning Team | Steven Coe | 23/10/12 | Telephone and Email | Confirmation sought that the Jacobs hydraulic modelling is still considered suitable for use in the 2012 planning application.<br>SC confirmed. |
| LCC | Lee Rowley – Senior Project Lead | 24/10/2012 | Telephone | Contact regarding access of EA data via Geostore for GIS Flood Zone data |

| Consultee | Contact and / or Position | Date | Method of Consultation | Issues Considered |
|---|---|---|---|---|
| Environment Agency – Mapping Team | Elizabeth Bowlt – Mapping Officer | 24/10/2012 | Telephone | Chase up of 22/10/12 query |
| LCC | James Baty – GIS Team | 25/10/2012 | Telephone and Email | Contact regarding access of EA data via Geostore for GIS Flood Zone data |
| **Archaeology and Cultural Heritage** | | | | |
| Lincolnshire County Council (Heritage) | Mark Bennett, Senior Historic Environment Officer | 21/09/2012 | Email | Request for HER data |
| | Beryl Lott, Historic Environment Manager | 18/10/2012 | Email | Request for pre-application advice. Response detailed issues with previous EIA undertaken by Jacobs and requirement for further evaluation. |
| | | 26/10/2012 | Meeting | HER mapping and presentation of data. Requirements for archaeological evaluation as part of the EIA - none. Variation to agreed Jacobs archaeological mitigation - none. Setting of heritage assets to be considered as part of assessment. |
| English Heritage | David Walsh | 18/10/2012 | Email | Request for pre-application advice. |
| | | 07/11/2012 | Letter | Setting and long distance views of heritage assets and between assets and the city/ cathedral. Landscape mitigation. Reference to previous consultation letter for previous scheme/ Jacobs EIA. |

## 5.3 Non Statutory Consultees

5.3.1 In 2008 Lincolnshire County Council undertook a public consultation exercise to capture the views of elected members, stakeholders and the public on three alternative routes for the Dual Carriageway LEB scheme. The aim was to help inform which route would be the subject of the 2009 planning application for the dual carriageway LEB scheme.

5.3.2 As the preferred route for the LEB had been extensively consulted on in 2008, it was considered appropriate by DfT that LCC should conduct a limited, but focused, exercise to ensure that the Proposed Scheme, although now a single carriageway, remains relevant to the development plans of local stakeholders and represented a good use of limited funds.

5.3.3 All the letters received from the contacted stakeholders were in support of the scheme and emphatically detailed why the LEB is of strategic importance to the area. There was particularly strong support from the Local Enterprise Partnership (LEP) and local business groups, who recognised the economic benefits of the scheme.

# 6 Scoping

## 6.1 Scoping of Potential Impacts

6.1.1 An underlying principle of the assessment process is that it should concentrate only on environmental issues where impacts associated with the Proposed Scheme have the potential to be significant. The Proposed Scheme has, been subjected to a process of scoping to determine those issues which should be assessed and the form that the assessments should take.

6.1.2 The DMRB guidelines provide a framework for identifying and considering potential impacts. These have been used as the basis for establishing the scope of this assessment.

6.1.3 Following consultation with Neil McBride (Lincolnshire County Council) it was agreed that the scope of this EIA should be the same as that undertaken in 2009 for the dual carriageway version of the LEB.

6.1.4 As such the following topics are being assessed:

- Flood Risk and Drainage
- Geology & Soils
- Landscape and Visual Impact
- Noise and Vibration
- Air Quality
- Cultural Heritage
- Ecology
- Community and Private Assets
- Effects on all Travellers
- Interactions and Cumulative Impacts

# 7 Road Drainage and the Water Environment

## 7.1 Scope of the Assessment

7.1.1 This chapter discusses impacts to the water environment due to construction and operation of the Proposed Scheme.

7.1.2 The assessments have been focused on the hydrology, flood risk, water quality, fluvial channel geomorphology and water resources of surface waters; and the flow, volume and water resources of groundwaters.

7.1.3 The scope of the assessment is based on the proposed single carriageway proposals described in Chapter 1.

7.1.4 The assessments in relation to potential impacts on the water environment have focussed on surface waters, groundwater and floodplains. Potentially significant impacts that are considered include:

- Pollution due to increased generation and release of sediments and suspended solids and increased risk of accidental spillage of pollutants such as oil, fuel and concrete during construction activities;
- Pollution due to operational routine road runoff. A broad range of potential pollutants, such as hydrocarbons i.e. 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 waterbodies;
- Pollution due to operational accidental spillage. On all roads there is a risk that accidents or vehicle fires may lead to an acute pollution incident. Where commercial vehicles are involved potential pollutants that may be spilled could range from hazardous chemicals to milk, alcoholic beverages, organic sludges and detergents;
- Increased flood risk due to development within the floodplain, increased runoff rates and volumes from hardstanding areas and proposed channel modifications such as culverting and watercourse realignment;
- Changes in the geomorphological regime of watercourses, such as culverting and watercourse alignment can affect the morphology and sediment regime of the watercourse. A reduction in morphological diversity can subsequently impact on water quality and biodiversity;
- Loss of standing waters where the proposed scheme will be constructed through existing ponds; and
- Changes in groundwater flows and levels due to: the dewatering of deep cuttings, construction of deep bridge foundations below the water table and reduced groundwater infiltration due to impermeable carriageway.

7.1.5 The findings of the *Flood Risk Assessment (FRA)* are summarised within this chapter. Full details of the assessment undertaken can be found in the separate *FRA* Report provided in Volume 3 – Technical Appendices.

7.1.6 Indirect impacts on the aquatic ecology of the affected waterbodies are reported in the Chapter 13 – Nature Conservation and Ecology.

7.1.7 The assessment of potential impacts on groundwater quality is addressed in Chapter 8 – Geology and Soils.

## 7.2 Statutory and Planning Context

7.2.1 The following key legislation and planning policies have been taken into account during the assessment. Further detail on their specific relevance to the assessments is provided in Volume 2 – Supporting Information.

- The Water Framework Directive (WFD) (2000/60/EC)
- The Freshwater Fish Directive (codified version) (FFD) (2006/44/EC)
- Groundwater Daughter Directive (GDD) (2006/118/EC)
- Groundwater Directive (80/68/EEC)
- Floods Directive (2007/60/EC)
- The Water Resources Act 1991 as amended
- The Water Act 2003 as amended
- The Flood and Water Management Act 2010
- The Salmon and Freshwater Fisheries Act 1975 as amended
- The Water Environment (Water Framework Directive (WFD)) (England and Wales) Regulations 2003
- The Groundwater (England and Wales) Regulations 2009
- The Environmental Permitting (England and Wales) regulations 2010
- The Surface Waters (Fishlife) (Classification) Regulations 1997 as amended
- The Surface Waters (Fishlife) Direction 2007
- The Control of Pollution (Oil Storage) (England) Regulations 2001
- The Environmental Damage (Prevention and Remediation) Regulations 2009
- National Planning Policy Framework (NPPF), paragraphs: 99-104, 109-110 and 120
- National Planning Policy Framework Technical Guidance, paragraphs 2-19.
- PPS 25 Development and Flood Risk Practice Guide Sep 2009
- East Midlands Regional Plan (2009) (RSS8) policies specific to the water environment are:

  - 2 - Promoting Better Design
  - 28 - Regional Priorities for Environmental and Green Infrastructure
  - 29 – Priorities for Enhancing the Region's Biodiversity
  - 32 – A Regional Approach to Water Resources and Water Quality
  - 33 - Regional Priorities for Strategic River Corridors
  - 35 - A Regional Approach to Managing Flood Risk
  - SRS8 – Flood Risk and Water Management
  - North Kesteven Adopted Local Plan (2007) policies specific to the water environment are:
  - C10 – Flood Risk
  - C11 – Pollution
  - C14 – Surface Water Disposal
- City of Lincoln Local Plan (1998) policy specific to the water environment is:
  - 46B – Protecting the Water Environment
- West Lindsey Local Plan (First Review) (2006) policies specific to the water environment are:
  - Sus 14 – Flood Risk Areas
  - NBE14 – Waste Water Disposal
  - NBE15 – Water Quality and Supply
  - NBE16 – Culverting Watercourses
  - NBE17 – Control of Potentially Polluting Uses
- Central Lincolnshire Core Strategy (not yet adopted) policies specific to the water environment are:
  - CL2 – Tackling Climate Change
  - CL23 – A Quality Environment
  - CL24 – Green Infrastructure & Biodiversity
  - CL25 – Managing Water Resources & Flood Risk

## 7.3 Method of Assessment

### *Baseline Data Collection*

7.3.1 The desk study involved:

- Review of the road drainage and the water environment chapter of the 2009 Environmental Assessment Report for the previously proposed dual carriageway scheme;
- Review of the current FRA and the previous one produced in 2009, including the Hydraulic Modelling Report;
- Identification of all catchments, surface and groundwater bodies including watercourses, drains, ponds, wetlands and springs;
- Estimation of watercourse low, mean and peak flows using the software LowFlows 2000 and the Institute of Hydrology Flood Studies Report and Flood Estimation Handbook;
- Collation of Environment Agency (EA) data on water quality and WFD status of waterbodies;
- Collation of data on existing abstractions and discharges; and
- Review of data on the previously proposed dual carriageway road drainage systems that are being retained for the 2012 Proposed Scheme.

7.3.2 A site visit carried out on the 5th October 2012 concentrated on gaining a good overall understanding of the water environment of the study area. Visual inspections and geomorphological assessments of the main watercourses were also undertaken. Photographs taken during the site visit are provided in Volume 2 – Supporting Information.

### *Construction Assessment*

7.3.3 A qualitative assessment of construction impacts was carried out, which involved a review of areas where construction is proposed in close proximity to waterbodies and the proposed mitigation measures targeted at avoiding or minimising the risk of construction pollution.

### *Routine Runoff Assessment*

7.3.4 The Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 10, HD 45/09 – Road Drainage and the Water Environment specifies mandatory procedures for the assessment of pollution impacts from routine runoff on surface waters and groundwaters, known as Method A and Method C respectively.

7.3.5 In this instance, only Method A has been used as all proposed road drainage outfalls have been designed to discharge to surface waters, and therefore there will be no pollution impact on groundwaters from routine runoff.

7.3.6 The Method A assessment comprises two separate elements:

- Highways Agency Water Risk Assessment Tool (HAWRAT) Assessment: the HAWRAT is a Microsoft Excel application designed to assess the short-term risks related to the intermittent nature of road runoff. It assesses the acute and chronic pollution impacts on aquatic ecology associated with soluble and sediment bound pollutants respectively; and
- Environmental Quality Standards (EQS) Assessment: EQS are the maximum permissible annual average concentrations of potentially hazardous chemicals, as defined under the WFD. The long-term risks over the period of one year are assessed through comparison of the annual average concentration of pollutants discharged with the published EQS for those pollutants.

7.3.7 These assessments are carried out for each proposed road drainage outfall. Cumulative assessments have also been carried out where multiple road drainage outfalls discharge to a single reach of a watercourse.

7.3.8 Detailed explanations of both the HAWRAT and EQS assessment methods are provided in Volume 2 – Supporting Information.

### *Accidental Spillage Assessment*

7.3.9 The DMRB document HA 45/09 specifies mandatory procedures for the assessment of pollution impacts from accidental spillage, known as Method D. The assessment takes the form of a risk assessment, where the risk is expressed as the annual probability of a serious pollution incident occurring. This risk is the product of two probabilities:

- The probability that an accident will occur, resulting in a serious spillage of a polluting substance on the carriageway; and
- The probability that, if such a spillage did occur, the polluting substance would reach the receiving watercourse and cause a serious pollution incident.

7.3.10 The probability of a serious spillage occurring is dependent on a variety of factors: traffic volumes, percentage of heavy goods vehicles in the traffic volumes, whether the road is motorway, rural or urban trunk road, the road type categories within the road drainage catchment under assessment i.e. ‘no junction’, ‘slip road’, ‘cross road’ or ‘roundabout’, and the length of each road type within the catchment.

7.3.11 The probability of a serious spillage causing a serious pollution incident is dependent on the receiving waterbody type, i.e. surface water or groundwater,

and the response time of the emergency services, i.e. less than 20 minutes, less than one hour or greater than one hour.

7.3.12 Typically an annual probability of 1% (i.e. a 1 in 100 chance of a serious pollution incident occurring in any one year) is considered an acceptable risk. However, where a road drainage outfall discharges within 1km of a sensitive receptor, such as a protected conservation site, a higher level of protection is required such that the risk has an annual probability of 0.5% (i.e. a 1 in 200 chance of occurring in any one year).

7.3.13 A detailed explanation of the accidental spillage assessment method is provided in Volume 2 – Supporting Information.

### *Channel Geomorphology Assessment*

7.3.14 A qualitative fluvial geo-morphological assessment was carried out using data collated through a desk study and field survey. Previous reports and historic mapping was studied for evidence of historic channel change in the relevant watercourses. The field survey undertaken involved a river survey, which identified channel morphology, areas of channel instability and the wider geo-morphological setting.

7.3.15 From this baseline assessment a qualitative estimation can be made of both how 'active' the watercourse is and the likely effect the Proposed Scheme proposals (such as culverts, bridges and watercourse realignments) may have on the existing status of the water environment.

### *Groundwater Assessment*

7.3.16 To determine the likely impact of dewatering of cuttings on groundwater flows and levels, the drawdown distance/area of influence has been calculated for the cuttings that intercept groundwater. The radius of influence was calculated using groundwater levels from the ground investigations and design levels of the cutting.

7.3.17 A qualitative assessment was then made of the impact on the groundwater aquifer and nearby groundwater dependent receptors, such as public water supply boreholes and wetlands.

7.3.18 The impact due to impermeable surface of the carriageway was assessed by considering the likely loss of rainfall infiltration and comparing this with the overall volume of licensed abstractions for public water supplies to the east. The impact of the loss of groundwater recharge on the baseflow to surface water bodies was assessed qualitatively.

7.3.19 The impact of structures and their foundations on groundwater flow was assessed qualitatively.

### *Flood Risk Assessment*

7.3.20 The *Flood Risk Assessment* has been carried out in accordance with the National Planning Policy Framework, and the supporting document Technical Guidance to the National Planning Policy Framework.

7.3.21 The objectives of the *FRA* were to:

- Assess the risk to the Proposed Scheme from all potential sources of flooding;
- Assess the risk of increasing flooding elsewhere as a consequence of the Proposed Scheme; and
- Determine appropriate mitigation measures to limit the impact of flooding on the Proposed Scheme and offsite flooding due to increased runoff.

7.3.22 The flood risk baseline has been established through desk study, field survey and consultation. A drainage assessment has been carried out for the whole scheme, with hydraulic modelling of the River Witham and Delph watercourses and case-by-case assessments of culverting and realignment requirements on small watercourses and field drains. Using the findings of these investigations, a risk assessment of flooding from all sources has been undertaken and practical mitigation measures identified, where necessary.

7.3.23 Further details of the *FRA* methodology can be found in Volume 2 – Supporting Information, and in the *Flood Risk Assessment* provided in Volume 3 – Technical Appendices.

### *Impact Assessment Criteria*

7.3.24 The predicted significance of impacts on surface waters and groundwaters has been based on the importance or sensitivity of the relevant waterbody and the magnitude of the impact from the Proposed Scheme, as recommended in DMRB document HD 45/09.

7.3.25 The importance or sensitivity of the waterbodies has been evaluated taking into account their quality, rarity, scale and substitutability. The criteria used in determining the importance of each waterbody are detailed in Volume 2 – Supporting Information, and are in keeping with the guidance and examples given in HD 45/09.

7.3.26 The magnitude of the various impacts is evaluated taking into account the extent of loss and effects on integrity of the relevant waterbody attributes. The criteria used in determining the magnitude of impact are detailed in Volume 2 –

Supporting Information, and are in keeping with the guidance and examples given in HD 45/09.

### *Impact Significance*

7.3.27 The estimation of the impact significance has been arrived at by combining the estimated importance of the affected waterbodies and the magnitude of the impacts as indicated in Table 7-1 below, taking into account mitigation and the guidance provided in HD 45/09. Where the significance is shown as being one of two alternatives a single description is provided based upon reasoned judgement of the specific case.

*Table 7-1: Impact Significance Matrix*

| **Importance of Waterbody** | **Magnitude of Impact** | | | |
|---|---|---|---|---|
| | Major | Moderate | Minor | Negligible |
| Very High | Very Large | Large/Very Large | Moderate/Large | Neutral |
| High | Large/Very Large | Moderate/Large | Slight/Moderate | Neutral |
| Medium | Large | Moderate | Slight | Neutral |
| Low | Slight/Moderate | Slight | Neutral | Neutral |

## 7.4 Baseline Environment

7.4.1 A brief overview of the water environment baseline is provided below, with full details provided in Volume 2 – Supporting Information. The key surface water and groundwater features of the study area are shown in Figures 1030171-LEB-HYD-001 to 004.

7.4.2 The Proposed Scheme corridor lies on the eastern edge of Lincoln, running broadly north to south. The northern and southern ends of the scheme lie on the gently undulating higher ground of the limestone escarpment known as the Lincoln Edge, while the central section crosses the valley of the River Witham, where it flows through the Lincoln Gap. Elevations to the northern end of the Proposed Scheme are approximately 35mAOD, falling to less than 5mAOD in the River Witham valley and rising to approximately 55mAOD to the southern end of the Proposed Scheme.

7.4.3 The Proposed Scheme lies within an area of predominantly agricultural land on the urban fringe of Lincoln.

7.4.4 The principal watercourses from north to south of the Proposed Scheme comprise the Reepham Beck, Wragby Road Ditch, Greetwell Fields Drain, North Delph, River Witham, South Delph, Canwick Fen Drain, Branston Brook Tributary and the Ashfield Beck. Most of these watercourses eventually drain in to the River Witham and Delph system.

7.4.5 In addition to the principal watercourses there is a network of small streams, drains and ditches throughout or within close proximity of the corridor, including the land drainage ditches within the River Witham and Delph system corridor.

7.4.6 The Reepham Beck and Greetwell Fields Drain, Branston Brook Tributary and Ashfiled Beck all arise from springs within agricultural land on the higher ground at either end of the scheme.

7.4.7 The North Delph, River Witham, South Delph and Canwick Fen Drain lie parallel to each other in the bottom of the valley and all flow from west to east. The North Delph is maintained by the Witham Third Internal Drainage Board (IDB) and flows are controlled by pumps at Greetwell and Short Ferry which discharge into the River Witham. The River Witham and South Delph are designated Main River and are maintained by the Environment Agency. The Canwick Fen Drain is maintained by the Witham First IDB and flows are controlled by pumps at Sandhill Beck, which discharge into the River Witham.

7.4.8 Interaction of these watercourses, other than controlled pumping, occurs between the South Delph and Canwick Fen Drain through seepage from the South Delph into the Canwick Fen Drain under normal flow conditions and overtopping under the high flow/flood conditions.

7.4.9 There is one area of notable floodplain and flood risk. This is associated with the River Witham/Delph system/Canwick Fen Drain corridor. Fluvial flooding is currently well managed in the River Witham catchment, meaning there is a limited number of people and properties at flood risk. The fluvial defences protecting this area consist of earth embankments and upstream flood storage reservoirs. Consultation with the Environment Agency indicated that the raised defences are in good/fair condition with an official Standard of Protection (that includes calculated freeboard for the defence) against a flood event with a 20% chance of occurring in any year (1 in 5) and with an Annual Exceedance Probability (AEP) of over topping against a flood event with 1% chance of occurring in any year (1 in 100). The Environment Agency inspects these defences regularly to ensure that any potential defects are identified early.

7.4.10 With these defences in place the 1 in 100 year flood event flows are retained within channel for the North Delph and River Witham. However, overtopping of the southern bank of the South Delph occurs. These flows enter the Canwick Fen Drain, but do not extend into the wider floodplain in the location of the Proposed Scheme embankments.

7.4.11 However, when taking climate change into account, flood defences might provide less than the 1% AEP protection. The main findings of the Environment Agency broad scale modelling in the River Witham catchment area are: very little

flooding expected for the 1 in 10 year event (no flooding was predicted for this event in current conditions) and an increase in the 1 in 100 year flood extent.

7.4.12 The Anglian Water Canwick Sewage Treatment Works (STW) is located to the south of the Witham Valley watercourses, between the Washingborough Road and the railway line (NGR 499922, 370472). Under normal conditions and less severe storm events the treated effluent and storm water pumps discharge into the South Delph. However, during a severe storm event, the discharge is restricted due to high water levels within the South Delph. Under these circumstances we believe that the storm water overflows inundate the floodplain between the Canwick Fen Drain and the railway embankment. Anglian Water has no additional contingency plans for severe storm conditions.

7.4.13 There is no notable flood risk associated with the Reepham Beck, Wragby Road Ditch, Greetwell Fields Drain, Branston Brook Tributary and the Ashfield Beck in proximity of the Proposed Scheme.

7.4.14 Due to historic land drainage and flood risk management activities in the River Witham Valley many of the surface waters of the study area are man-made, or heavily modified due to realignment and straightening. The North Delph and Canwick Fen Drain are maintained by the relevant Internal Drainage Boards, and it is assumed that the maintenance regime includes regular bankside and channel vegetation clearance and occasional dredging. The Reepham Beck, Branston Brook Tributary and Ashfield Beck are small streams draining agricultural land which have discrete sections of modification.

7.4.15 Of the principal watercourses within the study area, only the River Witham and South Delph are designated under the Water Framework Directive. Both are classified as heavily modified waterbodies of ‘Moderate Ecological Potential’. It has been assumed that the remaining watercourses in the study area will have a similar water quality and would also be classified as having a ‘Moderate’ status under the WFD.

7.4.16 The River Witham and South Delph are locally important for angling, however only the River Witham is designated under the Fresh Fish Directive as a Cyprinid fishery.

7.4.17 A number of the watercourses have abstractions and discharges, of most interest are the abstractions on the North Delph and Branston Brook Tributary for agricultural spray irrigation.

7.4.18 There are several small ponds within the study area.

7.4.19 In relation to the geology of the study area the superficial deposits are limited to the alluvium and river terrace deposits in the flood plain of the River Witham, which are designated as a Secondary A type aquifer of High Vulnerability.

Recent Alluvium also occurs along the courses of the Branston Brook Tributary and Ashfield Beck, which are not included in the aquifer designation. The deposits associated with the Branston Brook Tributary, are classified as having as an Intermediate Vulnerability.

7.4.20 The bedrock geology in the northern and southern sections of the study area is dominated by the Lincolnshire Limestone, designated as a Principal Aquifer of High Vulnerability. The older strata located in the Witham Valley (Lias Clay Formation and Northampton Sand Formation) and the younger strata located in the north and to the east of the study area (Rutland Formation, Blisworth Limestone Formation, Blisworth Clay Formation, Cornbrash Formation and the Kellaways Formation) are a succession of aquifers and aquitards grouped together and classified as Secondary Aquifers. The Northampton Sand and Ironstone is in hydraulic continuity with the overlying Lincolnshire Limestone. The Rutland and the Blisworth Clay Formations are Non-Aquifers, while the Blisworth Limestone, Cornbrash, Kellaways and Oxford Clay Formations are Secondary B type aquifers of High Vulnerability.

7.4.21 The Lincolnshire Limestone is a fractured aquifer, unconfined in the west where it outcrops and confined in the east and northeast where it is overlain by the younger formations and cut by a group of faults. Groundwater recharge in the Lincolnshire Limestone is mainly via direct rainfall infiltration in the outcropping areas. The general groundwater flow direction is down-dip i.e. west to east. To the east, where the aquifer is confined by the Middle Jurassic clays, it becomes increasingly artesian in nature. The rest of the groundwater discharges through springs and provides baseflow for streams.

7.4.22 There is one groundwater abstraction within 1km of the Proposed Scheme with a deregulated licence for <300$m^3$/yr for general agricultural, and domestic use.

7.4.23 There are two public water supply boreholes located at least 3.5km to the east. The Proposed Scheme is almost entirely within the outer groundwater protection zone (SPZ 2) for these abstractions, with the exception of the sections between Washingborough Road and Sheepwash Grange, where the route passes through the total catchment (SPZ 3), and the River Witham valley, which is outside the SPZ.

7.4.24 Table 7-2 below summarises the importance of each feature of the water environment identified above. Full details of the baseline data which has informed this assessment are provided in Volume 2 – Supporting Information.

*Table 7-2: Importance of Water Features along Proposed Scheme*

| Feature | Attribute | Comment | Importance |
|---|---|---|---|
| Reepham Beck/Wragby Road Ditch | Water Quality & Biodiversity | Assumed 'Moderate' WFD status, no FFD designation, local biodiversity value | Medium |
| | Water Resources | No abstractions, one drainage discharge | Low |
| | Hydrology and Flood Risk | Small watercourses, primarily receives runoff from surrounding agricultural fields. No notable flood risk is associated with this watercourse in proximity to the Proposed Scheme | Low |
| | Channel Geomorphology | Small, moderately modified watercourse, low geomorphological activity | Low |
| Greetwell Fields Drain | Water Quality & Biodiversity | Assumed 'Moderate' WFD status, no FFD designation, less than local biodiversity value | Medium |
| | Water Resources | No abstractions or discharges | Low |
| | Hydrology and Flood Risk | Small watercourses, primarily receives runoff from surrounding agricultural fields. No notable flood risk is associated with this watercourse in proximity to the Proposed Scheme | Low |
| | Channel Geomorphology | Small, modified watercourse, low geomorphological activity | Low |
| North Delph | Water Quality & Biodiversity | Assumed 'Moderate' WFD status, no FFD designation, county biodiversity value | Medium |
| | Water Resources | Several agricultural abstractions, one industrial site surface water runoff discharge | Medium |
| | Hydrology and Flood Risk | Pumped system with limited capacity for additional runoff; lies within the defended floodplain of the River Witham and Delph system corridor | High |
| | Channel Geomorphology | Assumed small, heavily modified watercourse, low geomorphological activity. | Low |
| River Witham | Water Quality & Biodiversity | 'Moderate' WFD status, FFD Cyprinid fishery with imperative pass but guideline fail, locally important for angling, county biodiversity value | Medium |
| | Water Resources | One industrial water abstraction, no discharges | Medium |
| | Hydrology and Flood Risk | Limited capacity, complex operation and interaction with North and South Delphs; defended floodplain with interaction between the North Delph, South Delph and Canwick Fen Drain | High |

| Feature | Attribute | Comment | Importance |
|---|---|---|---|
| | Channel Geomorphology | Medium sized, heavily modified watercourse, low geomorphological activity. | Low |
| South Delph | Water Quality & Biodiversity | 'Moderate' WFD status, no FFD designation, locally important for angling, county biodiversity value | Medium |
| | Water Resources | No abstractions, two sewage discharges | Low |
| | Hydrology and Flood Risk | Limited capacity for additional runoff, complex operation and interaction with the River Witham; defended floodplain with interaction between the North Delph, River Witham and Canwick Fen Drain | High |
| | Channel Geomorphology | Medium sized, heavily modified watercourse, low geomorphological activity. | Low |
| Canwick Fen Drain | Water Quality & Biodiversity | Assumed 'Moderate' WFD status, no FFD designation, local biodiversity value | Medium |
| | Water Resources | No abstractions or discharges | Low |
| | Hydrology and Flood Risk | Close proximity to the River Witham and South Delph, interaction with the South Delph; lies within the defended floodplain of River Witham and Delph system corridor | Medium |
| | Channel Geomorphology | Small, artificial watercourse, no geomorphological activity. | Low |
| Branston Brook Tributary | Water Quality & Biodiversity | Assumed 'Moderate' WFD status, no FFD designation, local biodiversity value | Medium |
| | Water Resources | Several agricultural abstractions, no discharges | Medium |
| | Hydrology and Flood Risk | Small water course, main purpose of a land drain to carry runoff from surrounding agricultural fields; No notable flood risk is associated with this watercourse in proximity to the Proposed Scheme | Low |
| | Channel Geomorphology | Small, modified watercourse, low geomorphological activity. | Low |
| Ashfield Beck | Water Quality & Biodiversity | Assumed 'Moderate' WFD status, no FFD designation, local biodiversity value | Medium |
| | Water Resources | Several agricultural abstractions, no discharges | Medium |

| Feature | Attribute | Comment | Importance |
|---|---|---|---|
| | Hydrology and Flood Risk | Small watercourse, main purpose of a land drain to carry runoff from surrounding agricultural fields; No notable flood risk is associated with this watercourse in proximity to the Proposed Scheme | Low |
| | Channel Geomorphology | Small, modified watercourse, low geomorphological activity | Low |
| Standing Waters | Water Quality & Biodiversity | Several small ponds scattered within the study area, no water quality data, do not support abstractions or discharges, | Medium |
| Alluvium / River Terrace Deposits | Base Flow to Rivers, Groundwater Flow | Secondary A aquifer, high vulnerability<br>WFD – not classified<br>No groundwater abstractions within the study area | Medium |
| Blisworth, Cornbrash and Kellaway Formations | Groundwater Flow, River Base Flow | Secondary B aquifers, high vulnerability<br>WFD – good status for Blisworth Limestone and Cornbrash Formations; Kellaways and Oxford Clay Formations – not classified<br>No abstractions within the study area | Medium |
| Lincolnshire Limestone | Water Supply, Water Quality, Groundwater Flow, Base Flow to Rivers | Principal aquifer, high vulnerability<br>WFD – good status, at risk for drinking water and for pesticides<br>One licensed groundwater abstraction within 1km of the proposed route<br>The proposed route is within SPZ2 and SPZ3 | High |
| Northampton Sand | Groundwater Flow, Base Flow to Rivers | Secondary Aquifer in hydraulic continuity with the Lincolnshire Limestone;<br>WFD – not classified | Medium |

## 7.5 Predicted Impacts

### *Scheme-Water Environment Interactions*

7.5.1 Table 7-3 details the scheme elements which interact with the water environment. It should be noted that the scheme chainage starts at Wragby Road and increases from north to south towards Sleaford Road.

*Table 7-3: Scheme-Water Environment Interactions*

| Water Feature | Approx. Chainage (m) | Scheme Elements |
|---|---|---|
| Reepham Beck (inc Wragby Road Ditch) | 0-125 | Topsoil storage area adjacent to Reepham Beck |
| | 10 | Realignment / channel amendments of Reepham Beck and Wragby Road Ditch. 900mm diameter culvert on the Wragby Road Ditch |
| Greetwell Fields Drain | 575 | Realignment of 350m field drain and new 900mm diameter culvert |
| North Delph | 2000-2500 | Diversion of land drains into earthworks drainage |
| | 2500-2600 | Clear span road bridge over North Delph. Supporting piers clear of main channel |
| | 2575 | Network A road drainage outfall, approximately 75m east of scheme carriageway |
| River Witham | 2600-2675 | Clear span road bridge over River Witham. Supporting piers clear of main channel |
| South Delph | 2675-2725 | Clear span road bridge over South Delph. Supporting piers clear of main channel |
| | 2700 | Clear span footbridge |
| Canwick Fen Drain | 2725-2750 | Clear span road bridge over Canwick Fen Drain. Supporting piers clear of main channel |
| | 2735 | Footbridge culvert, 600mm diameter |
| | 2735 | Network B road drainage outfall, approximately 20m east of scheme carriageway |
| | 3150-4400 | Diversion of land drains into earthworks drainage. Culverting of diverted land drains / earthworks drainage under Washingborough Road and Heighington Road |
| Branston Brook Tributary | 5065 | 1800 x 1200mm box culvert. Network C road drainage outfall, approximately 140m east of scheme carriageway |
| Standing Waters | 600 | Pond under footprint of the scheme |

| Water Feature | Approx. Chainage (m) | Scheme Elements |
|---|---|---|
| | 1100 | Pond created for habitat enhancement adjacent to the carriageway |
| | 1500 | Greetwell Quarry Pond under scheme footprint |
| | 2150 | Pond under scheme footprint |
| | 2200-2450 | 1 pond under scheme footprint, 5 within 150m of the scheme footprint |
| | 6050 | Pond within 200m of the scheme footprint |
| Alluvium / River Terrace Deposits | 2575 | Network A attenuation ponds |
| | 2500-2750 | Foundations of the North Delph, River Witham, South Delph and Canwick Fen Drain Bridge. Sheet piling installed on both banks of the North Delph |
| | 2850 | Network B attenuation ponds |
| | 2990 - 3200 | Cutting 3, total length 1195m, length in Alluvium /River Terrace Deposits 210m |
| Blisworth, Cornbrash, Kellaways Formations | 125 - 550 | Cutting 1, length 425m |
| | 500 | Network 1 attenuation ponds |
| | 775 - 1350 | Cutting 2, total length 645m, length in Blisworth etc formations 575m |
| Lincolnshire Limestone | 1350 - 1420 | Cutting 2, total length 645m, length in Lincolnshire Limestone 70m |
| | 1550 | Network 2 attenuation ponds |
| | 3365 - 4185 | Cutting 3, total length 1195m, length in Lincolnshire Limestone 820m |
| | 5250 | Network C attenuation ponds |
| | 5470 - 5825 | Cutting 4, length 355m |
| Northampton Sand | 3200 - 3365 | Cutting 3, total length 1195m, length in Northampton Sand 165m |

### *Construction Impacts*

#### *Construction Related Pollution*

7.5.2 Silt and sediment laden site runoff generated during construction activities, such as soil stripping and earthworks, can have a detrimental impact if allowed to enter watercourses untreated. Fine sediments can increase water turbidity and smother stream beds, affecting water quality and causing harm to fish, aquatic invertebrates and plants by interfering with feeding, respiration and spawning. The effects of sediment release can extend considerable distances downstream.

7.5.3 In addition, accidental spillages of potential pollutants such as oils, fuels, concrete, cement and sewage from staff welfare facilities can impact both groundwater and surface waters. Such pollutants can seep into aquifers and reach the groundwater. The absence of superficial deposits over the Lincolnshire

Limestone and its fractured character make it particularly susceptible to such risks. Due to the slow movement of groundwater any such impact could cause long-term adverse effects on nearby groundwater abstractions. In surface waters, oils form a film on the water surface and can coat organisms, blocking respiration, photosynthesis and feeding. Biodegradation of oils in aquatic systems can lead to oxygen depletion; and many hydrocarbons are toxic, persistent and bio-accumulate in the environment i.e. they build-up in the body tissue both directly and from feeding on other contaminated organisms. Concrete and cement is highly alkaline and can harm aquatic organisms if the pH of the receiving waters is affected.

7.5.4 The risk of construction pollution is highest where the proposed scheme would run alongside or require construction within the watercourses, such as at proposed bridges, outfalls and watercourse realignments.

7.5.5 The scheme proposals involve the realignment and culverting of the Wragby Road Drainage Ditch and Greetwell Fields Drain in the vicinity of Ch. 0 and 575 respectively. The mobilisation of construction sediment will be mitigated through offline construction i.e. the diversion channel is constructed under dry conditions, with the watercourse flows diverted into the new channel once it is completed.

7.5.6 Similarly culverts are proposed on the Canwick Fen Drain (for the footpath crossing) and the Branston Beck Tributary, at Ch. 2735 and 5065 respectively. These culverts will be constructed under dry conditions in isolated opencut, with flows temporarily diverted around the working area. The diverting of flows may be via flume or overpumping.

7.5.7 A multiple span bridge crossing is proposed over the North Delph, River Witham, South Delph and Canwick Fen Drain between Ch. 2500-2800. A pedestrian footbridge is also proposed on the South Delph at Ch. 2700. The abutments of both bridges and the piers of the road bridge will be located on the banks between each of the watercourse channels. Whilst both have been designed to avoid the need for construction within the channels, the works would involve the introduction of bank stabilisation and protection, particularly on the North Delph where permanent sheet piling is proposed, to address potential erosion in the vicinity of the structures. Temporary works would involve the use of cofferdams along the margins of the watercourses to enable construction to proceed and prevent the migration of soils and sediment into the watercourses.

7.5.8 Similarly, the construction of the road drainage outfalls on the North Delph, Canwick Fen Drain and Branston Beck Tributary at Ch. 2575, 2735 and 5065 respectively, will require some in channel construction works. As described above cofferdams will be used to isolate the working area, allow dry working and prevent sediment migration.

7.5.9 In all instances of working in, or close to, water mitigation measures similar to those described above, including restrictions on working distances and the provision of temporary barriers to prevent migration of sediments, would ensure that any pollution would be minor.

7.5.10 Therefore construction pollution impacts on the water quality and biodiversity of surface waters and on groundwaters would be short-term and of minor magnitude, resulting in a potential significance of slight.

### *Operational Impacts*

#### *Pollution Related to Routine Runoff*

7.5.11 A broad range of potential pollutants can accumulate on road surfaces. These can subsequently be washed off the road during rainfall events, polluting the receiving waterbodies. Such runoff can result in both acute and chronic impacts on water quality and subsequently on the biodiversity of the receiving watercourses, due to both soluble and sediment bound pollutants. The road drainage networks are proposed to discharge to surface waters.

7.5.12 There are three main road drainage networks proposed, Networks A, B and C, which will discharge into the North Delph, Canwick Fen Drain and Branston Brook Tributary respectively. Attenuation ponds and small sections of filter drain are proposed for all three networks, which will provide flood risk and water quality mitigation. Network A has been divided into sub-catchments 1, 2 and A, each with their own intermediate attenuation ponds. The carrier pipes, filter drains and attenuation ponds will be lined and sealed to prevent infiltration of road runoff to groundwaters, thereby preventing pollution of the surrounding groundwater aquifers.

7.5.13 The full calculations and results of the HAWRAT and EQS assessments for the three proposed road drainage outfalls are presented in Volume 2 – Supporting Information. The results are summarised in Table 7-4 below.

*Table 7-4: Summary of Routine Runoff Assessment Results*

| Water Feature | Network ID | Proposed Treatment / Mitigation | HAWRAT Results | | | EQS Results | |
|---|---|---|---|---|---|---|---|
| | | | Cu[1] | Zn[2] | Sed[3] | Cu[1] | Zn[2] |
| North Delph | A (1, 2, A) | 2 attenuation ponds in series | Pass | Pass | Pass | Pass | Pass |
| Canwick Fen Drain | B | 2 attenuation ponds in series | Pass | Pass | Pass | Pass | Pass |
| Branston Beck Tributary | C | 2 attenuation ponds in series | Pass | Pass | Pass | Pass | Pass |

[1] Cu – copper, [2] Zn – zinc, [3] Sed - sediment

7.5.14 The results demonstrate that, allowing for the proposed mitigation, all networks individually pass all elements of the HAWRAT and EQS assessments. Consequently the magnitude of routine runoff impacts for each of the individual networks is negligible, resulting in a potential significance of neutral.

7.5.15 It should be noted that the above results relate to the currently proposed single carriageway scheme. If in the future the road is to be upgraded to dual carriageway it is highly likely that additional routine runoff treatment will be required, particularly on Network B.

### *Pollution Related to Accidental Spillages*

7.5.16 On all roads there is a risk that road traffic accidents or vehicle fires may result in accidental spillage of potential pollutants on the road surface. These may then enter the road drainage network and subsequently be discharged to the water environment, causing an acute pollution event.

7.5.17 Full details of the accidental spillage calculations and results are presented in Volume 2 – Supporting Information. The results are summarised in Table 7-5 below.

*Table 7-5: Summary of Accidental Spillage Assessment Results*

| Water Feature | Network ID | Accidental Spillage Return Period (years) |
|---|---|---|
| North Delph | A (1, 2, A) | 492 |
| Canwick Fen Drain | B | 787 |
| Branston Beck Tributary | C | 655 |

7.5.18 As can be seen the results for each of the accidental spillage assessments are well within the target of at least a 1 in 100 year return period recommended in the DMRB. As a result the magnitude of the impacts due to accidental spillage is negligible, resulting in a potential significance of neutral.

7.5.19 It should be noted that the results presented above do not include any allowance for mitigation measures. The results indicate that no specific accidental spillage mitigation is required. However, the attenuation ponds proposed for flood risk and routine runoff mitigation will also provide some accidental spillage mitigation. In addition, shut-off valves are proposed on all networks, which will allow the networks to be isolated in the event of an accidental spillage.

### *Increased Flood Risk*

7.5.20 The proposed scheme could potentially increase flood risk as a result of development within the floodplain, increased runoff rates and volumes from

hardstanding areas and proposed channel modifications such as watercourse realignments.

7.5.21 The scheme has been designed to minimise impinging on the floodplain wherever possible through location of embankments and structures outside of the floodplain as far as practicable. Some floodplain volume will still be lost due to the Proposed Scheme for which floodplain compensation will be provided. Further details are provided in Volume 2 – Supporting Information and the *FRA*.

7.5.22 The surface water runoff discharge rates are restricted to greenfield equivalent of 2l/s/ha with attenuation to be provided within each of the proposed surface water runoff drainage catchments.

7.5.23 The proposed realignments of the Reepham Beck and Greetwell Fields Drain will be designed to maintain the current channel capacities as a minimum.

7.5.24 The Proposed Scheme will intercept overland flow and a number of minor land drains and open ditches. The earthworks drainage has been designed to accommodate these flows and route them appropriately such that they will not present a flood risk to the new road, or increase flood risk in the surrounding area.

7.5.25 With the above proposed measures in place the overall magnitude of the impact on the hydrology and flood risk of the relevant waterbodies would be negligible, resulting in a potential significance of neutral.

### *Geomorphological Changes*

7.5.26 Channel modifications such as watercourse realignment and the construction of in-channel structures can result in changes to the geomorphological regime, such as erosion, deposition and channel migration. A reduction in morphological diversity can subsequently affect water quality and biodiversity.

7.5.27 The proposed five span road bridge across the North Delph, River Witham, South Delph and Canwick Fen Drain has been designed such that the piers and abutments will be constructed set back from the banks of the watercourses (with the exception of the North Delph), which will not interfere with the geomorphological regime of these watercourses under normal flow conditions. Erosion protection of the piers and abutments may be necessary to protect these from scouring during flood events, while soft engineering techniques will be employed where feasible to minimise the impact on the floodplain morphology. The footbridge across the South Delph will be designed similarly.

7.5.28 Sheet pilling of the North Delph channel sides is proposed to provide support for the bridge piers in this location. This sheet piling will be appropriately designed to ensure the channel dimensions are maintained and the piling is properly tied into

the upstream and downstream banks, thereby preventing increased scour and bank instability. Additional 'soft' engineering bank support will be provided upstream and downstream of the sheet piling where necessary and appropriate.

7.5.29 The proposed road drainage outfalls on the North Delph, Canwick Fen Drain and Branston Brook Tributary will be constructed to current good practice standards to minimise the impact on the geomorphology of the relevant watercourses. This will include construction of the outfall structures flush to the watercourse bank, with discharge in the direction of watercourse flow. Outfall structure headwalls, wingwalls and erosion protection aprons, if required, will be designed to prevent erosion of the bed and banks of the watercourse.

7.5.30 The realignment of the Greetwell Fields Drain will result in an approximate 5m shortening of the original 340m reach. The realignment will open up a 100m section which was previously culverted. However, a new 55m culvert will be introduced where the LEB crosses the watercourse. The proposed realignment will be designed to replicate the existing open channel profile, where feasible. This will help maintain the hydraulic capacity and flow dynamics of the channel, and minimise changes to the existing erosion and deposition regime.

7.5.31 All proposed culverts will be constructed to current good practice standards to minimise the impact on the geomorphology of the relevant watercourses. This will include the appropriate sizing of the culverts to maintain the hydraulic capacity of the channel and the existing channel dimensions and gradient wherever possible. The culvert inverts will be buried and backfilled with appropriate bed material to retain natural bed and flow levels. Scour protection will be included upstream and downstream of the culverts, where necessary.

7.5.32 With the above proposed measures in place the overall magnitude of the impact on the geomorphology of the Greetwell Fields Drain and Branston Brook Tributary would be minor, resulting in a potential significance of neutral. The magnitude of impact on the remaining watercourses will be negligible, resulting in a significance of neutral.

### *Loss of Standing Waters*

7.5.33 There are several small ponds scattered throughout the scheme corridor. The proposed alignment of the scheme will result in the loss of four of these ponds. Several other ponds lie within 250m of the scheme footprint and may be impacted by the works.

7.5.34 Ponds will be lost that support populations of common amphibians. It is proposed to replace these with a single new pond to be located adjacent to the LEB at Ch. 1100. Further information is provided in Chapter 11 – Ecology and Nature Conservation. As a result the magnitude of the impact is considered to be minor, resulting in a potential significance of slight.

### *Groundwater Changes*

7.5.35 Four road cuttings are proposed as part of the scheme. Where these cuttings are deep they have the potential to intersect the groundwater table, resulting in dewatering effects such as changes to groundwater flows and levels in the surrounding area. These effects can subsequently impact on nearby groundwater dependant features, such as wetlands and groundwater abstractions.

7.5.36 The results of the groundwater assessment are provided in full in Volume 2 – Supporting Information, a summary is provided in Table 7-6 below.

*Table 7-6 Summary of Groundwater Assessment Results*

| Water Feature | Importance | Cutting No. | Radius of influence (m) | Magnitude | Significance |
|---|---|---|---|---|---|
| Alluvium | Medium | 3 | 45 | Minor Adverse | Slight |
| Blisworth, Cornbrash, Kellaways Formations | Medium | 1 | 0 | Negligible | Neutral |
| | | 2 | 0 | Negligible | Neutral |
| Lincolnshire Limestone | High | 2 | 0 | Negligible | Neutral |
| | | 3 | 0 | Negligible | Neutral |
| | | 4 | 0 | Negligible | Neutral |
| Northampton Sand | Medium | 3 | 0 | Negligible | Neutral |

7.5.37 In determining the magnitude of impact from each cutting the proximity and likely effect of groundwater drawdown on groundwater dependant wetlands, surface water courses and abstractions was considered in addition to the effect on the aquifer itself.

7.5.38 The creation of impermeable carriageway will result in a loss of groundwater recharge to the underlying aquifer, due to the impermeable road surface intercepting rainfall and the road drainage networks discharging this runoff to nearby watercourses. Based on annual effective rainfall of 147mm and impermeable surface area of 135,901m$^2$ the loss of groundwater recharge was estimated to approximately 20,000m$^3$ annually. This equates to 0.6% of the annual licensed abstraction of the nearby public water supply. As the current proposals are for single carriageway, which has less impermeable area, the impact will be even less. Therefore, the impact is considered to be of negligible magnitude, resulting in an impact significance of neutral.

7.5.39 The piled foundations of the Witham Valley Bridge will penetrate the full thickness of the underlying alluvium/river terrace deposits to reach the Lias Clay bedrock. There is no risk of the piles creating a pathway between aquifers as the Lias Clay is not an aquifer. The piles will intercept the groundwater table within the alluvium/river terrace deposits, however the effect on groundwater flows will be highly localised. Similarly the sheet piles to be installed on both sides of the North Delph will have a localised effect on groundwater flows, which is not considered significant.

7.5.40 Therefore, the impact of the scheme on groundwater flows and levels is considered to be of negligible magnitude and of neutral significance.

## 7.6 Proposed Mitigation

### *Construction Mitigation*

7.6.1 Mitigation beyond the design commitments described above and which will be incorporated into the Construction Environmental Management Plan (CEMP) for the scheme will include where practicable:

- Oil absorbent booms installed, as appropriate, on the surface watercourses immediately downstream of the works area, and regularly inspected and maintained.
- Temporary cut-off drains used uphill and downhill of the working area to prevent clean runoff entering and dirty water leaving the working area without appropriate treatment.
- Vegetated buffer strips maintained adjacent to all watercourses.
- Works required on the watercourse banks, or in-channel, vegetation clearance restricted to the immediate working area and undertaken only immediately prior to the commencement of those works. Vegetation re-established as soon as practicable. If necessary additional measures such as geotextiles (biodegradable and non- biodegradable), mulching, brushwood mattresses etc. used to protect soils before vegetation has re-established, particularly on the watercourse banks.
- Sediment laden water generated on site appropriately treated before discharge. This may be through the use of silt fences, silt traps, filter bunds (possibly straw bales or gravel bunds), settlement ponds and/or proprietary units such as a ‘siltbuster’. Discharges will not be direct to any watercourse, but will be made to ground, with suitable erosion protection put in place.
- Any contaminated waters produced, for example from dewatering of deep excavations, will be disposed of off-site at an appropriate facility in accordance with the Environmental Permitting (England and Wales) Regulations, 2007.
- Control and treatment measures will be regularly inspected to ensure they are working effectively.

- Local weather forecasts will be monitored and works scheduled accordingly. In particular earthworks and in-stream works will be stopped during storm events.
- Emergency response plans will be developed and spill kits made available on site.
- All relevant consents will be sought from the EA and relevant IDB for temporary discharges and in-stream works; the discharges will be limited to equivalent greenfield runoff rates.
- Construction compounds and stockpiling areas will be located 20m to 30m from watercourses where feasible. Where this is not feasible additional care will be undertake with sediment control measures and frequent inspections will be undertaken.
- Fuels and potentially hazardous construction materials will be stored in bunded areas with external cut-off drainage; fuel will be stored in double skinned tanks with 110% capacity.
- Fuelling and lubrication of construction vehicles and plant will generally be on hardstandings or on haul roads, where reasonably practical, with appropriate cut-off drainage and located away from watercourses. In the event of plant breakdown drip trays will be used during any emergency maintenance and spill kits will be available on site.
- Construction plant checked regularly for oil and fuel leaks, particularly when construction works are undertaken in or near the existing site waterbodies.
- Waste fuels and other fluid contaminants will be collected in leak-proof containers prior to removal from site to an approved recycling facility.
- Washing out of ready mix cement lorries carried out off site or into container receptacles that can then be taken off site for disposal.
- Foul drainage from site welfare facilities will be disposed of appropriately. This may be by discharge to the foul sewer or by collection in septic tank for disposal off site.

7.6.2 The above list is not exhaustive. The CEMP will incorporate guidance from all relevant EA Pollution Prevention Guidelines (PPG).

7.6.3 Specific Construction Method Statements (CMS) will be developed and implemented for construction works in or near the watercourses, including the construction of the bridges, outfalls and watercourse realignments. These will include details of methods proposed to control run-off on site and minimisation of sediment pollution of the watercourses. These may include offline working, or isolation of the working area using cofferdams.

7.6.4 A programme of water quality monitoring on the relevant watercourses, upstream and downstream of the working corridor will be implemented. The monitoring parameters, duration and frequency will be agreed with the EA prior to construction works commencing.

### *Operational Mitigation*

7.6.5 The impact assessment has informed the development of the planning and design proposals in the form of relevant measures targeted at mitigating potential impacts associated with the proposed scheme.

7.6.6 The following measures are required to mitigate the identified impacts of the Proposed Scheme on the Water Environment:

- Use of SUDS features such as attenuation ponds to remove hydrocarbons, soluble metals, sediment and sediment bound pollutants from road drainage discharges where the HAWRAT and EQS assessments have identified a need for treatment. Further details on the specific routine runoff mitigation proposed are presented in Volume 2 – Supporting Information.
- The road drainage networks, including any SUDS features, will be lined/sealed to prevent road drainage infiltration to groundwater.
- Shut-off valves will be installed on all drainage networks to isolate the networks in the event of an accidental spillage. The SUDS features included on the networks for treatment of routine runoff will also contribute to the control of pollution from accidental spillage.
- All road drainage discharges will be attenuated to greenfield runoff rates.
- Road drainage outfall structures will be designed flush with the watercourse bank and will discharge in the direction of flow. The structure headwalls, wingwalls and erosion protection aprons will be designed to prevent erosion of the watercourse bed and banks.
- The road and footbridge over the North Delph, River Witham, South Delph and Canwick Fen Drain will be constructed with bridge supports set back from the watercourse channels, to minimise potential loss of floodplain volume and protect the integrity of the river banks. Where piers are located within the floodplain the upstream faces will be streamlined to reduce the risk of large debris becoming trapped during flood flows.
- Where the Proposed Scheme will impinge on the River Witham floodplain level-for-level floodplain compensation will be provided for the 1 in 100 year flood event plus 30% climate change allowance.
- River bank erosion protection will be installed if necessary at the bridge crossings to protect the bridge piers and abutments from scour.
- The proposed culverts will be appropriately sized to accommodate the 1 in 100 year return period flows plus a 30% climate change allowance. The culverts will also be sized to maintain the natural channel width and gradient wherever possible. The culvert inverts will be buried and backfilled with appropriate bed materials to retain natural bed and flow levels. Scour protection will also be installed upstream and downstream of the culverts where appropriate.

- Watercourse diversions will be aligned and profiled to maintain hydraulic capacity, replicate existing channel gradients and cross-sections and reflect the existing channel geomorphology.
- Where erosion protection is required within the new diversion channels, soft engineering techniques will be used where feasible. This may include the use of geotextiles, coir rolls, pallets and log jams, where applicable.

7.6.7 Similarly a programme of post-construction geomorphological monitoring will be implemented to ensure the proposed channel modifications, in particular the channel diversions/realignments, have bedded in and are stable.

## 7.7 Conclusions and Effects

7.7.1 The assessment has concluded that, with the inclusion of the proposed design and mitigation measures, impacts on the water quality, geomorphology, hydrology and flood risk of surface waters and on the water quality, flows and levels of groundwaters would be no greater than slight at specific locations and would be slight overall.

7.7.2 Table 7-7 summarises the potential impacts and resulting significance of the residual effects, after mitigation, from the construction and operation of the Proposed Scheme.

*Table 7-7: Summary of Effects*

| Potential Impact | Feature | Attribute | Importance | Magnitude | Significance |
|---|---|---|---|---|---|
| Pollution due to increased sedimentation and increased risk of accidental spillage of pollutants such as oil, fuel and concrete during construction | Reepham Beck | Water Quality & Biodiversity | Medium | Minor | Slight |
| | Greetwell Fields Drain | | Medium | Minor | Slight |
| | North Delph | | Medium | Minor | Slight |
| | River Witham | | Medium | Minor | Slight |
| | South Delph | | Medium | Minor | Slight |
| | Canwick Fen Drain | | Medium | Minor | Slight |
| | Branston Beck Tributary | | Medium | Minor | Slight |
| | Ashfield Beck | | Medium | Minor | Slight |
| | Standing Waters | | Medium | Minor | Slight |
| | Alluvium / River Terrace Deposits | Water Supply, Water Quality, Groundwater Flow, Biodiversity | Medium | Minor | Slight |
| | Blisworth, Cornbrash & Kellaways Formations | | Medium | Minor | Slight |
| | Lincolnshire Limestone | | High | Minor | Slight |
| | Northampton Sand | | Medium | Minor | Slight |
| Pollution due to operational routine road runoff | North Delph | Water Quality & Biodiversity | Medium | Negligible | Neutral |
| | Canwick Fen Drain | | Medium | Negligible | Neutral |
| | Branston Book Tributary | | Medium | Negligible | Neutral |
| | Alluvium / River Terrace Deposits | Water Supply, Water Quality, Groundwater Flow, Biodiversity | Medium | Negligible | Neutral |
| | Blisworth, Cornbrash & Kellaways Formations | | Medium | Negligible | Neutral |
| | Lincolnshire Limestone | | High | Negligible | Neutral |
| | Northampton Sand | | Medium | Negligible | Neutral |
| Pollution due to operational accidental spillage | North Delph | Water Quality & Biodiversity | Medium | Negligible | Neutral |
| | Canwick Fen Drain | | Medium | Negligible | Neutral |
| | Branston Book Tributary | | Medium | Negligible | Neutral |
| | Alluvium / River Terrace | Water Supply, Water | Medium | Negligible | Neutral |

| Potential Impact | Feature | Attribute | Importance | Magnitude | Significance |
|---|---|---|---|---|---|
| | Deposits | Quality, Groundwater Flow, Biodiversity | | | |
| | Blisworth, Cornbrash & Kellaways Formations | | Medium | Negligible | Neutral |
| | Lincolnshire Limestone | | High | Negligible | Neutral |
| | Northampton Sand | | Medium | Negligible | Neutral |
| Increased flood risk due to development within the floodplain, increased runoff from hardstanding areas and proposed channel modifications | Reepham Beck/Wragby Road Ditch | Hydrology and Flood Risk | Low | Negligible | Neutral |
| | Greetwell Fields Drain | | Low | Negligible | Neutral |
| | North Delph | | High | Minor | Slight |
| | River Witham | | High | Minor | Slight |
| | South Delph | | High | Minor | Slight |
| | Canwick Fen Drain | | Medium | Minor | Slight |
| | Branston Brook Tributary | | Low | Negligible | Neutral |
| | Ashfield Beck | | Low | Negligible | Neutral |
| Changes in the geomorphological regime such as erosion, deposition and channel migration due to proposed channel modifications | Reepham Beck/Wragby Road Ditch | Channel Geomorphology | Low | Negligible | Neutral |
| | Greetwell Fields Drain | | Low | Minor | Neutral |
| | North Delph | | Low | Negligible | Neutral |
| | River Witham | | Low | Negligible | Neutral |
| | South Delph | | Low | Negligible | Neutral |
| | Canwick Fen Drain | | Low | Negligible | Neutral |
| | Branston Brook Tributary | | Low | Minor | Neutral |
| | Ashfield Beck | | Low | Negligible | Neutral |
| Loss of standing waters where proposed scheme will be constructed through or close to existing ponds | Standing Waters | Water Quality & Biodiversity | Medium | Minor | Slight |
| Changes in groundwater flows and levels as a result of groundwater drawdown effects from dewatering of deep cuttings, loss of groundwater | Alluvium/River Terrace Deposits | Water Supply, Groundwater Flow, Biodiversity | Medium | Minor | Slight |
| | Blisworth, Cornbrash & Kellaways Formations | | Medium | Negligible | Neutral |

| Potential Impact | Feature | Attribute | Importance | Magnitude | Significance |
|---|---|---|---|---|---|
| infiltration due to impermeable carriageway and installation of piles and deep foundations below the water table | Lincolnshire Limestone | | High | Negligible | Neutral |
| | Northampton Sand | | Medium | Negligible | Neutral |

# 8 Soils and Geology

## 8.1 Scope of the Assessment

8.1.1 The purpose of this chapter is to assess the potential impact of the Proposed Scheme on the underlying and surrounding soils and geology. The baseline conditions are discussed and potential impacts summarised. Mitigation measures are suggested and residual impacts discussed.

8.1.2 The Proposed Scheme is described in Chapter 4. The potential impacts, mitigation measures and residual impacts are considered to be similar to those identified following the Environmental Impact Assessment that was undertaken for the dual carriageway which was granted planning permission in 2009 (see Volume 3 – Technical Appendices).

8.1.3 This chapter utilises information provided as part of the Environmental Statement prepared in August 2009, including a Landmark Envirocheck Report from 2007. It is considered unlikely that any of the information relating to Soils and Geology will have changed since 2009 and therefore the earlier information remains valid.

8.1.4 This assessment describes the existing baseline conditions in relation to geology and soils (including made ground and potentially contaminated land) and to provide a summary of the general characteristics of the locality.

8.1.5 The assessment area has focused on land immediately adjacent to, or within the footprint of the Proposed Scheme. Reference has also been made to landfill sites and other higher risk sites within a further 100m to ensure that potential contaminant linkages associated with the Proposed Scheme are assessed.

## 8.2 Statutory and Planning Context

### *Contaminated Land*

8.2.1 The presence of contaminants in the ground, which may pose a risk to human health or the environment is a material planning consideration. For planning it should be considered whether the site is suitable for its proposed use, and the responsibility for securing a safe development (including cumulative effects of pollution on health, and the potential sensitivity of the proposed development to adverse effects from pollution) rests with the developer/landowner.

8.2.2 The National Planning Policy Framework, paragraphs 120 to 122 consider pollution and remediation.

8.2.3 Section 57 of the Environment Act 1995, adds Part 2A (ss.78A-18YC) to the Environmental Protection Act 1990 and contains the legislative framework for identifying and dealing with contaminated land.

### *Unstable Ground and Mining*

8.2.4 The National Planning Policy Framework, paragraphs 120 to 122 consider unstable ground and mining.

### *Sites of Special Scientific Interest*

8.2.5 The City of Lincoln Local Plan, policy 44A (Sites of Special Scientific Interest and Other Critical Natural Assets) notes that "the Local Planning Authority will not grant planning permission for any development which will diminish, or in any other way adversely affect, the interest and importance of a Site of Special Scientific Interest (SSSI)".

## 8.3 Method of Assessment

8.3.1 Assessment of the baseline conditions makes use of information from the following sources:

- Landmark (2007) Envirocheck Report;
- British Geological Survey (1973), Solid and Drift Sheet 114, Lincoln;
- Soil Survey of England and Wales (1983). Soils of Midland and Western England, Sheet 3 1:250,000;
- Jacobs (2009) Lincoln Eastern Bypass Environmental Statement;
- Environment Agency website. www.environment-agency.gov.uk;
- British Geological Survey website. www.bgs.ac.uk;
- Natural England website. www.naturalengland.org.uk.

8.3.2 The methodology to assess predicted impacts is based on the principle that the potential significance is related to the sensitivity of the baseline environment and the magnitude of the impact.

8.3.3 For this assessment, the sensitivity of predicted impacts has been defined in accordance with the criteria set out in Table 8-1.

*Table 8-1: Sensitivity Criteria*

| Sensitivity | Description and examples |
|---|---|
| Very High | Principal aquifers providing regionally important resource (SPZ I)<br>Protected surface waters such as SSSI and RAMSAR sites.<br>Other Sites of Special Scientific Interest |
| High | Principal aquifer providing a locally important resource (SPZ II)<br>Regionally Important Geological Sites (RIGS)<br>High quality agricultural land |
| Medium | Principal aquifer providing water for agricultural or industrial use (SPZ III) or Secondary Aquifer<br>Medium quality agricultural land |
| Low | Secondary or Tertiary Aquifer<br>Low quality agricultural land |
| Negligible | Tertiary Aquifer<br>Former industrial / developed land |

8.3.4 The magnitude of predicted impacts on soil and geology has been defined in accordance with the terms set out in Table 8-2.

*Table 8-2: Magnitude Criteria*

| Magnitude | Description / Example |
|---|---|
| Major | Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements (Adverse). |
| | Large scale or major improvement of resource quality; extensive restoration or enhancement; major improvement of attribute quality (Beneficial). |
| Moderate | Loss of resource, but not adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements (Adverse). |
| | Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality (Beneficial). |
| Minor | Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements (Adverse). |
| | Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring (Beneficial). |
| Negligible | Very minor loss or detrimental alteration to one or more characteristics, features or elements (Adverse). |
| | Very minor benefit to or positive addition of one or more characteristics, features or elements (Beneficial). |
| No change | No loss or alteration of characteristics, features or elements; no observable impact in either direction. |

8.3.5 The significance has been assessed in accordance with the matrix detailed in Table 2.4, Volume 11 Section 2, Part 5 of DMRB.

## 8.4 Baseline Environment

8.4.1 Drawing 1030171-LEB-HYD-002 (see, Volume 2 – Supporting Information) presents the published geological map referenced below.

### *Superficial and Drift Geology*

8.4.2 The British Geological Survey published geological map, Sheet 114, Lincoln, shows superficial and drift deposits are largely absent from the route. However, superficial deposits comprising alluvium and undifferentiated river terrace sand and gravel are indicated to be present associated with the River Witham and may also be present in the vicinity of the small watercourse that flows through nearby Branston (Branston Brook).

### *Solid Geology*

8.4.3 The British Geological Survey published geological map, Sheet 114, Lincoln, shows the site to be entirely underlain by Jurassic strata. The stratigraphical sequence is summarised in the table below.

*Table 8-3: Summarised stratigraphical sequence*

| | Strata name | Description |
|---|---|---|
| Jurassic | Cornbrash | Shelly limestone, commonly only a thin layer |
| | Bilsworth Clay | Lower horizons are black or green clays, upper horizons are dark blue clays and shales |
| | Great Oolite Limestone | Buff coloured well bedded limestone, usually laminated with marls and clays |
| | Upper Estuarine Beds | Clays with thin limestones within the upper parts |
| | Upper Lincolnshire Limestone | Oolitic limestone with clays |
| | Crossi Beds | Oolitic limestone with clays |
| | Lower Lincolnshire Limestone | Very thinly bedded, closely jointed strong limestone |
| | Lower Estuarine Beds/Northampton Sand and Ironstone | Ferruginous sandstone and limestones |
| | Upper Lias Clay and Shale | The Upper Lias is generally blue clay |

8.4.4 To the north of the River Witham and the railway line, the bedrock geology is heavily faulted and this section comprises the entire stratigraphic sequence summarised above.

8.4.5 To the south of the railway line and the River Witham, the route generally crosses the older parts of the stratigraphic sequence from the Upper Lincolnshire Limestone to the Upper Lias Clay. Faults are almost absent from this section of the route and the strata are generally horizontal with a shallow dip of approximately 2º to 4º to the east.

### *Soil*

8.4.6 Assessment of the published soils map, Soils of Midland and Western England, Sheet 3 indicates that the majority of the site is underlain by Elmton 1 soils. These are defined as “shallow, well drained, brashy, calcareous, fine loamy soils over limestone”.

8.4.7 Within the River Witham valley, the soil type is Adventurers 1. This is described as a “deep peaty soil”.

8.4.8 Blackwood soils are present to the north of Washingborough Road, although the data resolution makes it difficult to map the exact route of the highway. These soils are described as “deep, permeable sandy and course loamy soils derived from glacio fluvial drift deposits”.

8.4.9 Wickham 2 soils are present to the north and south of Washingborough Road, although the data resolution makes it difficult to map the exact route of the Proposed Scheme. These are described as “slowly permeable seasonally waterlogged fine loamy soils derived from Jurassic clays and mudstones”.

### *Sites of Special Scientific Interest*

8.4.10 At the northern end of the route, adjacent to Greetwell Road is the Greetwell Hollow Quarry Site of Special Scientific Interest (SSSI). The site is a former ironstone and limestone quarry and is classified as a SSSI due to the important exposures of Lincolnshire Limestone Formation.

8.4.11 Greetwell Hollow Quarry is one of the most significant exposures of the Lincolnshire Limestone Formation. It has provided the bulk of the very rare ammonites that are of considerable stratigraphic significance for the correlation of this unit with other horizons in Southern England.

### *Hydrogeology and Hydrology*

8.4.12 This section summarises the hydrogeology and hydrology baseline which is discussed in detail in Chapter 7.

8.4.13 The Proposed Scheme is located in the vicinity of the following watercourses:-

- Main Rivers (maintained by the Environment Agency): River Witham and South Delph (also called Sincil Dyke further upstream).
- Non-main rivers: North Delph, Canwick Fen Drain (also known as Soak Dyke).
- Smaller drainage ditches including Reepham Beck, Greetwell Fields Drain, Greetwell Beck, Branston Brook and its tributary and Ashfield Beck.

8.4.14 A number of engineered drains, issues and springs discharge from the slopes of the valley into the river. The Proposed Scheme crosses a number of these close to the river.

8.4.15 The *Environmental Statement* prepared in August 2009 for the Dual Carriageway makes reference to Greetwell Beck rising to the north of Greetwell Road and flowing south into the North Delph.

8.4.16 The alluvium and river terrace deposits in the flood plains of the River Witham are designated as 'Secondary A type aquifers of High Vulnerability' due to their relative permeability and importance as the source for river base flow.

8.4.17 The alluvial deposits associated with the tributaries of the Branston Brook are not included in the aquifer designation. The deposits associated with Branston Brook are classified as being of "intermediate vulnerability".

8.4.18 The Lincolnshire Limestone is classified as a "Principal Aquifer of high vulnerability".

8.4.19 The Northampton Sand and Ironstone Formation and the Cornbrash are classified as "Secondary Aquifers".

8.4.20 The Blisworth Clay and Lias Clay Formations are classified as "non-Aquifers".

### *Mining and Mineral Extraction*

8.4.21 Ironstone mining and limestone extraction is known to have occurred within the footprint of the Proposed Scheme, predominantly around the Greetwell Hollow Quarry SSSI.

8.4.22 Review of the historical maps within the *Envirocheck Report* identified former quarries close to but not directly within the Proposed Scheme at the following locations:

- South of the sewage works on Washingborough Road (to the west of the Proposed Scheme);
- North of Wheeler Road (to the west of the Proposed Scheme);
- Adjacent to Branston Heath Farm (to the east of the Proposed Scheme). The farm is now labelled as Westfield Farm; and
- South of Heighington Road (to the west of the Proposed Scheme).

### *Potential Sources of Contamination*

8.4.23 The historical maps, dating back to 1890 indicate that the majority of the Proposed Scheme has generally been occupied by agricultural land and farms

with no significant industrial uses being identified. However, two historic landfills were identified.

8.4.24 It is understood from the *Environmental Statement* prepared in August 2009 that part of the Greetwell Hollow Quarry site has been backfilled with waste. Waste materials are recorded as being encountered during ground investigation works in this area. The site is recorded in the Envirocheck report as a historic landfill site, but limited information is provided. This site however does not appear on the Environment Agency website as being a former landfill.

8.4.25 The Environment Agency website records a historic landfill immediately to the north east of the proposed junction with Washingborough Road. The site received inert, industrial, household and special waste between 1962 and 1993.

8.4.26 The historical maps indicate that the remainder of the Proposed Scheme has generally been occupied by agricultural land and farms with no significant industrial uses being identified.

8.4.27 Immediately west of the proposed Washingborough Road junction is the sewage works at Canwick. Contaminants could include heavy metals, oils and hydrocarbons, polychlorinated biphenyls, e-coli and coliforms.

8.4.28 There is also the potential for contaminants to be present on agricultural land and could include herbicides and pesticides, nitrates, oil/fuel spills and small scale deposition of waste materials.

8.4.29 Made ground is also likely to be associated with the existing highways and railways.

8.4.30 The Proposed Scheme is within a nitrate sensitive area, due to the limited drift cover.

#### *Landslips*

8.4.31 The *Environmental Statement* prepared in August 2009 makes reference to landslip deposits encountered during ground investigations along the scarp face to the south of Washingborough Road. Whilst this would be considered a minor environmental issue, it should be considered further for the geotechnical highway design.

## 8.5 Predicted Impacts

8.5.1 This section details the potential operational and construction impacts of the Proposed Scheme.

### *Construction Impacts*

#### *Geology and Geomorphology*

8.5.2 Apart from the SSSI at Greetwell Hollow Quarry, (which is discussed below under *Operational Impacts*) the impact on geology is considered to be neutral. However, excavations are required immediately to the north and south of the boundaries of the SSSI in order to reduce ground levels slightly which may result in some excavation of bedrock at the upper levels of the quarry face, although it is difficult to confirm this without a detailed construction design.

#### *Disturbance of Made Ground and Contaminants*

8.5.3 There is the possibility for made ground/contaminated ground to be encountered and disturbed during construction which could:-

- Mobilise contaminants and create new pathways
- Generate new contaminant linkages.

8.5.4 The *Environmental Statement* prepared in August 2009 confirmed that ground investigation works targeted potential sites of made ground/contaminated ground. The likelihood of encountering further made ground/contaminated ground during construction is considered low, although the potential still exists.

8.5.5 The magnitude of any impact from contaminated ground is considered to be moderate or major, depending upon the incident and how it is dealt with. The resulting significance is considered to be moderate to large adverse.

#### *Mining and Mineral Extraction*

8.5.6 The *Environmental Statement* prepared in August 2009 references the presence of underground ironstone workings in the area of Greetwell Hollow Quarry. The main impact is likely to be related to drainage and water flow through any workings that need to be treated to facilitate construction of the highway.

8.5.7 The magnitude of any impact is considered to be moderate and the resulting significance is considered to be moderate or large adverse. However, the significance of any impacts are related to how the issues are dealt with at detailed design and construction stage.

#### *Earthworks*

8.5.8 Construction projects of this nature usually require a large amount of cut and fill engineering. It is understood that the Proposed Scheme is to be designed to re-use all excavated materials, so no impact is expected. However there is always a risk that unacceptable material may be excavated that requires offsite disposal.

8.5.9 Consolidation of embankment fill has the risk of causing changes in surface or groundwater flow, resulting in ponding adjacent to embankments as the flow of water is impeded. If this risk is realised solutions would need to be agreed with the planning authority.

#### *Surface Water and Groundwater*

8.5.10 Predicted impacts associated with surface water and groundwater are discussed in the Water Quality Chapter (Chapter 7).

#### *Landslips*

8.5.11 It is possible that where cuttings are constructed into strata where landslips have occurred historically, this could lead to re-activation of existing slip surfaces or generation of new ones. Mitigation will be required at detailed design stage. The magnitude is considered to be no change and the resulting impact is considered to be neutral.

### ***Operational Impacts***

#### *Surface Water and Ground Water*

8.5.12 Predicted impacts associated with surface water and groundwater are discussed in the Water Quality Chapter (Chapter 7).

#### *Designated Sites*

8.5.13 The Proposed Scheme cuts across the south east corner of the Greetwell Hollow Quarry SSSI. It is estimated that the Proposed Scheme would result in the loss of approximately 5% of the entire SSSI but would obscure about 18% of the total geological outcrop. However, much of the Lincolnshire Limestone Formation in this quarry is already covered by quarry waste, so the actual loss of existing exposed layers of geological interest would be less. The magnitude of the impact is considered to be moderate, therefore the significance of the resulting impact is considered to be moderate or large adverse

## 8.6 Proposed Mitigation

### ***Designated Sites***

8.6.1 It is understood that the proposed highway embankment will obscure a part of the rock exposure at Greetwell Hollow Quarry but other exposed areas of the sequence will remain visible.

8.6.2 Currently, access to allow close inspection of the rock outcrops is poor. As part of the Proposed Scheme, it may be possible to engineer improved/safer pedestrian access to the exposed outcrop via the proposed embankment. This

would allow closer inspection/study of the outcrop to be undertaken than is currently possible. Whilst this will not mitigate against obscuring the rock outcrop, it is considered that the construction of improved access to the outcrop will provide a positive benefit to those wishing to study the geological formations.

### *Geology and Geomorphology*

8.6.3 Apart from the impacts on the SSSI (discussed in the section on Designated Sites), no geology and geomorphology impacts are considered to exist and therefore no mitigation measures are considered necessary.

### *Disturbance of Made Ground and Contaminants*

8.6.4 Further assessment of the encountered areas of made ground/waste materials is considered necessary to identify suitable disposal routes for materials requiring excavation, including re-use within the Proposed Scheme. Further assessment would also be necessary to identify engineering solutions to prevent made ground/waste materials remaining in situ from further impacting the surrounding environment.

8.6.5 Detailed mitigation measures of impacts from made ground/contaminated materials encountered during construction cannot be easily provided at this stage, but should be managed by the Contractor through their method statements and good construction practices, and controlled with a Construction Environmental Management Plan.

### *Mining and Mineral Extraction*

8.6.6 Further details of the construction methodology and geotechnical investigation works will be required to assess the nature and extent of any workings and to mitigate the risk of encountering these during construction.

### *Earthworks*

8.6.7 In order to minimise the impact of off-site disposal of surplus excavated materials or the impact of importing fill materials, a cut and fill balance exercise should be undertaken.

8.6.8 A robust understanding of the hydrology and hydrogeological regimes is required where embankments or cuttings are to be constructed to ensure minimal impact on the surface water and groundwater flow.

### *Surface Water and Groundwater*

8.6.9 Mitigation measures for surface water and groundwater are discussed in Chapter 7 – Flood Risk and Drainage.

8.6.10 The Proposed Scheme is within a nitrate sensitive area, due to the limited drift cover. Consideration should be given to this designation when considering fill materials for import, to ensure they will not impact the nitrate sensitive area.

#### *Landslips*

8.6.11 It is understood that the mitigation of landslip potential is to be undertaken at the detailed design stage and could include:

- shallow slope angles to achieve a suitable factor of safety
- soil nailing where shallow slopes are not possible

#### *Dust*

8.6.12 Dust control measures are discussed in Chapter 11 - Air Quality.

## 8.7 Conclusions and Effects

8.7.1 Apart from at Greetwell Hollow Quarry SSSI no significant impacts on soils and geology are considered likely during construction or operation phases of the Proposed Scheme.

8.7.2 There will be a negative residual impact as a result of the Proposed Scheme obscuring the rock outcrops in the south east corner of the SSSI. Whilst the proposed improvement to the access will not mitigate the potentially significant impacts, it is considered that this will provide a positive benefit to those wishing to study the geological formations.

# 9 Landscape and Visual Impact

## 9.1 Scope of the Assessment

9.1.1 This chapter reports the findings of the assessment of the predicted impacts of the Proposed Scheme on the existing landscape character and sensitive visual receptors.

9.1.2 The following assessment has been considered:

- Effects on the local landscape character; and
- Effects on the surrounding visual receptors.

9.1.3 The study area has been defined as the area through which existing landscape character may change or be influenced as a direct result of construction and operation of the Proposed Scheme. This has broadly been defined by the extent to which the scheme will visually influence the landscape and to include sensitive visual receptors with an appreciation of the Proposed Scheme.

## 9.2 Statutory and Planning Context

9.2.1 This section outlines statutes, guidance, policies and plans relevant to the environmental interests forming the focus of the assessment reported in the chapter.

### *National Legislation*

9.2.2 Statutes exist to ensure both direct and indirect protection of our most valued and important landscapes, their intrinsic visual qualities and the individual elements and components that constitute their appeal. Those relevant to the assessment include the following:

- Town and Country Planning Act 1990;
- Planning (Listed Buildings and Conservation Areas) Act 1990;
- Environment Act 1995; and
- Countryside and Rights of Way Act 2000.

9.2.3 Statutes and national planning policy make no direct provision for the protection or conservation of specific views. They are, however, an implicit part of the values and qualities recognised in broader landscape designations that seek to protect areas of recognised character and quality.

### *National Planning Policy Framework*

9.2.4 National planning policies are set out in the National Planning Policy Framework, adopted 27th March 2012. Promoting a strong theme of sustainable development, the framework aims to strengthen local decision making and reinforce the importance of up-to-date plans. The Framework replaces numerous National Planning Policy Guidance (PPG) and Statements (PPS) previously issued by central government.

### *Regional*

#### *East Midlands Regional Plan (2009)*

9.2.5 The relevant Regional Plan for this assessment is the East Midlands Regional Plan, (RSS8), adopted by the Government Office for the East Midlands in March 2009. Although the Localism Bill has been passed into an Act, the RSS8 remains relevant to this assessment.

9.2.6 Beyond the Core Strategy the RSS8 considers policy through both spatial considerations and also by topic. The following policies are of relevance to this assessment:

- In the Core Strategy, Policy 1c supports the idea of the promotion of high quality design which reflects local distinctiveness to protect and enhance the environmental quality of urban settlements.

- Within the Topic Based Priorities, Policy 27 requires the historic environment to be understood, conserved and enhanced, requiring local authorities to use characterisation in understanding contribution to landscape and townscape.

- Policy 31 requires the region's natural and heritage landscape to be protected and enhanced.

### *Local*

9.2.7 The Proposed Scheme falls within the boundaries of three local planning authorities and as such under three Local Plans:

- Local Plan (adopted 1998), Lincoln City Council;
- Local Plan First Review (adopted June 2006) West Lindsey District Council; and
- Local Plan (adopted September 2007) North Kesteven District Council.

9.2.8 Local planning context is explored in greater detail in Volume 2 – Supporting Information.

## 9.3 Method of Assessment

9.3.1 The assessment has been undertaken in accordance with the Highways Agency's Interim Advice Note (IAN) 135/10. Reference has also been made to the Guidelines for Landscape and Visual Impact Assessment (Second Edition), published by the Landscape Institute and the IEMA (2002) (GLVIA) and Landscape Character Assessment: Guidance for England and Scotland published by Scottish Natural Heritage and the Countryside Agency (2002). A detailed explanation of the method of assessment is provided in Volume 2 – Supporting Information.

9.3.2 The guidance acknowledges the relationship between the perception of landscape character and the experience of viewers (referred to as receptors - defined as residents, people in their workplace, attending school, using recreational facilities and using the countryside, shoppers etc) and the development proposals.

9.3.3 The *Environmental Statement* produced in 2009 has been referred to in describing the baseline environment supported by further desk and field based studies and surveys.

### *Stages in the Assessment Process*

9.3.4 There have been four key stages in the assessment:

- Recording and analysis of the existing landscape and visual context of the receiving environment (the baseline environment);
- Identification of impacts that will be associated with the proposals and their significance in the context of the baseline landscape and visual context of the study area;
- Identification of mitigation where the assessment identifies potentially significant impacts appropriate to the proposed development and the views of the receiving local area; and
- Description of the residual impacts and effects associated with the Proposed Scheme.

### *Landscape Character*

9.3.5 The prime criteria used to evaluate the effect on landscape character are centred on the extent to which existing landscape elements, features and key characteristics will be lost or modified by the proposals. The criteria that were used to establish character, quality and value are detailed in Volume 2 – Supporting Information.

9.3.6 Effects can be adverse where features or key physical characteristics, such as established planting, hedgerows or structures have to be removed, in full or part,

to permit construction. Conversely, effects can prove beneficial where existing degraded landscapes or poorly maintained features are restored or replaced, or where there is reclamation of derelict land, constituting an improvement in the existing settlement and land use pattern.

9.3.7 The analysis of the significance of an effect derives from consideration of sensitivity to change and magnitude of impact in relation to local landscape character areas and their constituent components. In determining the significance of the effect account is taken of the degree to which proposed mitigation measures will address potentially significant effects.

### *Assessment Ratings*

9.3.8 The findings are represented using a descriptive, descending scale ranging from large - moderate - slight and adverse, through neutral, to an ascending scale of slight - moderate - large and beneficial. Explanation of the significance of effect ratings is provided in Volume 2 – Supporting Information.

### *Significance of Effect Application and Evaluation*

9.3.9 Each of the Local Landscape Character Areas identified in Section 9.4 - Baseline Environment have been evaluated against the key character effect criteria and allocated a significance of effect rating accordingly.

9.3.10 The assessment and evaluation for each LLCA concludes with a summary statement of the effect of the scheme, taking into account proposed mitigation measures and reflecting the significance of change over time.

### *Specific Assessment Tasks*

9.3.11 The following key tasks have been undertaken as part of the landscape assessment:

- Analysis of existing assessment data derived from previous environmental studies of the area, particularly Lincoln Eastern Bypass - *Environmental Statement, (August 2009)*, Volume 3 – Technical Appendices.
- Desk based analysis of available mapping and aerial photography covering the study area to identify landform, vegetation and settlement patterns;
- Desk based review of any available background landscape studies and appraisals (North Kesteven Landscape Character Assessment (2007) & West Lindsey Landscape Character Assessment, 1999);
- A review of available planning policy documentation relevant to the scheme;
- Preliminary desk based plotting of potential LLCAs;

- Site appraisal and appropriate modification of preliminary zones. Site recording involved annotation of 1:1,250 and 1:10,000 scale Ordnance Survey plans to define areas and the key elements determining character;
- Site photography to illustrate LLCAs, notable views / viewpoints and key landscape elements;
- Drafting and description of LLCAs, analysis of their sensitivity to change and evaluation of change in character and potential resultant effect on existing quality;
- Development of appropriate mitigation proposals; and
- Identification of potential residual effects.

### *Visual Effects Assessment Criteria*

9.3.12 The criteria for visual effects are set out in Volume 2 – Supporting Information. The assessment into visual effects has involved the three stages of assessment. described below;

- Identification of principal visual receptors and an indication of their sensitivity to changes in their view related to the implementation of the development;
- Site survey to verify receptors and determine the potential magnitude of impact for the identified receptors arising from the scheme; and
- Identification of broad mitigation measures to potentially address significant effects identified by the assessment.

#### *Baseline Environment*

9.3.13 Establishment of the existing visual context for the proposed development has involved consideration of the information relating to existing landscape character established during the landscape character baseline assessment, the definition of a zone of visual influence (the visual envelope) for the proposed development and the identification of key visual receptors within the visual envelope.

#### *Key Receptors*

9.3.14 The identification of key receptors involved a review and initial plotting of buildings including residential and businesses, areas open to public use, rights of way, informal routes and local roads located within the visual envelope. Site surveys were then undertaken to establish the nature, location and actual availability of view. This enabled a schedule of key receptors to be identified for the purpose of assessing the order of impact they will be likely to experience.

#### *Significance of Effect Assessment*

9.3.15 Where appropriate, receptors were grouped, with numbers of individual properties in the group or an estimate of number of users being noted.

9.3.16 Each of the receptors identified has been evaluated against the key visual impact criteria and has been allocated a significance of effect rating. Identified receptors, potentially subject to the various degrees of effect, are then identified. The assessment concludes with a brief discussion of the overall visual implications of the proposals and a summary rating for the significance of the visual effect.

## 9.4 Baseline Environment

### *Introduction*

9.4.1 The City of Lincoln dates back to Roman times and developed on the southern face of a limestone escarpment interrupted by the River Witham and is now the largest development in what is a largely rural county.

9.4.2 The city is located at the intersection of a number of historical routes and former Roman roads still reflected by the locations of the A46 and A15. These roads give the city an important strategic position between the north and south of the country. Other local roads radiate from the city and a more recent ring road links with these as it extends around the perimeter of the city from the south west to the north east.

9.4.3 The most striking feature of the city is the Cathedral that occupies a prominent position on the very edge of the escarpment slope, approx 55m above the Witham Gap to the south. As a result, the structure is visible at a considerable distance and is itself afforded extensive views across the local landscape to the gently rolling agricultural land to the west and the expansive fenlands to the east.

### *National Character Areas*

9.4.4 'The Character of England Map' undertaken by the Countryside Commission and English Nature (now Natural England) in 1996 subdivided the country into broad areas of landscape character. Lincoln's position adjacent to the Witham Gap is further strengthened by its relationship with natural features such as the River Witham, the influence of the underlying landform and visual links to the surrounding countryside. Lincoln itself lies to the eastern edge of the Trent and Belvoir Vales (No. 48) with the Northern and Southern Lincolnshire Edge (No.45 and 47 respectively) extending to the east of the city to include the majority of the study area, refer to Figure 1030171-LEB-LAN-001. The key characteristics of this wider landscape that are relevant to the study area are:

#### *45 & 47 – Lincolnshire Edge*

- Large-scale 'upland' arable escarpment broadly divided into north and south by river Witham at Lincoln. Area broadens to south;
- Prominent scarp slope of Lincoln 'Cliff' marks western edge of area;

- Open landscape with rectilinear fields and few boundaries. Where enclosure still present, a mixture of limestone walls, discontinuous hedges and shelter belts;
- Sparse settlement on top of escarpment. Spring-line villages to west at foot of 'cliff' and small parklands to east towards the clay vale;
- Active and redundant airfields;
- More complex landscape of the northern section includes a double scarp, urbanisation and dereliction in Scunthorpe area and the Coversands area of heath, blown sand habitats and conifer woods; and
- Roman roads and ancient track ways such as Ermine Street or High Dyke follow north-south routes with one significant east-west route - Salter's Road. Green lanes occur in the southern area.

9.4.5 The City of Lincoln occupies a regionally important location on the limestone escarpment referred to as the 'cliff' that forms the western extremities of the Lincolnshire Edge with the Trent farmland extending to the west. Lincoln sits in a prominent position overlooking the break in this escarpment created by the River Witham as it flows eastwards before turning southwards to flow towards The Wash. A narrow wedge of fenland extends from the south-east associated with the River Witham towards the edge of Lincoln and is a stark contrast with the elevated arable farmland that is evident to the north and south.

### *Sub-Regional Character Areas*

9.4.6 At a sub regional scale the boroughs of West Lindsay and North Kesteven to the north and south of the study area respectively have undertaken landscape character assessments which are relevant to this study.

### *West Lindsey Landscape Character Assessment (1999)*

#### *Lincoln Fringe*

9.4.7 Extending to the north east of Lincoln, the character area is comparatively small and lies on the dip slope of the escarpment to the west. The relatively flat landscape retains views of Lincoln Cathedral, particularly along the A158. Fields are generally medium in size and are bounded by low hawthorn hedgerows with occasional mature ash and oak hedgerow trees. There is commonly a well defined edge between the open arable landscape and built environment which has expanded in recent years as a result of good communication links with Lincoln.

9.4.8 The south western fringe of the character zone as it abuts the City of Lincoln has increasingly urban fringe characteristics. Overhead power lines are highly visible detractors which in combination with local roads and fly tipping results in noticeable deterioration in visual quality of the area.

#### *Fenland*

9.4.9 Occupying the south of the study area the landscape comprises a small area of fenland that follows the route of the River Witham. The landform is flat with little in the way of vegetation bar some remnant field boundaries comprising sporadic hedgerow trees and outgrown hedgerow shrubs.

9.4.10 The flood defences associated with the River Witham represent a uniform element within the landscape and is largely un-vegetated, as a result the location of the river can be readily read within the landscape unlike the numerous drainage ditches and dykes that cross the landscape.

9.4.11 The landscape as a whole is largely unsettled, small historic villages occurring to the east. Their distinctive church spires locate them within longer distance views.

9.4.12 The western most extremity of the character area is directly relevant to the study area of the Proposed Scheme encompassing the floor of the River Witham.

### *North Kesteven Landscape Character Assessment 2007*

#### *Limestone Heathland*

9.4.13 A large character area that is characterised by its relative elevation, openness and uniform intensively farmed fields. Its key characteristics comprise a gently undulating landform, a notable absence of surface water features and large rectilinear fields. Field boundaries are typically managed hedgerows although these are frequently broken and interrupted; small copses or woodlands occur throughout and are prominent due to the relative open nature of the landscape. Settlement patterns are generally sparse and limited to small historic towns and villages on the periphery of the wider character area.

9.4.14 The northern extremities of this character area are relevant to this study although these display many of the characteristics commonly occurring throughout the wider character area.

#### *Central Clays and Gravels*

9.4.15 Extending through the district the area is characterised by gently undulating lowland and forms the transition between the Limestone Heathlands to the west with the Fenlands to the east. Fields patterns are more varied with less emphasis on arable land uses with increased pasture and more extensive areas of woodland. Settlement pattern reflects changes in underlying geology with noticeable line of villages to the west as local springs drain the upland limestone.

9.4.16 The very northern extremity includes the settlement of Washingborough and the adjoining slopes; this area does not display typical characteristics of the wider

character area being heavily developed and having more in common with the urban fringes of Lincoln.

### *Local Landscape Character Areas (LLCA)*

9.4.17 The *Environmental Statement* produced in 2009 identified 6 local landscape character units and 4 townscape character units, this has been reviewed and the majority of the landscape character areas have been adopted within this study. A single landscape character area (LCU3) has been split between adjoining character areas (LLCA 2 & 3), refer to Figure 1030171-LEB-LAN-001.

#### *LLCA1 – Northern Upland Plateau*

9.4.18 The landscape character consists mainly of open, gently undulating upland farmland, interspersed with small settlements, that extends extensively towards the north and east of Lincoln and falls gradually to the south. The plateau ranges between 25 – 35m AOD and is located directly to the eastern edge of Lincoln and forms part of the wider Lincoln fringe. The gentle undulating landform offers elevated views of the wider landscape with intermediate views of the Witham Gap and the northern valley slopes and more distant views to the south, towards Washingborough and Branston.

9.4.19 The intensive farming of arable crops has shaped the landscape, with predominately open fields bounded by well trimmed and low hedgerows. Individual trees are present within the landscape but are localised along hedgerows or associated with former hedge lines that have been removed or lost. Some small areas of woodland are present but are very sparse as the landscape has been heavily modified by farming. The irregular field pattern comprises fields of variable sizes mainly between Wragby Road and Greetwell Road. To the south the field pattern is more regular, however due to the undulation of the landform it is difficult to perceive these shapes from local roads.

9.4.20 A number of well used minor roads and lanes cross the area, which primarily radiate out from the City of Lincoln connecting with smaller settlements throughout the area, in particular Wragby Road (a former Roman road) has retained its linear form and is a distinctive feature. The presence of these roads does little to disturb the feeling of open farmland and their impact is localised. They contrast with the overhead cables and pylons which form a distinct element within the landscape. Local footpaths, generally used for recreation and cycling, are few and concentrated on the urban fringes.

9.4.21 For the most part the landscape character is characterised by open farmland. However, one distinctively different element within the landscape is a quarry towards the western edge of the urban fringe, which marks a man-made depression within the landform. This element is barely perceptible though from

the surrounding landscape because of landforms undulation and denser woodland planting along the urban edge.

9.4.22 The landscape is considered to be of **ordinary** quality and the proximity to the edge of Lincoln and its contribution to the setting of the edge of the city suggests that it has some value at a local level. The elevated nature and undulating landform combines with hedgerows to form a landscape that has a **medium** capacity to accommodate change. Within a range of **low** the sensitivity to change of the landscape would be at the upper end of the scale.

*LLCA2 – Northern Valley Slopes*

9.4.23 The character area is defined by the northern 'upslope' that forms the edge of the Witham Gap and extends eastwards towards Cherry Willingham, gently softening as it does so. This is a transitional zone between the elevated plateau that extends to the north (LLCA1) and the fringes of the fenland landscape that exists to the east. The slope itself is steep, descending rapidly from 25m to 5m AOD and offers some expansive views from the upper slopes, across the River Witham valley; south and east towards Washingborough with the expanding flat landscape of the fens visible to the east.

9.4.24 Land use is predominately intensive arable farming, similar to LLCA1, however field sizes are smaller and less regular due to the underlying landform which changes abruptly as the landform flattens and the fenland landscape starts. Field boundaries are more apparent within the less intensively managed landscape and being frequently interrupted they represent distinctive landscape features.

9.4.25 The Lincoln to Market Rasen railway sweeps across the character area forming a distinctive feature within it. Light industrial units on the eastern edge of Lincoln represent a marked boundary to the character area. The presence of the railway line forms a key detractor to the area's overall sense of tranquillity. The Greetwell/Friskerton Road crosses the character area from east to west and represents a local link with the settlements to the east.

9.4.26 Contained within the landscape character is part of the Greetwell Hall and Historic Parkland designated as a Scheduled Ancient Monument and site of nature conservation, and is partially accessible by public footpaths. The hummocky grassland area interspersed with mature trees, combined with the setting of buildings, contrasts with the surrounding open farmland; although different in appearance it still forms a feature within the wider landscape area. The Viking Way, a long distance footpath (147miles) runs east to west, parallel with the railway line, to the south before crossing it to the east of the industrial estate and skirting along the edge of the character area as it heads towards the city centre.

9.4.27 Woodland forms a significant element within the landscape: copses associated with the Greetwell site, the railway corridor and mature hedgerows create a sense of enclosure along the profile of the slope.

9.4.28 The landscape is considered **ordinary** quality however the presence of the Greetwell site, part of the Viking Way and the contribution that the landscape makes to the setting of the City of Lincoln suggests that the landscape is of regional importance. The transitional landform and its relationship with the valley floor (LLCA3) and the opposing slopes (LLCA4) result in a landscape that has a **low** capacity to accommodate change. The sensitivity to change to the type of development being proposed is considered to be **high**.

*LLCA3 – Fens*

9.4.29 The landscape character is typified by the flat and low lying (5m AOD) landform comprising extensive areas of grazing separated by a series of boundary ditches which flow into the River Witham. The River Witham flows from east to west and is accompanied by Delphs (ditches) which run parallel to the north and south, creating distinctive features along the valley. The flat nature of the landform gives rise to noticeable changes in landform variations, particularly associated with the flood embankments and railway corridors. The area sits to the eastern fringes of Lincoln on the interface of the urban edge and the extensive area of fenlands that gradually widen and broaden to the south east, beyond Washingborough.

9.4.30 The landform is dominated by a strong rectilinear field pattern that runs in a perpendicular pattern towards the River Witham along the valley floor. The strong geometric field patterns form part of a heavily modified landscape, which is typical of the Lincolnshire Fens. For the most part, fields become increasingly large to the east, as pasture gradually gives way to arable crops. Smaller fields that contain semi improved pasture are located on the fringes of the area.

9.4.31 As opposed to the previous landscape character types, significant wooded outcrops and hedgerows are present, particularly along the banks of the river and the used and disused railway embankments. There is a large length of linear woodland belt /scrub along the River Witham, and occasional mature willow trees. The vegetation creates a greater sense of containment within the valley, giving the area a sense of tranquillity.

9.4.32 The overhead power cables, industrial areas on the edge of Lincoln, and the sewage works combine to detract from the overall sense of tranquillity. The main access road is the B1190, which forms the southern edge of the character area, and the Lincoln to Spalding railway also crosses the area towards the southwest corner but form relatively discrete elements to the fringes of the character area.

9.4.33 The designated Scheduled Ancient Monument at Greetwell Hall extends into the character area, straddling the boundary with LLCA2: the southern section of the designated site includes a small woodland and a number of mature trees. The Viking Way crosses the designated site to the north before extending south towards the River Witham to cross the character area and extend to the east.

9.4.34 The River Witham represents a key recreational resource as a navigable watercourse and the associated footpaths and bridleways extend between the city centre and the outlying settlements to the east. Important and dramatic views are afforded from these routes to the city and, in particular, to the striking profile of Lincoln Cathedral. The valley's proximity to, and its contribution to the setting of, the City of Lincoln results in a heightened sensitivity.

9.4.35 The landscape is of **good** quality, representing the fringes of the wider and more coherent fenland landscape to the east, however as an important recreational resource it is considered to be of local and regional value. The low lying nature of the landscape, its relationship to Lincoln to the west and fragmented vegetation cover results in a landscape that has a **low** capacity to accommodate change. The landscape is considered to be of **medium** sensitivity to change.

*LLCA 4 Southern Valley Slopes*

9.4.36 This landscape character lies towards the south east of Lincoln and consists of a linear strip on the north facing slope of the River Witham valley, rising from 10m AOD to 45m AOD. The generally open aspect and elevated position above the Witham Gap offers panoramic views, providing open long distant views to the north, west and east to include a substantial part of the City of Lincoln with the cathedral appearing as a prominent feature on the horizon. To the east, the built up areas of Washingborough combine with trees and hedgerows to partially obscure views at the foot of the slope.

9.4.37 The area lies within the Waddington to Washingborough Green Wedge and there is a contrasting mixture of land uses throughout the area, ranging from large arable agricultural fields towards the east and the more leafy suburban area of Canwick with surrounding golf courses and a cemetery to the west. The extent of the character area is clearly defined by the Washingborough Road at the foot of the slope, the Heighington Road on the ridgeline and to the east the Lincoln - Spalding Railway, which sweeps along the western edge of Washingborough.

9.4.38 Individual farmsteads and properties are noticeable along the ridgeline, particularly Sheepwash Grange Farm and Manor Farm. The more open aspect of the character detracts from the overall sense of tranquillity. However, within these areas, towards the more sheltered locations around individual farmsteads and woodland enclosing the golf course, views are more contained and tranquil.

9.4.39 Hedgerow boundaries, particularly towards the east of the slope, are substantial and extensive, especially along the boundary of larger fields. However, there are indications that, due to a lack of management, they are starting to decline and become broken. The area in and around the golf course and Canwick is densely planted woodland, in contrast to the broad farmland, and provides for recreational use and footpaths.

9.4.40 The landscape is of **good** quality, the combination of features, landcover and pattern combine to represent a transitional zone between the fens, settlements and the open elevated arable landscape that extends to the south. The area has limited access through it. However, its contribution to the setting of the valley and Lincoln results in the landscape being considered to be of local and sub regional value. In a similar way to LLCA2, there is a strong relationship with the adjoining character areas, and its exposed slopes have a **low** capacity to accommodate change. The landscape is considered to be of **high** sensitivity to change.

*LLCA5 – Southern Upland Plateau*

9.4.41 This landscape character is represented by an extensive open expanse of largely arable farmland that lies to the south of Lincoln and extends towards Branston in the east and RAF Waddington to the south. It is typically characterised by gently undulating open farmland ranging between 20m AOD in the east towards 65m AOD to the northwest. The area gains frequent long distance views across the plateau to Lincoln Cathedral on the northern horizon and Branston Hall to the south.

9.4.42 The regular pattern of large intensively farmed arable fields is bounded by well trimmed hedgerows throughout the limestone heath. The main routes radiate from Lincoln to the southeast, connecting Canwick, Bracebridge Heath and comprise typically long straight roads, namely Heighington Road, Lincoln Road, Sleaford Road and Bloxholm Lane. Isolated properties are scattered throughout the area and are commonly set back from the primary routes and access by long narrow access tracks.

9.4.43 Away from the main transport corridors the elevated undulating nature of the landform gives rise to locally tranquil areas. Overhead power lines represent one of the most significant visual detractors crossing the area from north to south. Frequent flights from RAF Waddington to the south are also noticeable, albeit temporary, visual and noisy elements.

9.4.44 Tree cover is variable across the area: small groups surrounding isolated dwellings; shelter belts; small woods between fields; tree belts along watercourses; and the occasional tree lined hedgerow; and result in a fragmented pattern. The woodland and more coherent tree planting in and around Canwick marks the largest, most noticeable woodland in the area.

9.4.45 The wider countryside is accessible via the footpath and track network that exists particularly in the south. South of Branston there is a well defined network of lanes and tracks used for recreation.

9.4.46 The landscape is of **ordinary** quality, the combination of open elevated farmland, undulating landform and fragmented tree cover is capable of effectively accommodating frequent local transport corridors. Access to the landscape is good: a network of local lanes and tracks combining with footpaths results in a landscape that provides a resource at a local level. The landform and elevated nature of the landscape suggests that the landscape has a **medium** capacity to accommodate change. The landscape is considered to be of **low** sensitivity to change.

### *Summary of Landscape Character*

9.4.47 The landscape is dominated by the valley that forms the Witham Gap and is a locally significant landform. The resulting extension to the Lincolnshire fenlands permeates almost to the centre of Lincoln flanked to the north and south by the steep valley slopes which form LLCAs 2 and 4. These represent transitional zones and the steep landform has limited further development beyond the nucleated settlements that extend to the east of Lincoln.

9.4.48 To the north and south, the valley slopes quickly return to the expansive, undulating landform that is typical of the wider landscape. The landform combines with fragmented tree cover in the form of copses and small woodlands to give rise to a sense of enclosure although the perception of being elevated is retained as a result of only local horizon lines, the top of Lincoln Cathedral being the most frequently discernible landmark.

9.4.49 The majority of the landscape (LLCA 1 and 5) is considered to be of low sensitivity. The extensive areas of open farmland, elevated nature of the landform and local undulations result in a capacity to accommodate change. In contrast, the transitional slopes that mark the limits of the Witham Gap and associated valley floor contribute significantly to the perception of the valley and its relationship with the City of Lincoln to the west and open fens to the east (LLCA 2, 3 and 4). The relationship of the two slopes affords frequent and direct views to the opposing landform and as a result their capacity to accommodate change is limited and sensitivity is therefore considered **high**. The sensitivity to change is considered to be **medium** for the landscapes associated with the valley floor.

### *Visual Context*

9.4.50 The visual context of the Proposed Scheme is modified along its route transitioning from a typical urban fringe north of Washingborough Road to a distinctly rural one to the south. A frequent and recurring element throughout the

visual context of the Proposed Scheme is the important visual link that exists with Lincoln Cathedral, the tower becoming increasing in its inter-visibility from open areas within the Witham valley complex and its north facing slopes.

9.4.51 The northern limits of the Proposed Scheme have strong visual links to recently constructed housing to the west; dwellings to the eastern fringe of these areas are afforded open views towards the route of the Proposed Scheme currently comprising open arable countryside. Awareness also exists from this elevated position to the south to include the outline of Branston on the horizon. This diminishes to the south as the built environment gives way to a more rural one. The crossing of Greetwell Road and the descent into the Witham valley complex creates new visual links to the residential fringes and industrial estate to the west. Cherry Willingham to the east is largely screened by intervening vegetation with little awareness of the Proposed Scheme corridor.

9.4.52 From within the Witham Valley the landform and settlement pattern results in several settlements being visible, views of the industrial estate remain with increasing awareness of the city centre as it descends across the escarpment slope. To the south and west the rooflines and golf course associated with Canwick are visible, similarly to the south and east the larger settlement of Washingborough is clearly visible.

9.4.53 At the interface of the Proposed Scheme with Washingborough Road the visual links to Canwick and Washingborough decrease significantly and stronger links emerge with the City of Lincoln to the north and west including clear and direct views to Lincoln Cathedral.

9.4.54 South of Washingborough Road the visual context becomes more easily defined, the settlement pattern becoming noticeably more scattered and limited to a small number of farmsteads and isolated properties. Several properties that extend westwards along Lincoln Road and represent the western limits of Branston face north east. They are afforded oblique views in the direction of the Proposed Scheme.

9.4.55 South of Lincoln Road the gently undulating landform restricts wider appreciation of the open countryside and, in combination with intervening field boundaries, results in the settlement of Bracebridge Heath to the west being largely screened from the Proposed Scheme. At the tie in with Sleaford Road several properties, including the complex associated with Manor Farm, have direct visual links with the route of the Proposed Scheme. View south are screened by rising landform.

### *Zone of Theoretical Visual Influence (ZTVI)*

9.4.56 The development of the ZTVI has involved a review and adaptation to the work previously carried out as part of the Environmental Statement produced in 2009.

This has comprised further ground truthing to confirm the extent of the visual extent of the Proposed Scheme.

9.4.57 To the north a combination of undulating landform and intervening field boundary vegetation, including hedgerow trees, gradually reduces the visual influence. This continues to the east with the edge of the small hamlet on the Hawthorn Road marking the limit of the visual influence, views gradually begin to expand further afield as the landforms starts to descend to the valley complex. The visual extent of this northern section is limited to the west by recent residential development, gradually giving way to a rising landform as the ground gently lifts. The roofline of the hospital and the unmistakable outline of the Cathedral remain perceptible.

9.4.58 From the upper slopes of the valley, broad views to the east and west along the valley complex are afforded. The full extent of the City of Lincoln and its position on the scarp slope are clearly evident to the west.

9.4.59 To the east, open views of the flat fenlands as the Witham Valley widens are a marked contrast to the rapidly enclosing landform towards the city. Washingborough is a noticeable feature to the south of the valley: the curve of the landform gradually enclosing views.

9.4.60 To the south of the Witham Gap the steeply rising landform combines with boundary vegetation to enclose views to the east and west. However, as the elevation rises increasingly extensive views to the north are revealed. The return to an undulating landform and frequent hedgerows combine with blocks of woodland to diminish far-reaching views to local horizon lines, with occasional glimpses to more distant rises in the landform.

9.4.61 To the south of the scheme corridor, the eastern and southern fringes of Bracebridge Heath marks the limit of the visual context. In contrast, it is woodland and undulating open countryside that diminish views to the east, with a distinctive fold in the landform marking the southern extent of the ZTVI.

## 9.5 Predicted Impacts

9.5.1 This section describes the predicted impacts and evaluates their significance in accordance with the criteria detailed in the Methodology (Section 9.3). The assessment has been carried out making reference to the proposals as outlined in Chapter 4. In doing so, the anticipated impact on each LLCA has been assessed, taking into account the design proposals outlined in Chapter 4. The following provides a summary of the anticipated effects on the identified local planning policies, local landscape character areas and visual receptors. The assessment also takes account of the timescales for development, providing an

indication of the effect during construction, in the year of opening, and the design year (Year 15).

### *Impacts on local planning policies*

#### *City of Lincoln Local Plan*

9.5.2 The introduction of the Proposed Scheme is anticipated to have localised impacts on views to and from sites within the City of Lincoln and, in particular, views out from the environs of the Cathedral and Castle's walls will be modified. However, in the context of these very broad, elevated views any effect is not considered to be significant. The Proposed Scheme does, however, support the plan in delivering views from the route of the Lincoln Eastern Bypass to the city.

#### *West Lindsey District Council Local Plan*

9.5.3 The Proposed Scheme will take account of Policy NBE10, and will seek to mitigate potential impacts on local skylines through appropriate mitigation measures that reflect the distinctiveness of the wider landscape character.

#### *North Kesteven District Council Local Plan*

9.5.4 The Proposed Scheme will take account of Policy C2, and will seek to mitigate potential impacts on landscape character through appropriate mitigation measures that reflect the local distinctiveness and appearance.

9.5.5 The Proposed Scheme will be contrary to Policy LW1 in that the alignment of the corridor will result in a significant new cutting ascending the valley slope and is anticipated to adversely affect the landscape character.

### *Construction Impacts*

9.5.6 The construction phase is expected to temporarily impact local landscape as a result of activities to deliver the scheme. Key activities that are anticipated to contribute towards impacts on the local landscape have been identified as:

- Construction of temporary haulage/construction routes for site traffic;
- Introduction of heavy plant used for the construction of the new road;
- Temporary storage of spoil, prior to reuse or removal off site;
- Lifting equipment including the use of cranes; and
- Visual clutter associated with temporary diversions/closure of existing roads.

9.5.7 Some activities may be mitigated by the use of temporary screen mounds using the arisings from site to reduce visual intrusion or other nuisances such as dust. Presently, the location of these has not been identified, although where they are

used the visual intrusion is likely to be reduced due to the improved visual screening of the construction works for adjacent receptors.

### *Operational Impacts*

9.5.8 During the operational phase, it is anticipated that the new corridor will, in the medium to long term, become integrated into the wider landscape context when mitigation planting, particularly trees, become mature.

9.5.9 In assessing the operational impacts, consideration is given to the way in which the components of the Proposed Scheme will alter the way in which the local landscape is perceived or cause visual impacts on receptors, as a result of:

- Modification to the existing landscape components that form the characteristics of the wider landscape, e.g. changes to field boundaries and patterns, loss of existing trees/woodland;
- Changes to the layout of the local road network which may introduce new elements into the existing landscape, e.g. traffic movements, lighting, junctions;
- Changes to the existing land uses that contribute to the local landscape; and
- Introduction of new soft landscape features, e.g. replacement hedgerows, or roadside planting.

### *Landscape Character Impacts*

#### *LLCA1 – Northern Upland Plateau*

9.5.10 The Proposed Scheme will form a new linear feature to the south west fringes of the wider character area, defining a new limit to the eastern edge of Lincoln, with a clear demarcation between urban development and the open countryside.

9.5.11 Contained within a gently undulating landform, the Proposed Scheme will be either at grade or contained by long shallow cuttings. Where exposed sections occur, additional earth bunds, augmented by hedgerows and blocks of planting, will result in the impacts on the wider landscape being limited to the local area and the approach to the city from the north east.

9.5.12 Existing local roads will be heavily modified by the Proposed Scheme, a combination of screen mounding and planting creating a visual and physical barrier, disrupting the clear and direct visible link between the urban fringe of Lincoln and satellite settlement to the east on Hawthorn Road.

9.5.13 To the south of the LLCA, the transition to the northern valley slopes are heavily modified by the road as it transects the southern edge of the quarry site. The transition of cutting to embankment will be marked and noticeable with the loss of existing vegetation that currently screens the edge of the quarry site. This is to

be replaced with associated drainage attenuation ponds and proposed footbridges.

9.5.14 The landscape is considered to be of low sensitivity to change, although at the upper end of the scale, the modification to the wider character area will occur along the fringe of the LLCA and will provide definition to the urban fringe. The magnitude of impact is anticipated to be in the order of medium; as a result the significance of effect will be **slight and adverse** in the year of opening reducing to **neutral** in the design year.

*LLCA2 – Northern Valley Slopes*

9.5.15 Representing a narrow tract of land the steep landform will be heavily modified by the introduction of a new roundabout junction with Greetwell Road. The bridge over the Lincoln to Market Rasen railway will be linked by a short stretch of highway broadly set at grade with the adjacent landform. Proposals include an area of regrading to the east of the corridor, integrating the scheme with the landform in views from the east.

9.5.16 The effect of these changes will be a noticeable new element within the LLCA and the perception of the slope will be modified by the new corridor marking the limit of the urban influence of Lincoln. Of perhaps more significance is the perception of the slope from adjacent character areas LLCA3 and LLCA4, both of which have direct views of the modified slopes to the north. The modifications to the area will be a new and visually prominent element with the eastern limit of the urban area being extended by the road.

9.5.17 There will be no direct impacts on the Greetwell Hall and Historic Parkland, Scheduled Ancient Monument, to the east of the Proposed Scheme corridor. The existing vegetation within the site forms a visual barrier to broader views to the west and the site will be relatively unaffected by the proposals.

9.5.18 The landscape is considered to be of high sensitivity to change: the corridor will represent a noticeable new element within the character area occurring within the core of the LLCA. This change will modify the perception of the character area and, in particular, the perception of the slopes from the adjacent LLCAs to the south. The magnitude of impact is anticipated to be in the order of medium; as a result the significance of effect will be **large and adverse** in the year of opening reducing to **moderate** in the design year.

*LLCA3 – Fens*

9.5.19 The low lying fenlands lie to the fringes of the wider fenland character area. The Proposed Scheme will cross the area on a significant new and visually prominent embankment (approx 10m at its highest point) and will include a new bridge

crossing of the River Witham and associated drains that run parallel with the main watercourse.

9.5.20 These new visually prominent elements will disrupt views along the river valley, heavily modifying the existing mainly rectilinear landscape pattern. To the east of the Proposed Scheme corridor views along the valley towards Lincoln will be interrupted and replaced with an intermediate horizon line comprising the embankment, bridge structure and traffic movements.

9.5.21 The effect will be a new distinctly urban component within a fundamentally rural landscape that contributes much to the setting of the eastern edge of Lincoln, the interruption to the hedgerow pattern, the loss of views along the valley and erosion of the underlying character will be significant.

9.5.22 The Proposed Scheme crosses this character area at a location already heavily modified by a number of existing transport corridors. The Lincoln to Spalding railway is set on a high embankment and is crossed by the Washingborough Road to the east of the extensive water treatment works. The Proposed Scheme will cross the railway line on a descending embankment tying into the rising landform to the south at grade as it forms a junction with Washingborough Road.

9.5.23 Existing vegetation associated with the railway and the River Witham to the north will limit the impacts on the wider character area and the adjacent LLCA 3 to the north. The extent of the changes will be limited to a relatively small area within the character area and lies immediately adjacent to the existing water treatment works representing an existing urban fringe land use, as such the effect of the proposed road and junction will be a further consolidation of the urban fringe features.

9.5.24 There will be no direct impacts on the Greetwell Hall and Historic Parkland, Scheduled Ancient Monument, to the east of the Proposed Scheme corridor. Awareness of the embankment and the new crossing of the River Witham will be likely to be perceptible, particularly during winter however a combination of distance and intervening vegetation will not result in significant impacts.

9.5.25 Mitigation measures will seek to integrate the scheme into the existing landscape structure with blocks of scrub and woodland planted to link in with the existing vegetation, particularly to the south of the character area.

9.5.26 The landscape is considered to be of medium sensitivity to change, the corridor, embankment and bridge will represent a prominent new element, although on the fringes of the wider character area that extends to the east. The magnitude of impact is anticipated to be in the order of high; as a result the significance of effect will be **large and adverse** in the year of opening reducing to **moderate** in the design year as proposed mitigation measures mature.

### *LLCA 4 Southern Valley Slopes*

9.5.27 The primary direct impact on this LLCA is the provision of a new and deep cutting that will lift the Proposed Scheme from the junction with Washingborough Road to the elevated farmland that exists to the south and forms LLCA5. The cutting itself is orientated in a north south direction and perpendicular to the orientation of the main slope profile. The cutting itself will be approximately 16m deep and require the inclusion of a berm at its mid point,

9.5.28 The effect of the cutting will be a locally significant modification to the existing slope profile. Within the wider character area the impacts will not be significant and the remaining hedgerows and cutting profile will restrict the degree to which the new elements will be visible along the profile of the slope.

9.5.29 Where more significant impacts are anticipated to occur from the adjacent character areas, most notably LLCA2 and 3, the proposed cutting will appear as a notch on the southern horizon line, with the bridge accommodating Heighington Road reflecting the former horizon.

9.5.30 Proposed mitigation at the foot of the slope focused around the roundabout with Washingborough Road will, over time, provide a screen to the north of the cutting. However, as the Proposed Scheme rises up the slope profile, the road will become increasingly evident within the wider landscape.

9.5.31 The landscape is considered to be of high sensitivity to change, the Proposed Scheme will result in a new locally significant cutting within which traffic movements will be evident from areas to the north. The magnitude of impact is anticipated to be in the order of medium; as a result the significance of effect will be **moderate and adverse** in the year of opening, this is likely to remain **moderate** in the design year due to the limited influence of proposed mitigation measures.

### *LLCA5 – Southern Upland Plateau*

9.5.32 Having ascended the valley slopes that make up LLCA 4 the Proposed Scheme, set broadly at grade will appear as a new element within this broad undulating landscape. Numerous hedgerows and the predominantly rectilinear field pattern will be interrupted by the alignment of the Proposed Scheme.

9.5.33 Within the landscape, traffic movements are currently limited to three local roads radiating from Lincoln in a broadly south to east direction. The Proposed Scheme will introduce new traffic movements at odds with this established pattern and within areas of existing open countryside. Proposed local junctions with Lincoln Road (B1188) and Sleaford Road (A15) will broaden the influence of the existing road corridors and associated lighting will appear as new vertical elements.

However, the effect of these lights will be limited within the context of the existing overhead power lines that cross this open landscape.

9.5.34 The proposed mitigation measures will primarily take the form of extensive earth bunds aimed at providing immediate screening and additional planting in the form of hedgerows will over time integrate these within the surrounding landscape.

9.5.35 The landscape is considered to be of low sensitivity to change. The Proposed Scheme will result in a new linear corridor partially screened by proposed mitigation bunds. The magnitude of impact is anticipated to be in the order of major; as a result the significance of effect will be **moderate and adverse** in the year of opening, this is likely to reduce to **slight** and adverse in the design year. The inclusion of maturing hedgerows will integrate the scheme, and in combination with the extensive lengths of screen mounding will effectively modify the way in which the Proposed Scheme is perceived within the local landscape.

### *Visual Impacts*

### *Receptors*

9.5.36 The predicted visual effects for each of the visual receptor groups, including rights of way are identified on Figures 1030171-LEB-LAN-002 to 005. A total of 452 individual receptors have been identified as potentially being subject to visual effects as a result the Proposed Scheme, a summary of these are provided below.

9.5.37 During the construction phase 149 receptors will be subject to significant (moderate adverse and greater) visual effects, 22 of these will be in the order of very large and adverse.

9.5.38 Immediately post construction, the visual effects will reduce with 37 receptors subject to a large adverse effect and 60 moderate and adverse. A significant number (298) will be subject to a slight and adverse effect; this reflects the integration of the proposed earthworks at key locations to form immediate and effective visual screening to adjacent receptors.

9.5.39 In the summer of the design year (year 15) the significance of the visual effect is anticipated to diminish further, 3 receptors will be subject to a moderate and adverse effect with the majority, 266 and 183 subject to neutral and slight adverse effects respectively.

*Table 9-1 Summary of Visual Impacts on Individual Receptors*

| Impact Significance | Construction Phase | Year of Opening (Winter) | 15 Years (Summer) |
|---|---|---|---|
| Neutral | - | 57 | 266 |
| Slight Adverse | 303 | 298 | 183 |
| Moderate Adverse | 96 | 60 | 3 |
| Large Adverse | 31 | 37 | - |
| Very Large Adverse | 22 | - | - |

### *Rights of Way*

9.5.40 A total of 13 rights of way, including footpaths and bridleways, have been identified as subject to visual effects. All footpaths will be subject to adverse effects during construction, with 9 footpaths subject to significant adverse effects (moderate or greater). These include the Viking Way and Spires and Steeples Trail. Both of these notable local rights of way are crossed by the Proposed Scheme, refer to receptors P05 and P08 on Figure 1030171-LEB-LAN-008 (see Volume 2 – Supporting Information).

9.5.41 In the year of opening the number of rights of way experiencing very large adverse effects is anticipated to reduce to two, the majority of the effects remaining significant (3 moderate and 3 large adverse); five rights of way will not be subject to significant effects, ie neutral or slight adverse.

9.5.42 In the summer of the design year, the combination of screen mounding and establishing mitigation planting will reduce the effects of the Proposed Scheme on adjacent rights of way. It is predicted that significant effects will occur to six rights of way: these primarily relate to the footpaths set within the Witham valley that currently enjoy attractive views along the valley and include the cathedral, set on the escarpment slope. These views will be significantly modified by the visually prominent embankment and bridge structure. Of the remaining seven rights of way, all will be subject to neutral or slight adverse effects.

*Table 9-2: Summary of Visual Impacts on Rights of Way*

| Impact Significance | Construction Phase | Year of Opening (Winter) | 15 Years (Summer) |
|---|---|---|---|
| Neutral | - | 1 | 3 |
| Slight Adverse | 4 | 4 | 4 |
| Moderate Adverse | 4 | 3 | 2 |
| Large Adverse | 2 | 3 | 4 |
| Very Large Adverse | 3 | 2 | - |

### *Assessment of Lighting*

9.5.43 The Proposed Scheme is set within an essentially unlit landscape and the proposals provide for lighting at the junctions with local roads and include lighting across the Witham Valley between Greetwell Road and Washingborough Road. The lighting will comprise modern lighting design, including cut offs to reduce light spill, with lighting columns approximately 12m in height.

9.5.44 At the tie in with the A17, the inclusion of road lighting will represent a new additional light source within the landscape. However, from the north and east this feature will appear within the context of the existing lighting to the residential areas, and will not substantially modify the perception of the wider countryside.

9.5.45 At the tie in with Greetwell Road and in extending across the Witham Valley to Washingborough Road, the lighting will represent a new and noticeable light source within the open countryside. The relative low elevation of the Proposed Scheme from the higher ground either side of the valley will result in the cut offs limiting individual light sources. Instead, the Proposed Scheme will be illuminated within the existing 'dark' valley floor. However, from within the valley the combination of embankment, bridge structure and lighting columns will place the light sources significantly above the surrounding landscape and will result in noticeable changes to the perception of the landscape.

9.5.46 South of Washingborough Road the lighting extends up the slope and will highlight the location of the cutting slope when viewed from the north and west, the effect will be an extension to the existing light sources from the adjacent water treatment works and local road.

9.5.47 At the tie in with Lincoln and Heighington Roads, the proposed lighting will result in a new light source within what is a predominantly dark landscape, the existing roads are unlit and the new lighting will highlight the location of the road within the surrounding area. Cut offs will significantly limit this, though inevitably, there will be a perceptible new light source.

9.5.48 The final tie in with the A15 Sleaford Road will similarly introduce a new source of local light pollution, extending the existing roadside lighting present to the north, this will highlight the presence of the new junction. This will result in a perceptible extension to the existing lighting, although it is not anticipated to result in locally significant effects.

## 9.6 Proposed Mitigation

9.6.1 This section describes the mitigation measures which have been developed to address identified landscape and visual impacts, refer to Figure 1030171-LEB-LAN-006 to 010 (see Volume 2 – Supporting Information).

9.6.2 The targeted use of mitigation planting is proposed throughout the length of the Proposed Scheme corridor. This will comprise areas of structural native tree and shrub planting, native species hedgerows and areas of wildflower grassland.

9.6.3 To the north of the Proposed Scheme corridor between the A17 and Greetwell Road, lengths of mounding are supported by linear belts of shrubs and trees aimed at screening residential property to the west. To the east of the alignment, the mitigation comprises native hedgerow planting aimed at restoring connectivity and the local field patterns.

9.6.4 South of Greetwell Road and as the Proposed Scheme crosses the Witham Valley, areas of woodland are proposed to tie into adjacent woodland and replace that removed by the scheme. North of the Lincoln to Market Rasen railway line, the toe of the embankment slope will be extended to the east, with the aim of integrating the scheme with the local landform to reduce views from the historic Greetwell Hall site, located approx 800m to the east.

9.6.5 Elsewhere across the tall embankments, areas of scrub are proposed, aimed at reducing the impact of the slopes and seeking integration into the adjacent vegetation pattern. To the south, both ends of the River Witham structure are tied into the supporting embankment, with the inclusion of blocks of shrubs and trees, providing local height and screening to longer distance views along the valley floor towards Lincoln to the west.

9.6.6 The deep and extensive cutting south of Washingborough Road has differing treatments to reflect the anticipated differences in local microclimate. Wildflower grassland mix is proposed on the east facing slopes of the cutting, whilst the west facing slopes will be seeded with a low maintenance grass verge mix.

9.6.7 South of the cutting, the Proposed Scheme is broadly set at grade within the surrounding undulating landform, and the existing landscape framework comprises managed hedgerows and there is a noticeable absence of woodland. The approach to mitigation reflects this character, with the use of roadside hedgerows aimed at restoring local connectivity and local screening in conjunction with some lengths of mounding to the west.

9.6.8 South of the junction with Lincoln Road, the Proposed Scheme remains broadly at grade with the surrounding landform, supported by the inclusion of roadside hedgerows aimed at restoring local field patterns.

9.6.9 Approaching the end of the scheme and its junction with the A15, several visual receptors are located in relatively close proximity and are afforded potentially significant views. In order to mitigate impacts upon them, hedgerows aligned with the top of the embankment slope provide additional screening and integrate the mounding into the local landscape framework. Existing tree and shrub planting associated with the Manor Farm complex is reflected within the mitigation

design, with proposed tree and shrub planting extending along the length of the Bloxholm Lane diversion, providing screening to the junction with the A15.

## 9.7 Conclusions and Effects

9.7.1 At a local level the residual effect of the Proposed Scheme within the Witham Valley complex which accounts for approximately a quarter of the scheme's extent, would be significant. This arises as a result of the degree to which the prominent embankments and bridge structures, which by their very nature are difficult to effectively mitigate, would modify the local landform, landscape patterns and perception of the Valley to the east of the City of Lincoln.

9.7.2 The assessment of landscape effects concludes that, taking proposed mitigation measures into account the majority of the scheme could be accommodated within the wider landscape effectively.

9.7.3 The assessment of visual effects identified a number of visual receptors that in the year of opening would be subject to impacts ranging between neutral and moderate and adverse. Proposed mitigation measures would, over time reduce these impacts with the majority being no greater than slight and adverse. A number of receptors (29) would remain subject to a moderate and adverse impact in the winter of the design year. However this would substantially reduce to 3no. in the summer as a result of the screening capacity of the proposed planting being strengthened by summer foliage.

9.7.4 Several rights of way are directly impacted by the Proposed Scheme either being crossed or requiring diversions. The resulting impacts are identified as being significant (moderate adverse or greater) and would remain significant in the design year. These primarily occur within the Witham Valley complex as footpaths that follow the valley are crossed by the Proposed Scheme at odds with the underlying landform.

9.7.5 The landscape and visual assessment concludes that the Proposed Scheme will result in significant effects at a local level.

# 10 Noise and Vibration

## 10.1 Scope of the Assessment

10.1.1 This assessment has focused on the following:

- The evaluation of the potential noise and vibration impacts at sensitive receptors during the construction of the Proposed Scheme.
- The evaluation of potential operational noise and vibration impacts at sensitive receptors following the opening of the Proposed Scheme.

10.1.2 The study area for the operational assessment (evaluation of road traffic noise) has been defined based on the guidance contained in the Design Manual for Roads and Bridges (DMRB), Volume 11, Section 3, Part 7 'Noise and Vibration'. This is defined as 600m from all affected roads within 1km of the Proposed Scheme boundary, and 50m from all affected roads outside that 1km boundary.

10.1.3 Affected routes were determined by reviewing the 18 hour annual average weekly traffic (AAWT) forecasts, defined as flows from 06:00 to 00:00 hours, for the Do Minimum (without scheme) and Do Something (with scheme) scenarios for the year of opening (2017) and design year of 15 years hence (2032). Roads where traffic forecasts were predicted to experience a 25% increase or 20% decrease in traffic flows within the study area were determined to be affected routes, which may give rise to perceptible change, and have been considered within the assessment.

### *Identification of Sensitive Receptors*

10.1.4 A review of Ordnance Survey mapping and Address Layer II data was undertaken to identify the number of residential properties located adjacent to and within 600m of the affected roads. Sensitive receptors included:

- Residential dwellings
- Schools
- Community facilities
- Places of worship
- Care/nursing homes
- Heritage buildings

10.1.5 A total of 19017 residential properties and 181 non-residential noise sensitive receptors were identified as being within 600m of the Proposed Scheme or affected roads.

### *Background*

10.1.6 Noise level changes may result from differences in:

10.1.7 Road alignment (vertical and horizontal);

10.1.8 Noise generation (traffic flow, speed and composition, road gradient and road surface type);

10.1.9 Sound propagation (vertical alignment, ground absorption, reflection and scattering).

10.1.10 Noise is defined as unwanted sound. The range of audible sound is taken to be from 0dB to 140dB. For variable noise sources such as road traffic, an immediate increase of 1dB(A), which equates to an approximate 25% increase in traffic, would be the limit of perceptible change to the human ear under normal conditions.

10.1.11 The ambient noise level in an area is the total noise level experienced and will normally comprise of a combination of several individual sources such as road traffic, aircraft, industrial and human activities. Such noise levels generally fluctuate with time and may be described by a variety of indices. With regard to environmental noise levels (in the open air), these are rarely at a steady level, but rise and fall according to the activities being undertaken within the surrounding area at any given time. In an attempt to produce a figure that relates this variable nature of noise to human subjective response, a number of statistical noise metrics have been developed.

10.1.12 The index adopted for assessing road traffic noise is the $dBL_{A10,18h}$ level, defined as the arithmetic mean of the dB(A) noise levels exceeded for 10% of the time in each of the 18 one-hour periods between 06:00 and 00:00 hours on a typical weekday. A reasonably good correlation has been shown to exist between this index and residents' dissatisfaction with traffic noise over the range from about $30dBL_{A10,18h}$ to in excess of $80dBL_{A10,18h}$ which is within the range of external ambient noise levels found in the area of the Proposed Scheme.

10.1.13 Traffic induced vibration is derived, in the main, from two aspects of vehicle movements:

- From ground-borne vibrations produced by the interaction of the vehicle's tyres with the road surface; and
- From air-borne vibration transmitted by energy waves as the mass of the moving vehicle displaces stationary air.

10.1.14 Research demonstrates that there is little evidence to indicate that vibration, at the level induced by road traffic, causes damage to roadside buildings or structures; however traffic-induced vibration can be a perceptible source of

annoyance to local people (e.g. rattling of internal household fixtures and fittings).

## 10.2 Statutory and Planning Context

10.2.1 The key legislation and guidance which has informed this assessment are summarised below. Further detail is provided in Volume 2 – Supporting Information.

### *National Planning Policy Framework (NPPF)*

10.2.2 The NPPF[1] states that developments should aim to avoid significant adverse impacts on health and quality of life as a result of noise, and mitigate in order to reduce to a minimum, other adverse impacts on health and quality of life arising from the development.

10.2.3 Developments should protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

### *The Land Compensation Act 1973*

10.2.4 Part I of the Land Compensation Act 1973[2] includes provision for compensation for loss in property value resulting from physical agents including noise. Part II includes provision for noise mitigation measures at dwellings adjacent to new highways if certain conditions are satisfied.

### *The Noise Insulation Regulations 1975 as Amended 1988*

10.2.5 Under the conditions specified in The Noise Insulation Regulations (NIR)[3], residential properties experiencing an increase in noise levels as a result of road traffic noise may qualify for an offer of noise insulation if specific conditions are satisfied.

### *Control of Pollution Act 1974*

10.2.6 The Control of Pollution Act (COPA) 1974, provides guidance relating to the control of noise and vibration in order to minimise any potential impacts on neighbouring properties, Section 60 and 61 of COPA 1974 allows limits to be agreed with the Local authority during the Construction phase of a development.

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[1] Department for Communities and Local Government, (2012). 'National Planning Policy Framework,' Her Majesty's Stationery Office.

[2] Act of Parliament, (1973); 'The Land Compensation Act 1973, Part 1'. Her Majesty's Stationery Office.

[3] Secretary of State for Transport Statutory Instrument (1975/1988); 'The Noise Insulation Regulations (1975), as amended in 1988', Her Majesty's Stationery Office.

### *Local Noise Policy*

10.2.7 A review of the Local Plans has been undertaken; Policy NBE17 of the West Lindsey Local Plan was the only one to explicitly address the issue of noise. It states the following with regards to the Control of Potentially Polluting Uses:

- "Development that may be liable to cause pollution of water, air or soil, or pollution through noise, dust, vibration, light, heat or radiation will only be permitted if:
- The health and safety and amenity of users of the site or surrounding land are not put at risk;
- The quality and enjoyment of the environment would not be damaged or put at risk;
- Adequate protection and mitigation measures are implemented to ensure that any potential environmental receptors are not put at risk."

## 10.3 Method of Assessment

10.3.1 The assessment has focused on two aspects of traffic related noise; the magnitude of increase or decrease in noise levels which is predicted to result from the implementation of the Proposed Scheme; and changes in the percentage of the population that would experience noise nuisance as a result of the Proposed Scheme.

### *Construction Phase*

10.3.2 The qualitative construction noise assessment has been undertaken with reference to BS 5228.

10.3.3 This standard contains guidance on the prediction of noise levels at sensitive receptors from the operation of fixed and mobile noise sources usually found on construction sites. It provides typical sound level data for various machinery and tasks associated with the construction phase of a site. It also contains information pertaining to mitigation of noise from a construction site.

10.3.4 Following the criteria and methodology contained within BS 5228, thresholds of significant noise impacts have been derived from the established baseline noise survey results.

### *Operational Phase*

10.3.5 The operational noise assessment has been carried out in accordance with the DMRB and the Department for Transport's Calculation of Road Traffic Noise (CRTN)[4]. The procedures described within CRTN set out the requirements for

[4] Department for Transport (1988). 'Calculation of Road Traffic Noise'

traffic flow derivation, monitoring of existing traffic noise conditions, the type of ground cover, heights and distances for predicted noise level calculations, propagation of noise and barriers. Further information regarding the methodology given in CRTN is provided in Volume 2.

10.3.6 The opening year 2017 and the design year 2032 have both been assessed and each year has been modelled with the Proposed Scheme in place (do something scenario) and without the scheme in place (do minimum scenario). The difference between the do something and do minimum scenarios describes the predicted noise impact.

### *Impact Magnitude*

10.3.7 The magnitude of noise impacts has been determined using the criteria detailed within Table 3.1 of the DMRB, relating to noise level change at sensitive receptors, as detailed in the Tables below:

*Table 10-1 Classification of Magnitude of Noise Impacts in the Short Term*

| Noise Change LA10,18h | Magnitude of Impact |
|---|---|
| 0 | No Change |
| 0.1 – 0.9 | Negligible |
| 1 – 2.9 | Minor |
| 3 – 4.9 | Moderate |
| 5 + | Major |

*Table 10-2 Classification of Magnitude of Noise Impacts in the Long Term*

| Noise Change LA10,18h | Magnitude of Impact |
|---|---|
| 0 | No Change |
| 0.1 – 2.9 | Negligible |
| 3 – 4.9 | Minor |
| 5 – 9.9 | Moderate |
| 10 + | Major |

### *Noise Nuisance*

10.3.8 Noise nuisance, is defined as ‘a feeling of displeasure evoked by noise’ by the World Health Organisation. Surveys have shown that individuals vary considerably in their sensitivity to noise and that attitudes to traffic noise are also related to satisfaction with the neighbourhood in general. This variability in individual responses has resulted in the concept of an ‘average’ or ‘community’

annoyance rating for each noise level which is expressed as the percentage of people who are bothered by the traffic noise.

10.3.9 The 'percentage of people bothered' gives an indication of the relative difference between the nuisance caused by traffic noise before and after a road is opened to traffic.

10.3.10 DMRB provides guidance regarding the assessment of traffic noise nuisance for the period immediately following a change in traffic flow (short term changes) and the noise nuisance caused by a variation in traffic flow in the longer term.

10.3.11 In accordance with the DMRB, noise nuisance levels for the do minimum and do something in the proposed year of opening (2017) and 2032 (the design year, usually the 15th year after opening), have been calculated and reported**.**

### *Noise modelling*

10.3.12 NoiseMap Server Edition noise mapping software was used to predict noise levels at potentially sensitive receptor locations within the study area. This data includes 18hr Annual Average Weekday Traffic (AAWT) flows (06:00 to 00:00 hours), traffic composition expressed as the percentage of HGVs greater than 3,500kg (unladen weight) and the average speed of traffic in kilometres per hour (km/h).

10.3.13 The following scenarios have been modelled within the study area:

- Opening year (2017), Do Minimum scenario (without scheme).
- Opening year (2017), Do Something scenario (with scheme).
- Design year (2032), Do Minimum scenario.
- Design year (2032), Do Something scenario.

10.3.14 A number of Data Sources and Assumptions have been used for the purposes of the noise model setup and calculations, these are detailed within Volume 2 – Supporting Information.

10.3.15 With regard to airborne traffic induced vibration, the DMRB Annex 6 notes a correlation between the percentage of people bothered by vibration nuisance and the $L_{A10,18hr}$ statistical noise parameter experienced due to traffic noise. The correlation indicates that for a given level of noise exposure the percentage of people bothered “very much” or “quite a lot” by vibration is 10% lower than the corresponding figure for noise nuisance. Where noise levels are below $58dBL_{A10,18h}$ it can be assumed that the percentage of people bothered by vibration tends towards zero.

10.3.16 DMRB recommends that the assessment of the operational airborne vibration is limited to a corridor 40m wide on either side of the carriageway. There are no

potentially sensitive receptors within 40m of the Proposed Scheme, therefore the vibration nuisance assessment has been scoped out.

## 10.4 Baseline Environment

10.4.1 Existing background (ambient) noise levels were determined by monitoring the existing environmental noise climate at 10 locations within the vicinity of the Proposed Scheme.

10.4.2 Baseline noise surveys were undertaken on the 8th November 2012. Attended noise measurements were taken at 10 locations for 3 x 15 minute periods over 3 consecutive hours between the hours of 1000 and 1700 in accordance with the CRTN shortened measurement procedure.

10.4.3 The baseline survey was undertaken in accordance with the principles of BS 7445[5] and following the guidance given in CRTN. The meteorological conditions during the measurement periods were within the acceptable meteorological limits stated in BS 7445.

10.4.4 All the instrumentation used was within its calibration period. Details of instrumentation used and calibration certificates are included in Volume 2 – Supporting Information.

### *Description of Existing Noise Climate*

10.4.5 The noise environment at the monitoring locations consisted of general environmental noise dominated by aircraft noise from the aircraft of RAF Waddington together with traffic noise from the local roads (including A15, B1308, B1190, Heighington Road and B1188) as well as bird song and the noise of general agricultural activities.

### *Ambient Noise Levels*

10.4.6 Table 10-3 details the locations at which baseline noise monitoring was undertaken. The monitoring locations are also graphically presented in Volume 2 – Supporting Information.

[5] British Standards Institute, (1991); BS 7445, 'Description and measurement of environmental noise (Part 1-Part 3)', BSI group.

*Table 10-3 Monitoring Locations*

| Site | Description |
|---|---|
| MP01 | The Sound Level Meter (SLM) was positioned on a grass verge, adjacent to property No. 28 King Drive, Bracebridge Heath, Lincoln.<br>The dominant noise sources at this location included: near-constant road traffic on A15 – Sleaford Rd (~43m to the east); air traffic and other activities associated with the RAF Waddington station, including take-offs (~1.3km to the south). |
| MP02 | The SLM was positioned on a grass verge at the junction of Bloxholm Lane and the access road for Westfield Farm.<br>The dominant noise sources at this location included: occasional road traffic on Bloxholm Lane (SLM ~ 20m from the kerb), occasional air traffic associated with RAF Waddington station (~ 1km to the south), and distant traffic noise from A15 – Sleaford Rd (~ 330m to the west). Also audible were leaves rustling in the wind and very occasional shooting sounds. |
| MP03 | The SLM was positioned on the edge of a field, adjacent to a lay-by along the B1188 – Lincoln Road, approximately 150m north-west from the closest residential property in Branston.<br>The dominant noise sources at this location were the traffic on B1188 - Lincoln Road (~ 20m to the kerb) and the noise of aircraft associated with the RAF Waddington. |
| MP04 | The SLM was situated by the entrance road leading towards the Glebe Farm Nursery School.<br>The dominant noise sources at this location included intermittent/occasional traffic on Heighington Road (~ 10m to the kerb), overhead air traffic and very occasional shooting sounds. |
| MP05 | The SLM was placed on a grass verge adjacent to B1190 – Lincoln Road, in approximately equal distance between the road and the railway line.<br>The dominant noise source at this location was the road traffic noise. Occasional trains were also audible. Occasional aircraft noise. |
| MP06 | The SLM was positioned adjacent to a small car park in front of an apartment block on the western side of Allenby Close, Lincoln.<br>The noise environment included distant road traffic as well as industrial-type noise from the adjacent landfill and railway noise. Occasional aircraft noise. |
| MP07 | The SLM was situated on a grassed area near the junction of Greetwell Road and Greetwell Lane.<br>The noise sources in the area were local and distant road traffic noise. Occasional aircraft noise. |
| MP08 | The SLM was located on the side of the Whitefriars Road, Lincoln.<br>The noise environment included distant road traffic and birdsong. Occasional aircraft noise. |
| MP09 | The SLM was positioned alongside a footpath to the east of new residential properties on Hawthorn Close, approximately 57m north of Hawthorn Road.<br>The dominant noise sources at this location included distant traffic noise and distant aircraft. |

| Site | Description |
|---|---|
| MP10 | The SLM was placed to the east of the residential properties just south of B1131 – Canwick Avenue. The Homestead is located directly to the north of the monitoring position.<br>The dominant noise sources in the area included road traffic on Canwick Avenue, air traffic, birdsong and local domestic activities. Also audible were very occasional shooting sounds. |

10.4.7 A summary of the $L_{A10}$, $L_{AMAX}$, $L_{A90}$, and $L_{Aeq,T}$ values are shown in Table 10-4 below. Detailed noise monitoring data is provided in Volume 2 Supporting Information.

*Table 10-4 Summary of baseline environmental noise monitoring survey on 8th November 2012*

| Site | Date | Time (between the hours of) | Duration | Overall Level (dB) | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | $L_{A10}$ (3h equivalent) | $L_{Aeq,T}$ | $L_{A\ MAX}$ | $L_{A90}$ | Calculated $L_{A10}$ (18h) |
| MP01 | 08/11/12 | 1046 - 1346 | 3x15min | 58.0 | 55.7 | 73.2 | 45.2 | 57.0 |
| MP02 | 08/11/12 | 1027 - 1327 | 3x15min | 62.8 | 61.9 | 83.1 | 50.5 | 61.8 |
| MP03 | 08/11/12 | 1304 – 1604 | 3x15min | 71.7 | 69.2 | 96.5 | 54.7 | 70.7 |
| MP04 | 08/11/12 | 1320 – 1620 | 3x15min | 71.1 | 66.6 | 87.8 | 46.6 | 70.1 |
| MP05 | 08/11/12 | 1355 - 1655 | 3x15min | 71.7 | 66.9 | 83.8 | 46.7 | 70.7 |
| MP06 | 08/11/12 | 1310 - 1610 | 3x15min | 60.2 | 58.5 | 83.3 | 50.0 | 59.2 |
| MP07 | 08/11/12 | 1115 - 1415 | 3x15min | 73.6 | 68.5 | 84.0 | 47.1 | 72.6 |
| MP08 | 08/11/12 | 1054 - 1354 | 3x15min | 48.6 | 47.1 | 65.3 | 42.3 | 47.6 |
| MP09 | 08/11/12 | 1032 - 1332 | 3x15min | 53.5 | 51.4 | 67.6 | 47.9 | 52.5 |
| MP10 | 08/11/12 | 1003 - 1303 | 3x15min | 57.6 | 55.1 | 77.1 | 48.1 | 56.6 |

LA10 is the A-weighted sound level that is exceeded for 10% of the sample period; this parameter givens an indication of the upper limit of fluctuating noise such as that from road traffic.

LA90 is the A-weighted sound level that is exceeded for 90% of the sample period; generally used to quantify background noise.

LAeq,T is the A-weighted equivalent continuous sound level during the sample period (T) and effectively represents an average value.

LAMAX is the maximum A-weighted sound level during the sample period; the highest level of environmental noise during the measurement.

## 10.5 Predicted Impacts

### *Construction Impacts*

10.5.1 Construction works are known to generate noise and vibration. However, it has not been possible to predict noise levels from construction works at this stage as the exact details of the construction methods are not available. It is recommended that a Noise and Vibration Management Plan in line with BS5528 is agreed with the local Environmental Health Officers and implemented by the contractor. This should also include any Temporary Traffic Management (TTM) plan, for example traffic re-routing and diversions.

10.5.2 It is understood that piling may be necessary in the construction of the Proposed Scheme which may have vibration impacts depending on the type of piling plant used by the contractor. Vibration levels should be monitored by the contractor as part of the CEMP, and appropriate mitigation utilised to minimise vibration impacts where necessary.

10.5.3 Table 10-5 below gives recommended noise impact threshold limits for construction activities based on the guidance given in BS 5228 at each of the monitored locations. These locations are deemed to be representative of the surrounding area.

*Table 10-5 Summary of baseline environmental noise monitoring survey 8th November 2012*

| Location | $L_{Aeq,T}$ dB calculated using the BS 5228 ABC Methodology | | |
|---|---|---|---|
| | Weekday Daytime | | |
| | Ambient level | Rounded to nearest 5 dB | Threshold |
| MP01 | 55.7 | 55 | 65 |
| MP02 | 61.9 | 60 | 65 |
| MP03 | 69.2 | 70 | 65 |
| MP04 | 66.6 | 65 | 65 |
| MP05 | 66.9 | 65 | 65 |
| MP06 | 58.5 | 60 | 65 |
| MP07 | 68.5 | 70 | 65 |
| MP08 | 47.1 | 45 | 65 |
| MP09 | 51.4 | 50 | 65 |
| MP10 | 55.1 | 55 | 65 |

### *Assessment of Construction Vibration*

10.5.4 Without information relating to the specifics of piling and other construction operations which may be required (including piling rig size, pile diameters, depth and energy per blow etc), an assessment of vibration during construction for this Scheme has not been possible. Vibration from plant, and control measures to

mitigate the effects of such, should be considered by the construction delivery partner within the scope of the Noise and Vibration Management Plan.

### *Operational Impacts*

10.5.5 The results of the noise modelling exercise are given in the tables below, which detail the number of residential and non-residential sensitive receptors given in bands of significance of predicted noise level increase and decrease for each of the scenarios assessed.

### *Short Term Impacts*

*Table 10-6 Summary of Short Term Noise Impacts*

| Scenario: Short term Traffic Noise Impacts | | | |
|---|---|---|---|
| Comparison: DS scenario in 2017 relative to the DM scenario in 2017 | | | |
| **Change in noise level** | | **Number of Dwellings** | **Number of other sensitive receptors** |
| Increase in noise level $L_{A10,18h}$ | 5+ (Major) | 187 | 2 |
| | 3 - 4.9 (Moderate) | 497 | 1 |
| | 1 - 2.9 (Minor) | 1000 | 1 |
| | 0.1- 0.9 (Negligible) | 7457 | 77 |
| No Change | 0 | 1964 | 31 |
| Decrease in noise level, $L_{A10,18h}$ | 0.1 - 0.9 (Negligible) | 7502 | 67 |
| | 1 - 2.9 (Minor) | 410 | 2 |
| | 3 - 4.9 (Moderate) | 0 | 0 |
| | 5+ (Major) | 0 | 0 |

10.5.6 In the short term, only 1% of sensitive receptors are anticipated to experience major increases in traffic noise as a result of the opening of the Proposed Scheme whilst the impact will be negligible or beneficial to 91% of sensitive receptors.

### *Long Term Impacts*

#### *Do Minimum Change*

10.5.7 Table 10-7 summarises the predicted changes in noise levels **without** the introduction of the Proposed Scheme in the long term by comparing the two Do Minimum scenarios in the opening year 2017 and the projected design year 2032. This comparison is undertaken as a requirement of the DMRB in order to quantify the affect of inherent traffic growth between the proposed year of opening and the scheme design year if the Proposed Scheme was not constructed. Note that the noise level significance criteria bandings in the long term tables differ from those in the short term table as greater magnitudes of

change in noise level are required for them to be perceptible over a longer period.

*Table 10-7 Changes in Noise Levels without the Proposed Scheme*

| Scenario: Long Term Traffic Noise Impacts | | | |
|---|---|---|---|
| Comparison: DM Scenario in 2032 relative to the DM scenario in 2017 | | | |
| **Change in noise level** | | **Number of Dwellings** | **Number of other sensitive receptors** |
| Increase in noise level $L_{A10,18h}$ | 0.1- 2.9 (Negligible) | 18201 | 160 |
| | 3- 4.9 (Minor) | 134 | 4 |
| | 5- 9.9 (Moderate) | 0 | 0 |
| | 10+ (Major) | 0 | 0 |
| No Change | 0 | 460 | 11 |
| Decrease in noise level $L_{A10,18h}$ | 0.1- 2.9 (Negligible) | 222 | 6 |
| | 3- 4.9 (Minor) | 0 | 0 |
| | 5- 9.9 (Moderate) | 0 | 0 |
| | 10+ (Major) | 0 | 0 |

10.5.8 Without the Proposed Scheme the majority of the receptors studied are predicted to experience a negligible increase in noise level due to anticipated traffic growth over the 15 year period.

### *Do Something Change*

10.5.9 Table 10-8 below presents the results of permanent long term noise impacts due to the introduction of the Proposed Scheme. In the long term, comparing Do Something in the design year of 2032 relative to the Do Minimum situation in 2017, most receptors 16936 (89%) are expected to experience no change or a negligible increase in noise as a consequence of the implementation of the scheme and resulting traffic growth over a 15 year period.

10.5.10 The increase in traffic noise levels includes additional traffic expected to be generated by two major developments proposed in and around Lincoln between 2017 and 2032.

10.5.11 The noise level changes for both the short and long term impacts are represented visually in Figures 1030171-LEB-EIA-NOI-002 and 1030171-LEB-

EIA-NOI-003 (Volume 2 – Supporting Information) which show noise contour plots of level difference between the do minimum and do something scenarios.

*Table 10-8 Summary of Long Term Noise Impacts*

| Scenario: Long Term Traffic Noise Impacts | | | |
|---|---|---|---|
| Comparison: DS scenario in 2032 relative to the DM scenario in 2017 | | | |
| **Change in noise level** | | **Number of Dwellings** | **Number of other sensitive receptors** |
| Increase in noise level $L_{A10,18h}$ | 0.1- 2.9 (Negligible) | 16929 | 155 |
| | 3- 4.9 (Minor) | 1460 | 20 |
| | 5- 9.9 (Moderate) | 440 | 5 |
| | 10+ (Major) | 181 | 1 |
| No Change | 0 | 2 | 0 |
| Decrease in noise level $L_{A10,18h}$ | 0.1- 2.9 (Negligible) | 5 | 0 |
| | 3- 4.9 (Minor) | 0 | 0 |
| | 5- 9.9 (Moderate) | 0 | 0 |
| | 10+ (Major) | 0 | 0 |

10.5.12 Traffic noise predictions for the short term and long term impact show that the majority of the decreases in traffic noise are in and around the City of Lincoln. These noise benefits are as a result of the redistribution and movement of traffic as a result of the Proposed Scheme.

10.5.13 The majority of traffic noise changes in the short term and long term are negligible and will therefore not be perceptible to people at the identified sensitive receptors.

10.5.14 Some roads Lincoln will potentially experience an adverse impact following the opening of the Proposed Scheme. Notably in the short term, these areas are in close proximity to Webb Street and Ripon Street, where traffic flow increases result in traffic noise increases of approximately 4dB(A). However despite the increases, the absolute noise levels at these receptors are still relatively low (approximately 63.2dB(A)) and are not therefore anticipated to be significant.

10.5.15 Broadway, to the north of Lincoln, is also predicted to result in a substantial increase of traffic noise levels in the long term scenario, however this increase is expected to be a result of the additional traffic generated by the development of the North East Quadrant which was factored in the traffic model, but not by building the Proposed Scheme.

10.5.16 ‘Major’ adverse noise impacts (>10dB(A)) are predicted to occur at less than 1% of properties assessed. The noise increases as a result of the scheme would be clearly noticeable for occupants of such properties and the other sensitive receptors.

10.5.17 These properties experiencing major adverse impacts are located to the west of the Proposed Scheme, around the residential areas of Hawthorn Road, Bunkers Hill and Whitefriars Road. Further south, and some isolated properties along Greetwell Road. A number of residential properties within the village of Washingborough and surrounding isolated farms are also predicted to experience moderate to major adverse noise impacts.

10.5.18 A line of residential properties along the existing B1188 to the east of the proposed bypass and a large cluster of residential properties in proximity to the A15 Sleaford Road to the west of the proposed bypass are predicted to be exposed to moderate increases in traffic noise as a result of the scheme.

### *Nuisance Impacts*

10.5.19 Nuisance is measured in terms of the percentage of the population as a whole that is bothered “very much” or "quite a lot" by virtue of a specified road traffic generated noise level. The change in nuisance ratings as a result of the proposed scheme is presented below.

10.5.20 Noise nuisance takes into account both the long term and short term impacts. The methodology requires the reporting of the worst case noise level changes as a result of the comparisons undertaken within the first 15 years following opening of the scheme.

10.5.21 Table 10-9 below gives the predicted noise nuisance impacts for the day time period and shows that without the scheme, the do minimum nuisance impacts are predicted to be less than 10% for the majority of the residential receptors across the study area. With the inclusion of the Proposed Scheme, the distribution of changes in nuisance is wider. There are more significant increases in annoyance as a result of the Proposed Scheme.

*Table 10-9 Traffic Noise Nuisance Impacts*

| Scenario : Traffic Noise Nuisance Impacts | | | |
|---|---|---|---|
| **Change in noise level** | | **Do Minimum** | **Do Something** |
| | | **Number of Dwellings** | **Number of Dwellings** |
| Increase in nuisance level | < 10% | 12143 | 7300 |
| | 10 < 20% | 428 | 26 |
| | 20 < 30% | 255 | 8348 |
| | 30 < 40% | 179 | 601 |
| | > 40% | 26 | 83 |
| No Change | 0 % | 824 | 2041 |
| Decrease in nuisance level | < 10% | 4072 | 95 |
| | 10 < 20% | 531 | 188 |
| | 20 < 30% | 377 | 335 |
| | 30 < 40% | 166 | 0 |
| | > 40% | 16 | 0 |

### *Traffic Vibration Assessment*

10.5.22 There are no dwellings within 40m of the proposed scheme, therefore a vibration nuisance assessment has not been undertaken.

## 10.6 Proposed Mitigation

### *Construction Phase*

10.6.1 It is recommended that the construction delivery partner incorporates specific noise abatement measures as part of a Noise and Vibration Management Plan which should be implemented during the construction phase. Some of the measures available to the appointed contractor are listed below:

- Undertake a letter drop of local residents detailing the duration and type of works to be undertaken. A contact telephone number should also be provided in the event of complaints.
- Best Practice measures to be adopted on site with regards to noise abatement. Best practicable means including maintenance of plant to minimise the noise produced by operations on site, acoustic enclosure of static plant and portable screens where appropriate.
- All vehicles and mechanical plant to be fitted with effective exhaust silencers and to be maintained in good working order.
- Machinery that is used intermittently would be shut down or throttled back to a minimum during periods when not in use.
- Static plant known to generate significant vibration levels to be fitted with appropriate acoustic dampening.

10.6.2 In addition to the above measures, BS 5228 Section E.4 notes a number of measures that should be in place where noise levels are expected to exceed trigger levels as set out in Table E.2 of BS 5228 (Table 10-10, below).

*Table 10-10 BS 5228 Table E.2*

| Time | Relevant time period | Averaging time, T (h) | Noise insulation trigger level $L_{Aeq,T}$ (dB(A)) |
|---|---|---|---|
| Monday to Friday | 07.00 – 08.00 | 1 | 70 |
| | 08.00 – 18.00 | 10 | 75 |
| | 18.00 – 19.00 | 1 | 70 |
| | 19.00 – 22.00 | 3 | 65 |
| | 22.00 – 07.00 | 1 | 55 |
| Saturday | 07.00 – 08.00 | 1 | 70 |
| | 08.00 – 13.00 | 5 | 75 |
| | 13.00 – 14.00 | 1 | 70 |
| | 14.00 – 22.00 | 3 | 65 |
| | 22.00 – 07.00 | 1 | 55 |
| Sunday and Public Holidays | 07.00 – 21.00 | 1 | 65 |
| | 21.00 – 07.00 | 1 | 55 |
| [A)] All noise levels are predicted or measured at a point 1m in front of the most exposed of any windows and doors in any façade of any eligible dwelling. | | | |

10.6.3 It is recommended that a Noise and Vibration Management Plan in line with BS5528 is agreed with the local Environmental Health Officers and implemented by the contractor. This should also include any Temporary Traffic Management (TTM) plan, for example traffic re-routing and diversions.

### *Operational Phase*

10.6.4 Noise mitigation is defined as the measures necessary in order to control the level of noise experienced at a receiver point. These measures could include changing the location of the noise source, changing the characteristics of the noise source or obstructing the propagation of the noise through to the receiving environment.

10.6.5 DMRB guidance stipulates that a long term operational increase of 3dB(A) or greater should be mitigated. The findings of this assessment indicate a potential requirement to mitigate long term operational noise impacts.

10.6.6 The Highways Agency advise that a maximum reduction of -3.5dB(A) can be achieved by the use of thin low noise surfacing (LNS) compared to the standard hot rolled asphalt (HRA) road surfacing. It is important to note that the traffic noise reduction of -3.5dB(A) applies to roads where the mean traffic speed is above or equal to 75km/hr. LNS will therefore be applied along sections of the scheme where significant adverse noise impacts have been identified.

10.6.7 The reduction in noise level experienced at the dwellings exposed to a major/moderate adverse impact due to the mitigation effect of LNS is likely to result in a shift to more dwellings being exposed to negligible/minor impacts from traffic noise.

10.6.8 It is recommended that LNS is considered for the areas along the proposed scheme where Major noise impacts are predicted to occur, namely the section of the scheme which is in proximity to Hawthorn Road, Bunkers Hill and Whitefriars Road, in the area of Greetwell Road and in proximity to, and to the south of the village of Washingborough.

## 10.7 Conclusions and Effects

10.7.1 The assessment has indicated that with the implementation of appropriate mitigation measures the noise impact during construction would be negligible.

10.7.2 The traffic noise impact of the scheme is anticipated to be negligible for the majority of potentially sensitive receptors within the study area, however 181 dwellings are predicted to be exposed to major adverse impacts as a result of the proposed scheme. Low Noise Surfacing will be applied at specific areas along the proposed scheme in order to reduce the number of dwellings exposed to a major adverse impact.

10.7.3 Following the application of LNS, it is anticipated that the majority of properties exposed to major adverse traffic noise impacts will reduce by approximately 3.5 dB(A), with the residual impact becoming moderate rather than major.

### *Noise Insulation Regulations Assessment*

10.7.4 A Noise Insulation Regulations (NIR) 1975 (Amended 1988) assessment is not within the scope of this assessment. A separate assessment should therefore be commissioned to identify any properties which specifically meet the specific qualification criteria of the NIR.

# 11 Air Quality

## 11.1 Scope of the Assessment

11.1.1 Emissions from road traffic can have a significant impact on air quality. Any new road scheme will result in changes to existing traffic flows and/or traffic speeds, not only in the vicinity of the proposed alignment but also on local approach roads and the roads relieved by the scheme. These changes can be either detrimental or beneficial, depending on whether those local traffic emissions increase or reduce.

11.1.2 The assessment of the potential impacts of the Proposed Scheme on air quality has involved the following:

- An evaluation of the potential impacts associated with dust generated during earthworks, construction activities and trackout, on sensitive receptors located in the vicinity of the working areas, as well as along roads used during the anticipated 27 month construction period for the Proposed Scheme;
- An evaluation of the potential impact of additional traffic emissions associated with construction vehicles;
- An evaluation of the potential impact on local air quality due to changes in traffic-related emissions associated with predicted changes in vehicle flows, speed and any variations in traffic composition on roads within the local road network as a result of the opening of the Proposed Scheme to use; and
- An evaluation of the anticipated effect of the Proposed Scheme on carbon-related emissions, oxides of nitrogen ($NO_x$) and particulate matter ($PM_{10}$) at the regional level.

### *Dust Related to Construction Activities*

11.1.3 The assessment of dust impacts was undertaken at receptors located within 350m of the working areas and compounds required for construction of the Proposed Scheme.

11.1.4 The 350m distance has been selected on the basis that the substantial proportion of dust particles associated with earthworks and construction activities of the type proposed are relatively large and will normally be deposited within 100m of the construction site. The 350m buffer allows for the likelihood that smaller volumes of finer dust particles will be deposited beyond the 100m distance.

### *Traffic Emissions on the Public Highway during the Construction Phase*

11.1.5 As information on the number of vehicles associated with the construction phase is not available, a qualitative assessment of their impact on local air quality has been undertaken.

### *Changes in Local Air Quality Associated with Traffic Emissions during Operation*

11.1.6 The assessment has involved an evaluation of changes in concentrations of specific pollutants at particular receptors associated with parts of the road network where it is predicted significant changes in traffic characteristics will occur as a result of the Proposed Scheme.

11.1.7 The study area comprises roads within the local network which the Transport Assessment (TA) identified as being most likely to be subject to changes in flow, speed and traffic composition characteristics due to the Proposed Scheme.

11.1.8 The roads forming the focus of the TA are shown in *Study area and affected links* (Volume 2 – Supporting Information) The study area includes relevant Air Quality Management Areas (AQMAs) and affected roads as per current guidance, Design Manual for Roads and Bridges, (DMRB) Volume 11.

11.1.9 The pollutants considered in relation to public exposure receptors comprise nitrogen dioxide ($NO_2$) and particulate matter ($PM_{10}$). Worst case receptors likely to experience higher-than-average pollution concentrations, such as near roundabouts and junctions, as well as affected roads, were identified and assessed in the assessment.

11.1.10 The assessment has focused on defining a model with a suitable performance for the dispersion prediction in 2008, which could be compared with real monitoring data, and identification of changes in specified pollutant concentrations at identified receptors in 2017, the anticipated opening year for the Proposed Scheme.

### *Regional Emissions*

11.1.11 The assessment compares predicted total emissions of carbon (C), hydrocarbons (HC), oxides of nitrogen ($NO_x$) and $PM_{10}$ at the regional level for the local road network identified as being most likely to be subject to changes in traffic characteristics. Comparisons are made between the opening year 'Do-Minimum' (DM, i.e. without the scheme) and the 'Do-Something' (DS, i.e. with the scheme) scenarios.

11.1.12 The assessment has been focused on prediction of changes in total emissions in the opening year (2017).

11.1.13 The assessment considered a baseline year of 2008 for model verification and the opening year (2017) for the estimation of traffic related impacts on both local air quality and regional emissions.

11.1.14 In summary, the following scenarios were considered:

- Baseline 2008 (for model verification purposes);
- Opening year 2017 Do-Minimum (DM); and
- Opening year 2017 Do-Something (DS).

#### *Study Area*

11.1.15 The scheme lies in a suburban/rural area, where traffic emissions are likely to be the dominating sources for air quality. The total study area for both operation and construction impacts is presented in Volume 2 – Supporting Information.

## 11.2 Statutory and Planning Context

11.2.1 The key legislation and guidance are summarised below. Further detail is provided in Volume 2 – Supporting Information.

#### *European CAFE Directive (2008/50/EC) and Air Quality Standards Regulations 2010*

11.2.2 The Directive details air quality limit values, target values, and critical levels for a number of air pollutants established by the European Parliament and Council for the protection of human health, vegetation and ecosystems. These have been transposed into UK legislation by the 2010 Regulations.

#### *Air Quality Strategy*

11.2.3 The UK Government and the Devolved Administrations (DAs) published the latest Air Quality Strategy for England, Scotland, Wales and Northern Ireland in July 2007 defining standards and objectives for each of a range of air pollutants.

11.2.4 These are as prescribed within The Air Quality (England) Regulations 2000 (Stationery Office, 2000) and The Air Quality (England) (Amendment) Regulations 2002 (Stationery Office, 2002) (termed the ‘Regulations’) and coincide with the limit values for protection of human health (see Volume 2 – Supporting Information).

#### *The Environmental Protection Act 1990 (EPA)*

11.2.5 The EPA (Section 79, Chapter 43, Part III - Statutory Nuisance and Inspections) contains a definition of what constitutes a 'statutory nuisance' with regard to dust and places a duty on Local Authorities to detect any such nuisances within their

area. Dust arising from construction works could lead to statutory nuisance if it 'interferes materially with the well being of the residents, i.e. affects their well being, even though it may not be prejudicial to health'.

### *The National Planning Policy Framework (NPPF) March 2012*

11.2.6 The National Planning Policy Framework (NPPF) (March 2012) replaces existing national planning policy adopted since 2004. However, decision makers may continue to give consideration to relevant adopted policies for a 12 month period from its publication (i.e. until March 2013).

11.2.7 Paragraph 109 of the NPPF states that:

> *"The planning system should contribute to and enhance the natural and local environment by (..) preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water"*

11.2.8 Annex 2 of the NPPF defines 'Pollution' as "Anything that affects the quality of land, air, water or soils, which might lead to an adverse impact on human health, the natural environment or general amenity. Pollution can arise from a range of emissions, including smoke, fumes, gases, dust, steam, odour, noise and light."

11.2.9 The environmental impact of the proposed development will be a material consideration during the planning process. Paragraph 124 of the NPPF states that:

11.2.10 "Planning policies should sustain compliance with and contribute towards EU limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and the cumulative impacts on air quality from individual sites in local areas. Planning decisions should ensure that any new development in Air Quality Management Areas is consistent with the local air quality action plan."

### *Guidance on the Assessment of the Impacts of Construction on Air Quality and Determination of their Significance*

11.2.11 This guidance was produced by the Institute of Air Quality Management (IAQM) and provides assistance on how to assess construction impacts of developments or schemes to be considered. It focuses on classifying sites according to the risk effects and on identifying the mitigation appropriate to the risk.

### *Regional Planning*

11.2.12 The Lincolnshire's third Local Development Scheme (LDS) and Local Development Documents (LDDs) (March 2010) set out proposals for the next three years for Lincolnshire's Local Development Framework (LDF). These

include strategies to reduce air pollution within their areas of jurisdiction and particularly help reduce vehicular emissions in the town centres helping to ensure air quality within these areas is improved.

#### *Local Action Plans*

11.2.13 The City of Lincoln Council (CLC) has developed an Air Quality Action plan (AQAP) to provide a framework for improving the air quality within Lincoln City centre, and more specifically within the AQMA, which was declared in December 2001. Key strategic challenges include tackling transport related emissions. This is considered a high priority as it has the potential to limit future deterioration in air quality.

#### *General Guidance*

11.2.14 Defra has produced guidance for local authorities on the Local Air Quality Management process. This includes the document Local Air Quality Management Technical Guidance (LAQM.TG (09)), with methodologies to be used for local air quality assessments and complementing Technical Guidance Notes.

11.2.15 The Highways Agency Design Manual for Roads and Bridges (DMRB) provides guidance for engineers, planners, and environmental specialists to assess the impact of transport schemes. The Air Quality document, DMRB Volume 11, Section 3, Part 1, HA207/07 (DMRB HA207/0) provides guidance on the assessment of the impacts of road projects on the air quality. This includes local and regional air quality assessments of pollutants including total carbon

## 11.3 Method of Assessment

#### *Construction Phase - Evaluation of Dust Impacts*

11.3.1 The assessment methodology followed that provided in the Institute of Air Quality Management (IAQM) guidance released January 2012 (see Volume 2 – Supporting Information). Activities related to construction have been divided into three types to reflect their different potential impacts. These were:

- Earthworks (Site clearance and landscaping) ;
- Construction (infrastructure development); and
- Trackout (movement of dust off site by natural or mechanical means).

#### *Construction Phase - Evaluation of Traffic Related Emissions Impacts*

11.3.2 Information on construction traffic is not available. However, using professional judgement, a qualitative assessment of the potential impact on local air quality has been undertaken by considering:

- The levels of construction traffic likely to be generated by the various phases of the scheme;
- The number and distance of sensitive receptors in the vicinity of the site and along the likely routes to be used by construction vehicles; and
- The likely duration of the construction phases and the nature of the construction activities undertaken.

### *Operational Phase - Assessment of Impacts on Local Air Quality*

11.3.3 The assessment has been based on the guidance provided in LAQM.TG (09) and DMRB HA207/07. It has involved:

- Consultation with CLC Environmental Health Departments to establish the approach of air quality assessment;
- A review of Air Quality documents produced by CLC to gain baseline air quality information for the site and its surrounding area;
- Collation of traffic flow data from Mouchel Transport Planning Consultant;
- Use of the Defra LAQM tools to calculate current and future background air pollutant concentrations;
- Application of the methodology of the DMRB HA207/07 Localised Air Quality Assessment, to predict the impacts of traffic generated as a result of the Proposed Scheme of future local air quality; and
- Comparison of the predicted air pollutant levels with UK air quality standards and objectives and appropriate significance criteria; and

11.3.4 The assessment focuses on traffic related emissions, particularly $NO_2$ and $PM_{10}$ emissions, which are generally considered as the main vehicle emissions of concern to local authorities in terms of their risk of exceeding the current air quality objectives and damage to health. Details of the assessment methodology are presented in Volume 2 – Supporting Information.

### *Operational Phase -Total Regional Emissions*

11.3.5 Defra's Emission Factors Toolkit for Vehicle Emissions (EFT 5.1.3) has been used to calculate emissions of Carbon (C), Hydrocarbon (HC), Nitrogen Oxide ($NO_x$) and Particulate Matter 10µm ($PM_{10}$) at the regional level for annual vehicular use associated with the roads identified within the study area. Inputs to the toolkit have included traffic flows, speed and vehicle composition and type of road.

### *Potentially Sensitive Receptors*

#### *Construction Phase*

11.3.6 Premises and occupants within 100m of a construction site are generally considered to experience the most significant impacts from construction dust. However, impacts can be felt up to 350m. Indoor air quality impacts arising from construction dust are likely to vary depending on the use of the buildings affected. Exposure of the occupants of local premises will depend on the method of building ventilation and the frequency of access to these premises.

11.3.7 With the exception of properties in proximity to the Wragby Road and Stamford Road roundabouts, there are few existing residential receptors within 350m of the proposed road alignment.

#### *Completed Development Traffic*

11.3.8 The approach adopted by the UK Air Quality Strategy is to focus on areas where members of the public (in a non-occupational capacity) at locations close to ground level, are likely to be exposed over the averaging time of the objective in question.

11.3.9 Potentially sensitive locations relate mainly to residential properties and locations such as schools, where the public may be exposed for protracted periods.

11.3.10 60 existing residential receptors locations were selected for assessment on the basis of their proximity to the proposed road alignment and its access routes and are considered to represent areas within the road network which would be exposed to either worst case air quality impacts or indeed benefits associated with the diversion of existing traffic onto the proposed road. The locations of all 60 receptors are identified Volume 2 – Supporting Information.

## 11.4 Baseline Environment

### *Review of Local Authority Review and Assessment Results*

11.4.1 Information obtained from the CLC's Review and Assessment reports for Lincoln indicate that:

- An AQMA was declared in 2001 for exceedence of the annual mean $NO_2$ concentration objective. This area follows the major road network in the city centre;
- A $PM_{10}$ AQMA, encompassing the whole borough, was declared in 2008 as a result of a likely exceedence of the 24 hour mean objective;
- Air quality objectives for benzene, 1,3-butadene, carbon monoxide (CO) and lead (Pb) are met throughout the study area;

- The 2006 – 2011 monitoring data indicated that annual mean $NO_2$ objectives were not met at Drill Hall, Broadgate (A15). Traffic is likely to be the main contributor to these exceedences;
- there are no significant industrial processes within the study area which are likely to release significant quantities of $NO_x$, $NO_2$ or $PM_{10}$ to the atmosphere;
- the CLC's 2011 Progress Report suggested that the Proposed Scheme was expected to lead to improvements within the AQMA hotpots for both $NO_2$ and $PM_{10}$; and
- It also suggested that the East-West Link , designed to improve the flow of traffic across the City, would improve local air quality. A study undertaken by Mouchel Ltd in Nov 2011 concluded that the impact of the East-West Link on air quality would be negligible.

### *Background concentrations*

11.4.2 Average background concentrations across the study area are presented in Volume 2 – Supporting Information. The data indicates that annual mean background concentrations of $NO_2$ and $PM_{10}$ within the study area are below the annual mean objectives of 40 µg/$m^3$ in all assessment years.

### *Local Air Quality Monitored Concentrations*

11.4.3 A description and geographic locations of the continuous monitors and diffusion tube monitoring sites in the study area is presented in Volume 2 – Supporting Information.

11.4.4 Annual mean $NO_2$ concentrations measured at Canwick Road (A15) were either very close to or exceeded air quality standards during 2006 – 2011. $PM_{10}$ monitoring data from Broadgate (A15) was below the annual mean objective (40µg/$m^3$) but exceeded the 24-hour mean objective during the last five years.

11.4.5 Annual mean $NO_2$ concentrations measured at the twenty six diffusion tube monitoring locations within the study area are presented in Volume 2 – Supporting Information. The annual mean $NO_2$ objective (40µg/$m^3$) was exceeded at one location (Drill Hall, Broadgate) in 2006 – 2011. Other exceedences were observed within the AQMA in 2011. However, discussions with Environmental Health Officers indicated that the data from 2011 was unreliable and was therefore not used in the assessment.

## 11.5 Predicted Impacts

### *Construction Impact*

#### *Dust Generations from Construction Activities*

11.5.1 Information on construction traffic is not available. However, using professional judgement, a qualitative assessment of the potential impact on local air quality has been undertaken. The location and duration of each activity are not definitive; however major activities being undertaken for the Proposed Scheme include earthworks, construction activities and trackout.

11.5.2 As no demolition will be undertaken this activity was screened out of the assessment.

11.5.3 For the purposes of the assessment it has been assumed that the contractor will implement a fully compliant construction environmental management plan which will include the mitigation measures outlined in section 11.6 below. Impacts both prior to and following the implementation of mitigation measures have been identified and are described below.

11.5.4 Receptors at highest risk will be those within 350m of the proposed construction site/working area. A wind rose derived from data recorded at Waddington meteorological station suggests a south-west prevailing wind (see Volume 2 – Supporting Information). Therefore, those receptors to the north-east of the construction site are more likely to be affected by any dust emitted/re-suspended from any construction activities.

11.5.5 The 936 receptors identified within 350m of the Proposed Scheme are presented in Volume 2 – Supporting Information. These comprise of 913 residential receptors, 21 commercial premises, one hospice (day care) and one play area.

11.5.6 Of these receptors, 85 dwellings, 3 commercial premises and the play area are located downwind of potential construction areas. These properties are considered to be those most likely to be affected by unmitigated construction activities. Properties on Stocking Way are within 20m downwind of the LEB's alignment

11.5.7 Given the scale of the Proposed Scheme and that the nearest receptor is within 20m of the site, this area would be classified as High Risk according to the latest IAQM guidance (see Volume 2 – Supporting Information).

11.5.8 The majority of the site is located in a generally rural setting. With the exception of Stocking Way, which is located in a suburban area, approximately 8 other dwellings are located within 20m of the construction site. Therefore, the

sensitivity of these areas is classified as Medium to High (see Volume 2 – Supporting Information).

11.5.9 Taking into account the dust soiling risk and the sensitivity of the surrounding area, the overall significance of the effects arising from the construction phase of the scheme is likely to be Moderate Adverse without mitigation (see Volume 2 – Supporting Information).

#### *Emissions from Construction Associated Traffic*

11.5.10 Information on construction traffic was not available at the time of writing.

11.5.11 The greatest potential impact on air quality from traffic associated with the construction phase will be immediately adjacent to the site access areas. It is anticipated that construction traffic will access the site via the A158, A15 (Wragby Road East), B1308 (Greetwell Road), B1190 (Washingborough Road), B1188 (Lincoln Road) and A15 (Sleaford Road).

11.5.12 Whilst there are residential properties located along these roads, the contribution of construction traffic compared to existing traffic flows will be small. The maximum predicted annual mean concentration of $NO_2$ and $PM_{10}$ of 13µg/$m^3$ and 24µg/$m^3$ respectively in the Do Minimum scenario for the opening year at the worst case receptors located along the likely access routes were well below the objectives. Consequently, the predicted impacts of construction traffic on local air quality are considered to be temporary, short-term and slight adverse to negligible, prior to mitigation.

### *Operation Impacts*

11.5.13 Annual Mean $NO_2$ and $PM_{10}$ concentrations associated with predictive traffic levels both with and without the Proposed Scheme at worst case receptors identified within 200m of the affected roads are presented in Volume 2 – Supporting Information.

#### *Annual Mean $NO_2$*

11.5.14 The predicted annual mean $NO_2$ concentrations for DM and DS scenarios, and the change in concentrations between DM and DS scenarios at the worst case receptors in the study area are presented in Volume 2 – Supporting Information.

11.5.15 The highest predicted annual mean $NO_2$ concentrations at the worst case receptors in the DM and DS scenarios are 31 µg/$m^3$ and 28 µg/$m^3$ respectively, which are well below the Objective Limit Value (40 µg/$m^3$). It is therefore anticipated that exceedences of the Annual Mean $NO_2$ objectives are unlikely in the opening year (2017).

11.5.16 The majority (58 out of 60) of the worst case receptors are predicted to experience an imperceptible or a small change, with only two receptors predicted to experience a medium beneficial change (improvement).

11.5.17 The most improved receptor is located on the A15 Wragby Road/Pottergate junction (-2.7µg/$m^3$). The highest deterioration, a receptor on the A1434 (Newark Road/Stanley Street junction) is predicted to receive a 0.9µg/$m^3$ increase in $NO_2$. Both changes are considered to be small.

11.5.18 Impact significances for each worst case receptor are summarised in Volume 2 – Supporting Information. Table 11-2 indicates that the scheme would produce a negligible to slight beneficial impact for the worst case receptors considered within the study area.

*Table 11-1 Impact Significance Summary (Annual mean NO2 objective)*

| Impact Significance Category | Number of Receptors | % of Receptors |
|---|---|---|
| Substantial Adverse | 0 | 0 |
| Moderate Adverse | 0 | 0 |
| Slight Adverse | 0 | 0 |
| Negligible | 59 | 99 |
| Slight Beneficial | 1 | 1 |
| Moderate Beneficial | 0 | 0 |
| Substantial Beneficial | 0 | 0 |

### *1-Hour Mean $NO_2$*

11.5.19 No exceedences of 60 µg/$m^3$ as an Annual Mean $NO_2$ concentration have been identified at the worst case receptors, and thus exceedences of the 1-hour mean objective are unlikely with the implementation of the Proposed Scheme.

### *Annual Mean $PM_{10}$*

11.5.20 The predicted annual mean $PM_{10}$ concentrations in the DM and DS scenarios and the change between DM and DS scenarios at the worst case receptors in the study area are presented Volume 2 – Supporting Information.

11.5.21 The maximum annual mean $PM_{10}$ concentrations in both the DM and DS scenarios (36.2 µg/$m^3$ and 34.3 µg/$m^3$ respectively) at the worst case receptors considered in the study area are below the Annual Mean Objective Limit (40 µg/$m^3$), (see Volume 2 – Supporting Information). It is therefore anticipated that exceedences of the annual mean $PM_{10}$ objectives are unlikely in the opening year (2017).

11.5.22 The majority of the receptors considered are predicted to experience an imperceptible or a small change (59 out of 60 receptors) and only one receptor would have a medium change (improvement).

11.5.23 The most improved receptor is located on the A15 Wragby Road/Pottergate junction (-2.1µg/m$^3$). The highest deterioration is a receptor on the A15 (Sleaford Road) (1.9µg/m$^3$). Both changes are considered to be small.

11.5.24 The impact significance for each worst case receptor is summarised in Volume 2 – Supporting Information. The results indicate that the scheme would produce a negligible to a slight beneficial impact within the study area.

11.5.25 Air quality predictions for the short term and long term impact show that the majority of the air quality improvements are in and around the City of Lincoln. These air quality benefits are as a result of the redistribution and movement of traffic as a result of the Proposed Scheme.

*Table 11-2: Impact Significance Summary (Annual mean $PM_{10}$ objective)*

| Impact Significance Category | Number of Receptors | % of Receptors |
|---|---|---|
| Substantial Adverse | 0 | 0 |
| Moderate Adverse | 0 | 0 |
| Slight Adverse | 0 | 0 |
| Negligible | 58 | 97 |
| Slight Beneficial | 2 | 3 |
| Moderate Beneficial | 0 | 0 |
| Substantial Beneficial | 0 | 0 |

### *24-Hour Mean $PM_{10}$*

11.5.26 The number of days with $PM_{10}$ concentrations greater than 50µg/m$^3$ in the DM and DS scenarios and the magnitude for change in the number of days with $PM_{10}$ concentrations greater than 50µg/m$^3$ between the DM and DS scenarios are presented in Volume 2 – Supporting Information. .

11.5.27 The two worst case receptors, the A15 Wragby Road/Pottergate junction and A15 Broadgate/Melville Street junction, are predicted to continue to experience 24-hour exceedence of 50µg/m$^3$ (35 days a year) in both DM and DS scenarios. It is therefore anticipated that the 24-hour mean objective for $PM_{10}$ is still unlikely to be met in some areas along the A15 in the city centre in the opening year.

11.5.28 The magnitude for change in number of days with $PM_{10}$ concentrations greater than 50µg/m$^3$ between the DM and DS scenarios are presented in Volume 2 – Supporting Information. Up to 14 receptors will experience a deterioration in air quality associated with the Proposed Scheme, 22 receptors will experience no

change and 24 receptors will experience an improvement in air quality associated with the Proposed Scheme.

11.5.29 The greatest improvements were observed on the A15 Wragby Road and the A15 Broadgate, where receptors are predicted to see the number of days of exceedence reduce from 56 to 46 and 54 to 44 days respectively (Summarised in table 11-3, below). The highest deterioration was observed on the A1434 Newark Road, with a medium increase from 25 to 28 days between DM and DS. Although the receptors would receive a worsening impact associated with the Proposed Scheme, the predicted 24-hour mean $PM_{10}$ concentration in DS is well below the objective (35 days a year).

*Table 11-3 Worst Case Receptors with Greatest Magnitude Change for 24-hour mean PM10 Objective*

| Worst Case Receptor (ID) | Location | Number of 24-hour mean exceedences of 50µg/m$^3$ | | |
|---|---|---|---|---|
| | | **DM** | **DS** | **Change** |
| Adit110 | A1434 Newark Road | 25 | 28 | 3 (Worsening) |
| J_60 | A15 Broadgate/Melville Street | 56 | 46 | -10 (Improving) |
| Adit75 | A15 Wragby Road/Pottergate | 54 | 44 | -10 (Improving) |

11.5.30 The impact significance for 24-hour mean $PM_{10}$ objective at each worst case receptor are summarised in table 11-4 and presented in Volume 2 – Supporting Information. The results indicate that the Proposed Scheme would produce a slight adverse to a substantial beneficial impact for the worst case receptors considered within the study area.

*Table 11-4: Impact Significance Summary (24h mean $PM_{10}$ objective)*

| Impact Significance Category | Number of Receptors | % of Receptors |
|---|---|---|
| Substantial Adverse | 0 | 0 |
| Moderate Adverse | 0 | 0 |
| Slight Adverse | 1 | 2 |
| Negligible | 57 | 95 |
| Slight Beneficial | 0 | 0 |
| Moderate Beneficial | 0 | 0 |
| Substantial Beneficial | 2 | 3 |

### *Contribution to Regional Emissions*

11.5.31 The Proposed Scheme's contributions to total regional emissions in its opening year (2017) are presented in Table 11-5. Analysis of the results indicates that the scheme is likely to lead to slight increases in pollutant emissions, less than 1%. This increase is considered to be insignificant to regional emissions.

*Table 11-5: Regional Emissions for the opening year 2017*

| | $CO_2$ (kg/yr) | HC (kg/yr) | $NO_x$ (kg/yr) | $PM_{10}$ (kg/yr) | $PM_{2.5}$ (kg/yr) | Carbon (tonnes/yr) |
|---|---|---|---|---|---|---|
| DM | 1,004,908 | 186,411 | 1,881,966 | 224,432 | 133,135 | 274,066 |
| DS | 1,010,206 | 187,080 | 1,887,807 | 226,080 | 134,088 | 275,511 |
| DS - DM | 5,298 | 669 | 5,841 | 1,647 | 953 | 1,445 |
| % Change | 0.53% | 0.36% | 0.31% | 0.73% | 0.72% | 0.53% |

## 11.6 Proposed Mitigation

### *Construction Phase*

- The proposed measures focus on mitigation of construction phase related dust and those described below will be implemented by the contractor through a Construction Environmental Management Plan (CEMP) / Code of Construction Practice (CoCP).

11.6.1 A range of tried and tested mitigation measures are available for the contractor to use where specific impacts are identified and these may include:

- Roads and accesses being kept clean;
- grout or cement-based materials mixed using a process suitable for the prevention of dust emissions;
- fine material not be stockpiled to an excessive height in order to prevent exposure to wind and/or dust nuisance;
- dust generating activities (e.g. cutting, grinding and sawing) minimised and weather conditions considered prior to conducting potentially dust emitting activities;
- where practicable, plant will be located away from site boundaries close to residential areas;
- water will be used as a dust suppressant where applicable
- drop heights from excavators to crushing plant will be kept to a minimum.
- distances from crushing plant to stockpiles will be kept to the minimum practicable to control dust generation associated with the fall of materials;
- skips will be securely covered;

- soiling, seeding, planting or sealing of completed earthworks will be completed as soon as reasonably practicable following completion of earthworks;
- dust suppression and the maintenance of the surface of access routes will be appropriate to avoid dust as far as practicable, taking into account the intended level of trafficking;
- material will not be burnt on site; and
- engines will accord with appropriate British Standards and will be switched off when not in operation.

11.6.2 These are measures which will both reduce the magnitude and duration of dust deposition for all receptors. In relation to those receptors with the highest risk, located downwind and within 20m from the construction site, the measures will ensure that the temporary impact relative to the identified receptors will generally be slight adverse for the construction period (Table 11-6).

*Table 11-6: Summary Significance Table with Mitigation*

| | Dust Soiling and $PM_{10}$ Effects | Ecological | $PM_{10}$ Effects |
|---|---|---|---|
| Earthwork | Slight Adverse | None | Negligible |
| Construction Activities | Slight Adverse | None | Negligible |
| Trackout | Slight Adverse | None | Negligible |
| Overall Significance | Slight Adverse | | |

### *Operation Phase*

11.6.3 Given the predicted beneficial air quality impacts on receptors in Lincoln city centre and the unlikely adverse impact on receptors in proximity to the Proposed Scheme alignment, no specific mitigation measures are required.

## 11.7 Conclusions and Effects

11.7.1 With the implementation of mitigation measures during the construction phase, in accordance with a Construction Management Plan to be agreed by the local planning authority, no significant impacts associated with construction are anticipated.

11.7.2 The change of magnitude in ambient air concentrations associated with the implementation of the Proposed Scheme is negligible to small. The overall impact from the Proposed Scheme on air quality is slight beneficial to negligible for the two pollutants of health concern.

# 12 Cultural Heritage

## 12.1 Scope of the Assessment

12.1.1 This chapter provides an assessment of the potential impacts on both known and potential cultural heritage assets. Where impacts on known or potential interests have been identified, relevant archaeological and cultural heritage mitigation strategies have been proposed.

12.1.2 Cultural heritage assets include archaeological assets, built heritage assets and historic landscapes. An archaeological asset can be buried remains, identified through previous investigations or survey including aerial photographic survey, or upstanding remains visible as earthworks or cropmarks. Built heritage assets are upstanding structures, including buildings, monuments and ruins with historical, functional or architectural value. Historic landscapes are areas where social and economic activity has served to shape landscapes in which there is a discernable awareness of their evolution.

12.1.3 The assessment covers all assets within the footprint of the Proposed Scheme and within a 200m buffer zone. The assessment also covers all designated assets within the footprint of the scheme and 1km from the scheme boundary in order to assess the impact on setting.

## 12.2 Statutory and Planning Context

12.2.1 A summary of the current legislation, policy and guidance documents relevant to the assessment of impacts of the Proposed Scheme on cultural heritage is presented below.

### *Statutory Context*

#### *Ancient Monuments and Archaeological Areas Act, 1979*

12.2.2 This legislation sets out guidance and policy for protecting nationally important monuments through scheduled status. Consent must be obtained from English Heritage for all works on Scheduled Ancient Monuments.

#### *Planning (Listed Building and Conservation Areas) Act 1990*

12.2.3 The Act makes provision for the protection and conservation of historic buildings and areas by way of a process of listing and designation. Identified buildings are classified as being Grade I, Grade II* or Grade II, and historic areas are designated as conservation areas. Once listed, Listed Building consent must be obtained from the local planning authority before works to demolish, alter or

extend a listed building can be carried out. Similarly, consent must be obtained for the demolition of buildings in a Conservation Area.

### *National Policy Context*

#### *National Planning Policy Framework, 2012*

12.2.4 The National Planning Policy Framework for England was published in March 2012 and replaces the majority of the previous National Planning Policy Statements, including Planning Policy Statement 5: Planning for the Historic Environment. The NPPF provides guidance to local authorities and developers on the conservation of heritage assets (and their setting), requesting an assessment of heritage as part of planning applications, and recording and investigation where conservation is not possible.

### *Local Policy Context*

#### *East Midlands Regional Plan, 2009*

12.2.5 The East Midlands Regional Plan (2009) includes policies addressing the conservation of cultural heritage assets, including the following:

- Policy 26 - Protecting and Enhancing the Region's Natural and Cultural Heritage, which states that: Sustainable development should ensure the protection, appropriate management and enhancement of the Region's natural and cultural heritage
- Policy 27 - Regional Priorities for the Historic Environment, which explains the following: The historic environment should be understood, conserved and enhanced in recognition of its own intrinsic value and its contribution to the region's quality of life

#### *Central Lincolnshire Core Strategy (Draft), 2012*

12.2.6 The Central Lincolnshire Core Strategy partial plan became available for public consultation in June 2012. The main policy for the historic environment is Policy CL23: A quality environment. It states that: 'Development proposals will be required to contribute positively to environmental quality and local character, and not have an unacceptable effect on the area's natural or historic assets.'

#### *North Kesteven District Council Local Plan, 2007*

12.2.7 North Kesteven Local Plan will largely become superseded by the Central Lincolnshire Core Strategy. The saved 2007 policies still carry weight, and those relating to the historic environment are as follows:

- Policy HE1: Sites Containing Nationally Important Archaeological Remains
- Policy HE2: Archaeological Assessment and Evaluation

- Policy HE3: Sites Containing Archaeological Remains
- Policy HE9: Historic Parks and Gardens

*Lincoln City Local Plan, 1998*

12.2.8 The Local Plan was adopted in 1998 and will eventually be replaced by the Central Lincolnshire Core Strategy. The policies listed below and in full in Volume 2 – Supporting Information have been identified as relevant to the Proposed Scheme:

- Policy 21: Archaeological Assessment
- Policy 22: Archaeological Constraints
- Policy 23: Scheduled Ancient Monuments
- Policy 24: Development affecting Listed Buildings
- Policy 31: Development affecting Buildings and Structures of Local Importance
- Policy 32: Views Important to Conservation Areas

*West Lindsey Local Plan, 2004*

12.2.9 The West Lindsey District Council Local Plan was adopted in 2004 and it will be largely superseded by the Central Lincolnshire Core Strategy. Some policies were deleted in 2007 but the following remain as saved policies:

- Policy NBE7: Ancient Monuments, Sites and Remains of Archaeological Importance
- Policy NBE8: Historic Parks and Gardens

### *Guidance Documents*

12.2.10 The assessment has been undertaken in accordance with the following guidance documents:

- Institute for Archaeologists' Standard and Guidance for Archaeological Desk Based Assessment (Institute for Archaeologists, Revised 2011); and
- Design Manual for Roads and Bridges (DMRB), Volume 11, Section 3, Part 2 HA 208/07.
- Archaeological Handbook, Lincolnshire County Council (2010)

## 12.3 Method of Assessment

### *Baseline environment*

12.3.1 The baseline environment has been established through a desk-based assessment, site survey and consultation.

12.3.2 As part of the desk-based review, data has been obtained from the following resources:

- Lincolnshire County Historic Environment Record
- National Monuments Record
- Lincoln Archives (for historic maps, photographs and other documents)

12.3.3 A site visit was undertaken on 26th October and 1st November 2012 by a qualified heritage consultant.

12.3.4 Data and views concerning the Proposed Scheme have also been sought from the following authorities, organisations and groups:

- Lincolnshire County Council Planning Archaeologist
- English Heritage

12.3.5 This assessment has also reviewed the Desk Based Assessment and Cultural Heritage chapter for the *Environmental Statement* produced in 2009.

12.3.6 A programme of archaeological fieldwork was undertaken between 2002 and 2004 and in 2008 and 2009 to support an assessment of cultural heritage for the Lincoln Eastern Bypass scheme. The reports from the 2008 and 2009 fieldwork can be viewed in Volume 3 – Technical Appendices.

### *Predicted Impacts*

#### *Value*

12.3.7 Assessment of value has involved consideration of how far the asset(s) contribute to an understanding of the past, through their individual or group qualities, either directly or potentially. These are professional judgements, but they are also guided by legislation, national policies, acknowledged standards, designations, criteria and priorities.

12.3.8 The assessment has involved reference to Annexes 5, 6 and 7 of the Design Manual for Roads and Bridges (DMRB), HA208/07 (Cultural Heritage) which recommends the adoption of six ratings for value in relation to archaeology and built heritage: very high, high, medium, low, negligible and unknown. Definitions for each rating are outlined in Table 12-1 and Table 12-2.

12.3.9 Many of the assets are artefact scatters or findspots which have been identified through fieldwalking and surface collection. Since the items have been removed through surface collection, they have been assessed as negligible value. The location, frequency and value of the items themselves, however, may relate to the location of potential archaeological remains.

*Table 12-1 Factors for Assessing the Value of Archaeological Assets*

| Value | Example |
|---|---|
| Very High | World Heritage Sites (including nominated sites)<br>Assets of acknowledged international importance<br>Assets that can contribute significantly to acknowledged international research objectives |
| High | Scheduled Monuments (including proposed sites)<br>Undesignated assets of scheduled quality and importance<br>Assets that can contribute significantly to acknowledged national research objectives |
| Medium | Designated or undesignated assets that contribute to regional research objectives |
| Low | Designated and undesignated assets of local importance<br>Assets compromised by poor preservation and/or poor survival of contextual associations<br>Assets of limited value, but with potential to contribute to local research objectives |
| Negligible | Assets with very little or no surviving archaeological interest |
| Unknown | The importance of the resource has not been ascertained |

*Table 12-2 Criteria for Establishing the Value of Built Heritage Assets*

| Value | Status and Definition |
|---|---|
| Very High | International importance i.e. World Heritage Sites. |
| High | National importance<br>i.e. listed buildings at Grade I and II* Scheduled Ancient Monuments with standing remains, conservation areas containing very important buildings and undesignated structures of clear national importance. |
| Medium | Regional importance<br>i.e. listed buildings at Grade II, conservation areas containing buildings that contribute significantly to its historic character, historic townscape with important integrity in their buildings, or built settings and undesignated structures of clear regional importance. |
| Low | Local importance<br>i.e. undesignated assets of modest quality in their fabric or historical association and historic townscape of limited historic integrity (including buildings and structures included in local list prepared by local authority). |
| Negligible | Assets of no architectural or historical note |
| Unknown | Assets with some hidden i.e. inaccessible potential for historic or architectural significance. |

### *Magnitude of Impact*

12.3.10 The determination of magnitude of impact has been based on the vulnerability of the study area, its current state of survival/condition and the nature of the impact upon it. The survival and extent of the archaeological deposits is often uncertain and, consequently, the magnitude of change can be difficult to predict with any certainty.

12.3.11 The assessment has involved reference to Annexes 5, 6 and 7 of DMRB guidance HA208/07 (Cultural Heritage) which recommends the adoption of six ratings for value in relation to archaeology and built heritage: very high, high, medium, low, negligible and unknown. Definitions for each rating are outlined in Table 12-3 and Table 12-4.

*Table 12-3 Factors for Assessing the Magnitude of Impact for Archaeological Assets*

| Magnitude of Impact | Factors in the assessment of the magnitude of impacts |
|---|---|
| Major | Change to most or all key archaeological materials, such that the resource is totally altered<br>Comprehensive changes to setting |
| Moderate | Changes to many key archaeological materials, such that the resource is clearly modified<br>Considerable changes to setting that affect the character of the asset |
| Minor | Changes to key archaeological materials, such that the asset is slightly altered<br>Slight change to setting |
| Negligible | Very minor changes to archaeological materials, or setting |
| No Change | No change |

*Table 12-4 Factors for the Assessment of the Magnitude of Impact for Built Heritage Assets*

| Magnitude of Impact | Factors in the assessment of the magnitude of impacts |
|---|---|
| Major | Change to key elements of the built heritage asset(s), such that the resource is totally altered<br>Comprehensive changes to the setting |
| Moderate | Change to many key elements of the built heritage asset(s), such that the resource is significantly modified<br>Changes to the setting of a built heritage asset, such that it is significantly modified |
| Minor | Change to key elements of the built heritage asset(s), such that the asset is slightly different.<br>Change to setting of a built heritage asset, such that it is noticeably changed. |
| Negligible | Slight changes to elements of the built heritage asset(s) or setting that hardly affect it |

### *Impacts*

12.3.12 Table 12-5 illustrates how information on the value of the asset and the magnitude of the impact has been combined to arrive at an assessment of the significance of effect. The matrix is not intended to override professional judgement of the significance of impact but act as a check to ensure that judgements regarding value, magnitude of impact and significance of effect are reasonable and balanced. There are occasions when insufficient information is known to make informed judgements. In such cases an assessment of risk has been undertaken.

*Table 12-5 Impact Ratings*

| | Magnitude of Impact | | | | | |
|---|---|---|---|---|---|---|
| Value/Sensitivity | | **No Change** | **Negligible** | **Minor** | **Moderate** | **Major** |
| | **Very High** | **Neutral** | **Slight** | **Moderate/ Large** | **Large or Very Large** | **Very Large** |
| | **High** | **Neutral** | **Slight** | **Moderate/ Slight** | **Moderate/ Large** | **Large/ Very Large** |
| | **Medium** | **Neutral** | **Neutral/Slight** | **Slight** | **Moderate** | **Moderate/ Large** |
| | **Low** | **Neutral** | **Neutral/Slight** | **Neutral/ Slight** | **Slight** | **Slight/ Moderate** |
| | **Negligible** | **Neutral** | **Neutral** | **Neutral or Slight** | **Neutral or Slight** | **Slight** |

### *Mitigation*

12.3.14 Where the assessment has identified significant impacts, suitable mitigation measures have been identified and detailed. This may involve protecting a particular asset(s) or a requirement for further investigation or recording.

## 12.4 Baseline Environment

### *Site Description and Geological Context*

12.4.1 North of the River Witham the study area contains limestone deposits of the Jurassic period with sections of Bilsworth Clay. There are alluvial deposits in the floodplain area of the river. South of the River Witham there are river terrace

sands and gravels as far as Washingborough Road. Further south is the steep limestone escarpment with underlying deposits of Jurassic limestone and clay.[6]

12.4.2 The study area is located along the slope of the Lincoln Edge which is a limestone ridge running north to south to the east of the city of Lincoln. It is broken by the Lincoln Gap where the River Witham passes through.

12.4.3 The average elevation of the northern portion of the Proposed Scheme (north of the river) is 33m AOD. The Witham valley cuts the scheme east to west with an elevation of 4m AOD at the river's edge. Further south the elevation begins to rise again to 40m AOD at Heighington Road and 66m at Sleaford Road.

12.4.4 The land is largely under agriculture. The field boundaries tend to be hedgerows with some post and wire fences. The area becomes more urban to the west.

### *Archaeology*

#### *Previous archaeological studies*

12.4.5 An assessment was undertaken between 2002 and 2004 to support the 2004 Lincoln Eastern Bypass planning application. A programme of archaeological evaluation was undertaken to inform the assessment including the following:

- PCA 2003 Surface Collection Survey of Lincoln Eastern Bypass
- PCA 2003 Geophysical Survey, Lincoln Eastern Bypass
- PCA 2004 Report of a Programme of Archaeological Trial Trenching, Lincoln Eastern Bypass
- The Environmental Consultancy 2004 Topographic and Auger Survey on the Northern Floodplain of the River Witham, Lincoln Eastern Bypass

12.4.6 In 2006 a programme of fieldwalking and geophysical survey was commissioned by Jesus College in order to assess two alternative routes for the Lincoln Bypass scheme.

12.4.7 The scheme was reassessed between 2007 and 2008 and DMRB stage 1 and 2 assessments were prepared. Following the assessment, a new preferred route was identified and this was assessed as part of the *Environmental Statement Produced* in 2009. North of the River Witham was identical to the 2004 scheme and, therefore, no further archaeological fieldwork was required. South of the river a programme of archaeological evaluation was undertaken including the following:

- Stratascan 2008 Geophysical Survey, Lincoln Eastern Bypass

[6] British Geological Survey 1973

- Archaeological Project Services 2008 Trial Trenching on the route of the Lincoln Eastern Bypass, Lincolnshire

12.4.8 Since the current Proposed Scheme alignment remains the same as the 2009 application, no further evaluation is required to support this Environmental Statement.

12.4.9 The features identified through the archaeological studies above have been described in the context of the timeline below.

### *Known assets*

12.4.10 The location of the sites taken from the Lincolnshire Historic Environment Record (HER) and the National Monuments Record (NMR) and/or identified through site walkover survey which lie within the study area are shown on Figures 1030171-LEB-EIA-HER-001a and 1030171-LEB-EIA-HER-001b and are tabulated in the gazetteer in Volume 2 – Supporting Information. The numbers referenced on the plan and in brackets in the text (e.g. Reference 1) have been added for the purposes of this report only. HER and NMR references relating to each site where applicable are listed within Volume 2 – Supporting Information. Some of these entries are included in both the HER and the NMR and therefore include two numbers.

12.4.11 The principal sites and features within the study area are described in the context of a timeline of archaeological periods from prehistoric through to modern. The location of the recorded sites and features can be cross referenced with Figures 1030171-LEB-EIA-HER-001a and 1030171-LEB-EIA-HER-001b.

- The time periods which are discussed are:
- Prehistoric:
- Palaeolithic 250,000 – 10,000 BC
- Mesolithic 10,000 – 4,000 BC
- Neolithic 4,000 – 2,500 BC
- Bronze Age 2,500 – 700 BC
- Iron Age 800 BC – AD 43
- Roman AD 43 – 410
- Early Medieval AD 410 – 1066
- Medieval AD 1066 – 1540
- Post-Medieval AD 1540 – 1900

### *Prehistoric*

12.4.12 The earliest archaeological features found within the study area date to the Mesolithic period and consist of worked flint scatters and artefacts such as blades which tend to be located beside the River Witham (Reference 23, 46, 50, 51, 63, 95, 103, 114, 136, 137 and 156). During this period the river is likely to have been wider with patches of dry land. Geotechnical investigations and palaeoenvironmental assessment have identified a buried horizon underlying peat and alluvial deposits which have preserved it. Some of the flint scatters were recovered from this land surface during trial trenching in 2004. A possible settlement site with evidence of flint knapping debris has been identified at Reference 198.

12.4.13 Evidence dating to the Neolithic in the study area again largely consists of worked flint scatters, lithics and other artefacts (Reference 23, 43, 47, 49, 52, 57, 59, 62, 63, 83, 101, 103, 107, 114, 139 and 156). There is also a possible long barrow at Reference 76.

12.4.14 Known Bronze Age evidence within the study area is predominant with an extensive barrow cemetery stretching over the north and south sides of the River Witham (Reference 79 and 88) and possible round barrows at Reference 78 and 135. The barrow cemetery to the south of the river was subject to geophysical survey and trial trenching in 2008 and 2009 which revealed that the barrows were in a poor state of preservation. A middle Bronze Age cinerary urn was also discovered at the water treatment works (Reference 33) and a collared urn was discovered at Canwick Heath Farm (Reference 178) suggesting the area was part of a Bronze Age religious centre. Lithic, worked flint, pottery and other artefact scatters including two palstaves dating to this period have also been found within the study area (References 23, 32, 34, 38, 43, 44, 47, 48, 49, 52, 53, 57, 59, 83, 95, 101, 102, 103, 114, 137 and 139).

12.4.15 Iron Age evidence within the study area consists of pottery scatters (Reference 32) and findspots including a beehive quern (Reference 35). There are cropmarks showing a hut circle, boundaries, enclosures and trackway at Reference 75. Ring ditches have been identified at Reference 102 and 121 and possible ring ditches have also been identified at Reference 89 and 90. A triple ditch system also probably dates to the late Iron Age period (Reference 105). A late Iron Age settlement has also been identified at Reference 113 with ditches, gullies and pits containing Iron Age pottery, charred grain and animal bone. Further Iron Age activity has been found at Reference 162 and 163 and a late Iron Age field system has been identified at Reference 213. Waterlogged timbers discovered at Reference 198 may form part of an Iron Age boundary.

### *Roman*

12.4.16 Evidence relating to the Roman and the Romano-British period can be found throughout the study area. The Roman road from Lincoln to Burgh le Marsh follows the present line of the A15 Bunkers Hill/ Wragby Road at the north end of the study area (Reference 69). The A15 Sleaford Road and Bloxholm Lane, at the southern end of the Proposed Scheme, are also believed to be Roman roads that connected Mareham Lane, east of Sleaford, to Lincoln (Reference 69 and 70). Ditches and gullies containing Roman pottery have also been found south-west of Bloxholm Lane (Reference 129).

12.4.17 Roman pottery scatters have been identified through fieldwalking to the north and south of Washingborough Road (Reference 25, 82, 93 and 122), north of Greetwell Road (Reference 81), south of Hawthorn Road (Reference 100), north and south of Lincoln Road (Reference 153 and 155) and north-east and west of Bloxholm Lane (Reference 54, 67 and 108). Roman pottery and tile fragments were also recovered during trial trenching to the south of Greetwell Road (Reference 39 and 40). Three Roman coins were found to the north of the River Witham (Reference 202).

12.4.18 Human bones dating to the Roman period have been discovered off Greetwell Road (Reference 28) and Roman burials are said to have been found in the Ironstone Mines in the 19th century (Reference 174). Two further Roman inhumations were discovered south of Greetwell Road/ north of the railway line (Reference 175).

12.4.19 Ironstone mines, believed to be of Roman date, have been identified north and south of Greetwell Road (Reference 29 and 77). A copper alloy mount was discovered to the south of Greetwell Road and is believed to have been associated with the ironstone mines (Reference 203).

12.4.20 A Romano-British settlement site has been identified at Greetwell Quarry through fieldwalking and geophysical survey (Reference 80). The site includes evidence of hut circles, boundary ditches and a field system dating between the 2nd and 4th centuries. Further Roman enclosures were discovered south of Greetwell Road (Reference 106) which may be the location of a Roman villa and a linear cropmark boundary between Nettleham Glebe and Danby Hill has been dated to the Romano-British period (Reference 73). Further enclosures and linear features dating to the Roman period were discovered north of Greetwell (Reference 173). An Iron Age or Romano-British field system has also been identified north of Heighington Road (Reference 213). Three houses dating to the Roman period were also discovered at Monk's Lane and dated to the 2nd or 3rd century (Reference 184).

### *Early Medieval*

12.4.21 A number of Saxon artefacts and finds have been discovered along the proposed route including coins, pins, strap end, lava querns and pottery scatters to the north Washingborough Road (Reference 30 and 31). Saxon pottery sherds have also been recovered in the northern part of the study area (Reference 37). An Anglo-Saxon coin and strap end were also found north of Lincoln Road (Reference 177).

12.4.22 Remains dating from the 9th to 10th century were found north of Heighington Road and consisted of pits and ditches containing pottery and animal and fish bone. Other finds included a copper alloy pin head, fragments of a lava quern and a broken blade (Reference 161). Early medieval settlement sites are generally rare across the archaeological record.

### *Medieval*

12.4.23 The shrunken medieval village of Greetwell stands to the east of the Proposed Scheme and consists of a multitude of earthworks of tofts and crofts and holloways (Reference 2 and 74). At the centre of the settlement the 11th century church and medieval manor house remain standing and will be discussed further in the historic buildings section. The village of Greetwell is a designated Scheduled Monument (Reference 2). Further earthworks stand to the north of Westfield Farm and are separated from the main monument by Greetwell Road. Ridge and furrow evidence can be seen to the north and west of Greetwell suggesting that the area was predominantly arable (Reference 172). Ridge and furrow has also been identified through geophysical survey to the north of Hawthorn Road (Reference 181) and north of the River Witham (Reference 206 and 208).

12.4.24 The original Sheepwash Grange to the north of Washingborough Road was the site of a monastic outlying grange or manor (Reference 87). The site is known to have existed from the 12th century onwards and is shown on the 1787 enclosure map. A geophysical survey at the site revealed ditches and pits that may relate to the grange site. Documentary evidence also refers to a site called ‘Calscroft’ that may have been a wharf adjoining the grange for distributing wool (Reference 91).

12.4.25 The location of a medieval stub cross (Reference 235) marking the boundary of the city once stood along Greetwell Gate and is recorded in documentary evidence dating to the 13th century. The exact location of the cross, however, is uncertain.

12.4.26 Other medieval evidence includes pottery and ceramic scatters (Reference 22, 41, 42, 55, 56, 64, 84, 94, 126, 128, 154, 158, 194, 195 and 197); a hoard of 12th century coins found south of Greetwell Road (Reference 27); coins found north

of Lincoln Road (Reference 179); a possible cropmark boundary (Reference 97) and a possible field system (Reference 132); possible limekilns (Reference 119). The pottery and ceramic scatters may be related to manuring rather than a settlement.

### *Post-medieval and modern*

12.4.27 Again, the majority of the post-medieval pottery and metal finds evidence throughout the study area is probably associated with manuring (Reference 24, 26, 58, 65, 66, 85, 94, 138 and 217). Post-medieval field systems (Reference 86) are also evident throughout the study area with scattered farms, some still standing (see historic buildings section for further information) but some no longer visible above ground (Reference 201). Post-medieval ditches probably relating to the field systems and field boundaries have been found within the study area (Reference 112, 115, 116, 132, 164, 180 and 200). There have been two important hedgerows identified within the study area (Reference 204 and 205).

12.4.28 Parks began to be established to the east edge of the city, including St John's Heath Park and Monk's Tower Park (Reference 147 and 148) during the late 18th and 19th centuries. During the late 19th century ironstone quarries began to be opened up throughout the study area but particularly to the north of Greetwell Road (Reference 133, 149, 150, 151, 152 and 182). Quarries and limekilns have also been discovered north and south of Heighington Road (Reference 123 and 125). The Greetwell Road quarry had its own tramway (Reference 189) with bridges carrying the roads over the tramway lines (Reference 183). Crofton House is another building associated with the tramway but since lost (Reference 191).

12.4.29 The railways began to develop in Lincolnshire during the mid to late 19th centuries. In the study area this included the Sheffield and Lincoln Extension Railway in 1848 (Reference 167); East Lincolnshire Railway in c.1850 (Reference 168) and Spalding to Lincoln Railway which was established in 1882 (Reference 166).

12.4.30 The Lincoln Sewage Farm on Washingborough Road (Reference 229) was established at the end of the 19th century following increased concerns for public health. The sewage farm remains but has been modernised.

12.4.31 The Bracebridge airfield stands to the north-west of the south end of the Proposed Scheme (Reference 98). The airfield was established in 1916 and during the Second World War it was used to repair aircraft for A. V Roe and Company. A probable gun emplacement has also been identified west of the Proposed Scheme (Reference 131).

12.4.32 A Royal Observer Corps Monitoring post was established in 1962 within the study area (Reference 169). There is now no visible evidence above ground.

### *Assets of unknown date*

12.4.33 Some assets have been discovered through geophysical survey, walkover survey or trial trenching (i.e. ditches, pits, gullies, uncertain features) but cannot be assigned a date due to lack of dateable evidence.

#### *Archaeological potential*

12.4.34 The abundance of archaeological evidence dating from the prehistoric period to the present day demonstrates that the study area is a rich archaeological resource. Evidence to the north and south of the river is the most well preserved and within the floodplain there is a high potential for evidence dating from the prehistoric and Roman periods including paleoenvironmental evidence. This is largely due to the alluvium and peat deposits.

12.4.35 Other areas within the scheme also demonstrate that there is a potential for archaeological remains but the pottery and find scatters suggest that this evidence is largely due to manuring and likely features may have been damaged or destroyed through ploughing.

### *Built Heritage*

12.4.36 There is one Grade II* listed building and 18 Grade II listed buildings within the area of and within 1km of the Proposed Scheme. Lincoln Cathedral (Grade I), the Bishop's Palace (Grade I to Grade II) and Lincoln Castle (Grade I) have also been included in the assessment in order to assess the impacts on the wider setting, given that these buildings largely dominate the skyline to the west of the scheme. In addition to listed buildings, there are ten buildings of historical or architectural interest. The built heritage will be described by type.

#### *Religious structures*

12.4.37 The Scheduled Monument of Monk's Abbey (Reference 1 and 10) stands to the west of the Proposed Scheme. It is built of limestone rubble with ashlar dressings. It is well screened from the Proposed Scheme by later 19th century terraced housing.

12.4.38 The Grade II* listed building of All Saints Church (Reference 15) stands at the centre of Greetwell scheduled monument to the east of the Proposed Scheme. The church was built in the 11th century and was restored in the 19th century. It is constructed of limestone rubble with a square west tower and apsidal chancel. There are also two Grade II listed monuments within the churchyard dating to the 19th century (Reference 17 and 20).

### *Gentry houses*

12.4.39 Immediately to the north of the church is the Grade II listed Greetwell Hall which dates from the 17th century with 18th and 19th century additions (Reference 18). Like the church the Hall is built of a mixture of limestone and ironstone rubble with slate roofs. The Hall is accompanied by a 19th century stable block to the north which is also listed at Grade II and is built of coursed limestone rubble and ashlar with pantile roof (Reference 19). The lodge to the north-east of the Hall was built in the 19th century and is built in a similar style of coursed limestone and ironstone with pitched slate roofs (Reference 16). The lodge is also listed at Grade II.

### *Farmsteads*

12.4.40 Built heritage within the study area is predominantly farmsteads of varying types. Formally planned farmsteads with farmhouse and associated buildings can be seen at Manor House (Reference 3) which dates to the early 19th century and retains its accompanying farm buildings (Reference 12) and gates and walls (Reference 14). All are built of limestone rubble with ashlar dressings. Branston Heath Farmhouse and Ashfield House are also constructed in a similar way with limestone rubble and ashlar dressings and are a Grade II listed buildings (Reference 13 and 21).

12.4.41 Other farms of local gentry status include the early 18th century Sheepwash Grange Farm (Reference 5); the mid 18th century Glebe Farm (Reference 6) and the early 19th century Manor Farm (Reference 99). Sheepwash Grange and Glebe Farmhouse are Grade II listed buildings. All three buildings are built of coursed limestone rubble.

12.4.42 Smaller farm buildings relating to tenant farming include Ramper Farm (Reference 219); the mid 19th century Halfway House (Reference 61) and the late 19th century Canwick Heath Farm (Reference 60). These are not listed buildings.

12.4.43 The Lincolnshire Poacher Public House was also formerly an 18th century farmhouse but was converted in the late 20th century (Reference 7). In contrast to the other farm buildings, this building is constructed of yellow brick with a hipped slate roof. It is a Grade II listed building. The Harvest Moon Public House was also an 18th century farmhouse which has been converted. This building is constructed of limestone rubble with brick dressings and is a Grade II listed building (Reference 11).

12.4.44 A Grade II listed dovecote constructed of limestone rubble with a hipped pantile roof also stands at Hall Farmhouse (Reference 4).

#### *Infrastructure*

12.4.45 Structures relating to the roads and railways have been retained and continue to be utilised within the study area. These features include the railway underpass north of Washingborough Road (Reference 220) and the underpass for the Washingborough Road further to the east (Reference 221). Both are constructed of red and blue engineering bricks. A railway signal box dating to the 19th century also survives on the Great Northern line (Reference 231).

12.4.46 Further to the north of the Proposed Scheme, the Greetwell road bridge carries the Greetwell Road over Greetwell Beck (Reference 218).

12.4.47 The Bracebridge Heath Airfield is located to the north-west of the south end of the Proposed Scheme. The site was established in 1916. The site was not accessible during the walkover but the Environmental Statement produced in 2009 reported that the runways have been removed but buildings surviving on the site include a Hinaidi hangar (c.1920s), two hangers probably dating to the Second World War and two guard huts.[7]

#### *Institutional buildings*

12.4.48 Lincoln Prison was established to the west of the Proposed Scheme, between 1869 and 1872. The remaining buildings which include staff offices, cell blocks and boundary walls are constructed of red brick with stone dressings and slate roofs. The entrance buildings and cell blocks are both listed separately at Grade II.

### *Historic Landscapes*

12.4.49 The Proposed Scheme falls within three different Historic Landscape Character regions as defined by Lincolnshire County Council (2011). These regions include Regional Character Area 2: Northern Cliff, Regional Character Area 7: Southern Cliff and Regional Character Area 9: The Fens. These regions can be further subdivided into character zones. The Historic Landscape Character zones as defined by Lincolnshire County Council within the study area include the city of Lincoln (not assessed in detailed since it is a built up area); the Lincoln satellite settlements within the Northern Cliff; the Witham Fens; the Southern Cliff heath and the Fen Edge settlements within the Southern Cliff.

#### *City of Lincoln (LIN)*

12.4.50 The City of Lincoln is not described by the Historic Landscape Characterisation Project due to its complex urban nature. The older part of the city dominates the skyline of its surrounding hinterland as a result of its location on the limestone

[7] Jacobs 2009 Cultural Heritage Baseline Report

edge. At the very height of the edge is the Cathedral and Castle. The sections of the city which fall within the study area urban in character and consist of post-medieval residential, industrial and institutional buildings. These buildings tend to have been built in the 19th and 20th centuries as the city began to expand. The construction materials vary from red brick to limestone rubble and to later concrete and steel structures. Larger buildings tend to line the main streets whilst rows of terraced housing span from these routes. The main roads are the A15 (a former Roman road), B1190 and B1308.

*The Lincoln Satellite Settlements (NCL1)*

12.4.51 The south western tip of this character zone falls within the study area. The zone is characterised by small nucleated settlements which most likely have origins in the medieval period and have gradually grown to the size of small towns. The closest of these to the Proposed Scheme are North Greetwell and Cherry Willingham. The buildings of these areas tend to be residential and were built in the mid to late 20th century. Some historic buildings remain at the core of the villages and tend to be 18th or 19th century cottages with larger buildings such as churches and public houses. Amongst the nucleated settlements are scattered farmsteads which tend to date from the 18th and 19th centuries and include farmhouses and associated contemporary farm buildings. The rural areas of the character zones tend to comprise flat fields of rectangular shape demonstrating the enclosure of the land in the 18th and 19th centuries.

12.4.52 Prehistoric, Romano-British and Roman features have been found throughout the study area within this character zone. It is likely that the area, therefore, acted as the Roman hinterland to the city of Lincoln with some isolated farmsteads. The agricultural use of the land continued into the Saxon and medieval periods. Some of land is likely to have been held by the local monasteries and would have been sold to local gentry at the time of the dissolution. The land was largely enclosed in the 18th and 19th centuries. Some of these rectangular fields were amalgamated in the 20th century to accommodate increased use of machinery.[8]

*The Witham Fens (FEN1)*

12.4.53 The western end of the Witham Fens character zone falls within the centre of the study area between the two railway lines. This character zone was probably reclaimed during the Roman period and used for salt extraction during this period. Shrinkage of the peat fen due to low water table levels led to some flooding meaning that it probably was not occupied by permanent settlements in the post Roman period. However, Greetwell medieval village stands within this

[8] Lincolnshire County Council 2011 The Historic Character of the County of Lincolnshire. P 12-13.

character area although is located on higher ground. Today it remains as a small isolated farmstead of Greetwell Hall with adjacent church.

12.4.54 The area is largely made up of regular fields as a result of planned enclosure in the 18th and 19th centuries. Some of these fields were amalgamated in the mid 20th century onwards. Many of the surviving farmsteads within this zone are isolated farmsteads.[9]

### *Southern Cliff Heath (SCL1)*

12.4.55 The Southern Cliff Heath character zone covers the majority of the south section of the study area, south of the river. The limestone scarp runs north to south through this zone, dropping gradually to the east. It is truncated by the main A15 road (formerly a Roman road) and smaller roads running east to west. The zone is characterised by nucleated settlements of which Bracebridge Heath and Branston are the closest to the study area. These settlements tend to have a historic core with later 20th century development around the periphery. The landscape is also composed of isolated farmsteads, many of which date from the 18th or 19th century and are constructed of limestone rubble with slate or pantile roofs.

12.4.56 The Roman roads of Ermine Street and Mareham Lane are still largely discernible along modern roads and connected the city with its hinterland and other Roman settlements. A possible Roman villa is located in the northern part of the character zone, south of the river. During the medieval period the zone was characterised by nucleated settlements with open field systems. Some of the lands were held by monasteries and were worked by the monks or by tenant farmers. One such grange is Sheepwash Grange, located south of the river. Like much of the study area, the character zone was subject to planned enclosure in the 18th and 19th centuries resulting in the regular fields which largely remain today. New roads and railways were also developed and truncate the zone from east to west. During the 20th century the south edge of the study area became used for airfields including Bracebridge and RAF Waddington. This in turn led to further development of residential areas on the edges of existing settlements.[10]

### *The Fen Edge Settlements (SCL2)*

12.4.57 A small section of this character zone at its western tip falls within the study area where the land slopes downwards to the east from the limestone ridge. Like the Witham Fens character zone, this area was most likely occupied during the Iron Age and Roman period as the land was reclaimed. During the medieval period there were nucleated settlements, such as Washingborough, with associated

[9] Lincolnshire County Council 2011 The Historic Character of the County of Lincolnshire. P 90-91.

[10] Lincolnshire County Council 2011 The Historic Character of the County of Lincolnshire. P 71-72.

open field systems. The land was then largely enclosed as part of planned enclosure in the 18th and 19th centuries.[11] The section of the character zone within the study area is largely composed of residential housing constructed in the 20th century that has grown up around the periphery of the village of Washingborough.

## 12.5 Predicted Impacts

12.5.1 The predicted impacts on cultural heritage may take place during the construction and operation stages of the scheme. Some of these impacts are temporary and some are permanent/ long term. The impacts on known heritage assets from the Proposed Scheme have been listed in the impacts table in Volume 2 – Supporting Information. These impacts are summarised below.

### *Construction Impacts*

#### *Archaeology*

12.5.2 Short term or temporary impacts on known archaeological assets include visual and noise intrusions from construction. These short term impacts will affect the setting of known assets such as the scheduled Greetwell Medieval Village (Reference 2) and its associated post-medieval landscape setting and the barrow cemeteries (Reference 79 and 88) throughout the construction phase. The short term impacts are expected to be negligible.

12.5.3 Permanent construction impacts on known archaeological assets are those which will lead to their destruction or damage. These impacts are caused by groundbreaking and construction works for the road and associated infrastructure, access roads, catchment ponds, landscaping and working areas/ site compounds. The assets that will be directly affected by permanent construction works are listed in Volume 2 – Supporting Information. The unmitigated impacts on these assets range from minor to major. The majority of these pre-mitigation impacts are predicted to be of minor magnitude, however major adverse impacts are predicted at 19 sites (see Volume 2 – Supporting Information, Table of Impacts).

12.5.4 Given the frequency and extent of known archaeological remains identified through previous evaluation along the whole of the scheme, it is likely that the construction works will also impact on unknown buried remains. This is most likely to the north and south of the river where evidence of prehistoric, Roman, Saxon and medieval activity have been discovered. Known assets may also extend beyond the areas defined by previous survey and this will only be

[11] Lincolnshire County Council 2011 The Historic Character of the County of Lincolnshire. P 73-74.

determined by intrusive investigation. The peat deposits within the study area are also of geoarchaeological and palaeoarchaeological value.

### *Built heritage*

12.5.5 There are a number of built heritage assets which lie within the study area but which are at some distance and are well screened from the Proposed Scheme by later development. These assets include Reference 1, 4, 7, 8, 9, 10 and 11 and have, therefore, not been discussed below.

12.5.6 During construction of the Proposed Scheme there will be temporary noise and visual impacts on the setting of surrounding built heritage assets. Each of the assets affected are tabled in Volume 2 – Supporting Information. The construction works will be visible from the south side of All Saints Church (Reference 15) and is expected to have a moderate impact upon its setting. The works will also be visible from Sheepwash Grange (Reference 5); Manor Farm, farm buildings and gates and walls (Reference 12, 14 and 99); Monument to Thomas Winn (Reference 17); Monument To Thomas Straw (Reference 20); Canwick Heath Farm (Reference 60); Halfway House (Reference 61) and Foreman's House and Workers' Cottages (Reference 92). These impacts are expected to last for the duration of the construction works and are expected to be minor. The construction works will also be visible on the approach to Greetwell Lodge (Reference 16); Stable Block at Greetwell Hall (Reference 19); Greetwell Hall (Reference 18); Ashfield House (Reference 21); Glebe Farmhouse (Reference 6); Branston Heath Farmhouse (Reference 13) and Bracebridge Heath Airfield (Reference 98) and this impact has been assessed as minor to negligible.

12.5.7 As the construction works progress, new infrastructure will disturb the rural setting of these buildings, creating an increasingly urban context which will remain a permanent feature. Lighting at night will also mean the new scheme disturbs the rural setting of these buildings. The understanding of the sites, however, will remain unchanged. The long term impacts upon the Church of All Saints is expected to be moderate whilst on the other assets listed above, it is expected to be minor to negligible.

12.5.8 Construction works will also be visible from the crossing and south elevation of Lincoln Cathedral (Reference 222) and from the curtain walls and Observatory Tower of Lincoln Castle (Reference 223). These are protected views under Policy 55 of the City of Lincoln Local Plan and include views from the buildings to the wider hinterland. The construction works (ie movement of vehicles, construction activity and lighting) will be temporary and will not extend beyond the construction period. As the Proposed Scheme develops, however, more permanent infrastructure will be introduced into these views including the bridges over the railway and river and will create new urban elements into a largely rural

setting. The new infrastructure will not, however, prohibit the setting of the cathedral and its relationship with other features in the wider landscape (ie All Saints Church) from being understood. The magnitude of impact has been assessed as minor.

12.5.9 Visual impacts from the construction works and new infrastructure elements will be limited from the upper terrace of the Bishop's Palace. Again new infrastructure elements will introduce largely urban elements into a rural setting. This impact has been assessed as minor.

12.5.10 Within the Cathedral and City Conservation Area (Reference 225) and the Lindum and Arboretum Conservation Area the setting is largely contained within the built environment of the Conservation Area itself. Some taller buildings have views of the wider city and countryside beyond and the construction works and new infrastructure is likely to feature within those view. However, its presence will not severely damage the setting or views from the Conservation Area and the wider landscape and context of the Conservation Area will be visible and easily read. The impact upon the Conservation Area has been assessed as minor.

12.5.11 The construction of the scheme will involve the demolition and removal of the railway underpass (Reference 220) which will be a major impact.

*Historic Landscapes*

12.5.12 Short term or temporary impacts from the construction works include disturbance of the landscape character through vehicle movements, site compounds and access tracks, topsoil stripping, site lighting and creation of new landscaping and infrastructure elements. There will also be increased noise impacts into a largely quiet environment. This will affect HLC zones city of Lincoln (not assessed in detailed since it is a built up area); the Lincoln satellite settlements within the Northern Cliff; the Witham Fens; the Southern Cliff heath and the Fen Edge settlements within the Southern Cliff. The short term impacts upon these zones are expected to be moderate.

12.5.13 The Proposed Scheme will result in the presence of new built environment elements into a largely rural landscape. There will also be partial damage to 18$^{th}$ century field boundaries as these are truncated to allow the new road scheme to pass through. The long term construction impacts are expected to impact HLC zones city of Lincoln (not assessed in detailed since it is a built up area); the Lincoln satellite settlements within the Northern Cliff; the Witham Fens; the Southern Cliff heath and the Fen Edge settlements within the Southern Cliff. The long term impacts upon these zones are expected to be moderate.

### *Operational Impacts*

#### *Archaeology*

12.5.14 Long term impacts once the scheme is fully operational largely relate to the setting of heritage assets. Buried remains within the footprint of the scheme and its working areas will have been removed during the construction phase. The assets likely to be impacted by the long term operational impacts, therefore, include the scheduled Greetwell Medieval Village (Reference 2) and the two barrow cemeteries (Reference 79 and 88). These long term impacts include increased road noise and a new visual component within the setting of the assets deriving from new infrastructure. This visual intrusion will also be present at night with the presence of street lighting. This unmitigated impact has been assessed as minor to moderate.

12.5.15 The relationship of Greetwell Medieval Village (Reference 2) with the city of Lincoln and the Cathedral will be obscured by the presence of the new road. However, the Medieval Village is already well bounded by planting, meaning the visual relationship between the two is already limited. The road will create a physical barrier between the Medieval Village and the city but this will not prevent the landscape and setting of the Medieval Village from being understood. Later residential development and industrial buildings to the east side of the city already hinder this relationship to a certain extent. The impact on the setting of the Medieval Village has been assessed as minor.

12.5.16 The road will truncate the barrow cemeteries causing disturbance to their setting through the introduction of new infrastructure. The barrow cemeteries are already separated by field boundaries and ditches and this, combined with limited visual evidence and poor preservation of the barrows, already disturbs the group as a whole. The magnitude of impact has been assessed as moderate.

#### *Built heritage*

12.5.17 Once fully operational, the Proposed Scheme is expected to have an impact on the setting of a number of built heritage assets. The Proposed Scheme will be seen from the south of All Saints Church both during the day as new infrastructure elements and at night as the road is lit. This will introduce new elements into a largely rural setting. The relationship of the church will the Medieval Village (Reference 2) and Greetwell Hall (Reference 18) will remain unchanged but the relationship between these buildings and the city and Cathedral will be obscured, although the landscape setting and relationship between the two will still be discernible. The impact upon All Saints Church prior to mitigation is expected to be moderate.

12.5.18 The completed scheme will also be visible from Sheepwash Grange (Reference 5) Manor Farm, farm buildings and gates and walls (Reference 12, 14 and 99);

Monument to Thomas Winn (Reference 17); Monument To Thomas Straw (Reference 20); Canwick Heath Farm (Reference 60); Halfway House (Reference 61) and Foreman's House and Workers' Cottages (Reference 92). Again the impacts will relate to increased road noise and visual impacts from new infrastructure elements into a largely rural setting. The setting of these assets and their relationship with the wider landscape will, however, still be discernible. The impact is, therefore, expected to be minor. The completed scheme will also be visible on the approach to Greetwell Lodge (Reference 16); Stable Block at Greetwell Hall (Reference 19); Greetwell Hall (Reference 18); Ashfield House (Reference 21); Glebe Farmhouse (Reference 6); Branston Heath Farmhouse (Reference 13) and Bracebridge Heath Airfield (Reference 98) and will again introduce urban infrastructure elements into a rural setting. This impact has been assessed as minor.

12.5.19 The completed scheme will be visible from the crossing tower and south elevation of Lincoln Cathedral (Reference 222) and from the curtain walls and Observatory Tower of Lincoln Castle (Reference 223). These are protected views under Policy 55 of the City of Lincoln Local Plan and include views from the buildings to the wider hinterland. New infrastructure elements will be introduced into these views including the bridges over the railway and river and will create new urban elements into a largely rural setting. The new infrastructure will not, however, prohibit the setting of the cathedral and its relationship with other features in the wider landscape (ie All Saints Church) from being understood. The magnitude of impact has been assessed as minor.

12.5.20 Visual impacts from the completed scheme and new infrastructure elements will be limited from the upper terrace of the Bishop's Palace. Again new infrastructure elements will introduce largely urban elements into a rural setting. This impact has been assessed as minor.

12.5.21 Within the Cathedral and City Conservation Area (Reference 225) and the Lindum and Arboretum Conservation Area the setting is largely contained within the built environment of the Conservation Area itself. Some taller buildings have views of the wider city and countryside beyond and the completed scheme is likely to feature within those views. However, its presence will not severely damage the setting or views from the Conservation Area or individual buildings contained within the conservation area and the wider landscape and context of the Conservation Area will be visible and easily read. The impact upon the Conservation Area has been assessed as minor.

12.5.22 The reduction of traffic into the city as a result of the completed scheme will have a beneficial impact upon the Conservation Areas and wider built heritage assets of the city.

### *Historic Landscapes*

12.5.23 Once fully operational, the Proposed Scheme will impact the historic landscape through long term impacts. These include the introduction of infrastructure elements into a predominantly rural setting. This will have not only visual impacts but increased noise impacts. Lighting the carriageway at night will also ensure that the road scheme impacts the rural landscape. The impact upon the historic landscape character zones is expected to be moderate.

12.5.24 The road will also obstruct the relationship of the wider Lincoln City character zone with its rural hinterland. This will not, however, prevent future understanding of the landscape.

## 12.6 Proposed Mitigation

### *Archaeology*

12.6.1 The Proposed Scheme has the potential to damage or destroy known and unknown archaeological remains during construction. The preferred mitigation measure will be to avoid all assets and to preserve the archaeology in situ. Where this is not possible, the assets are to be investigated and recorded allowing for preservation by record. Specific mitigation measures have been identified for each of the known assets to be affected and these are detailed in Volume 2 – Supporting Information

12.6.2 Due to the amount of evaluation work completed to date, some of the assets have been sufficiently recorded. Where there are remains above ground such as the barrow cemeteries (Reference 79 and 88), it is proposed that a programme of topographic survey is undertaken which records each of the barrows but also the land between them where other features may exist.

12.6.3 For remains that are of low value, a programme of stripping the topsoil and recording/ mapping the features and sampling has been proposed. Where there are more complex or higher value remains, a programme of full and detailed excavation has been proposed. This is particularly relevant where important assets are to be affected through construction (ie barrows at Reference 79 and 88).

12.6.4 Where features are of low value and in areas where there is a possibility for associated remains but the risk is low, targeted archaeological monitoring should be undertaken to monitor all ground breaking works including the removal of topsoil. This will involve an archaeologist being able to determine the machinery used (i.e. stripping using toothless buckets or similar) to best reveal the archaeology and works are expected to stop to enable recording or further investigation of features. Where significant remains are encountered these will

need to be discussed with the Lincolnshire Historic Environment Manager to determine further mitigation if required. Archaeological monitoring should also be maintained on the area between Wragby Road and Heighington Road and the areas adjacent to Sleaford Road and Bloxholm Lane.

12.6.5 Archaeological monitoring will be undertaken on all other areas of the ground breaking works. This will not allow the archaeologist to control the machinery but works are still expected to stop to allow for recording and any significant discoveries will need to be reported and discussed with the Lincolnshire Historic Environment Manager.

12.6.6 All works will be detailed in a Written Scheme of Investigation (WSI) and will be agreed with the Lincolnshire Historic Environment Manager prior to the commencement of works.

12.6.7 Features that are not to be directly affected by the construction works but that may fall within working areas should be adequately protected. This will include temporary protective surfaces over features where vehicles and compounds are likely to be located and protective fencing around monuments (ie barrows at Reference 79 and 88).

12.6.8 It should be noted that access roads and site compounds have not yet been confirmed and may require additional mitigation. Buried remains may be protected in these areas using a protective membrane and layer of stone. This would reduce the amount of damage or destruction to the remains.

12.6.9 Mitigation against long term operational impacts on Greetwell Medieval Village (Reference 2) will take the form of landscape planting to soften the appearance of the new scheme. Details of the landscaping mitigation are detailed in Chapter 9.

12.6.10 The long term impacts on the barrow cemeteries (Reference 79 and 88) cannot be completely mitigated. It is proposed that a detailed photographic and topographic survey of the cemeteries and their setting is undertaken to help preserve the sites by record.

12.6.11 In order to remove part of the Important Hedgerows (Reference 204 and 205) an Important Hedgerow Notice will served alongside the planning application (this issue is also addressed in Chapter 13.

### *Built Heritage*

12.6.12 Landscape planting along the road embankments to the north of the river will help to soften the appearance of the Proposed Scheme and will help it integrate into the rural setting of and long distance views both to and from the built heritage assets. Details on the proposed mitigation can be found in Chapter 9

12.6.13 Directional lighting at night will help to limit the visual impact on the setting of built heritage assets at night.

12.6.14 It is proposed that an English Heritage level 2 Historic Building Record is created of the railway underpass and its immediate setting (Reference 220) prior to the commencement of construction works. This will include a written record, photographic record and measured plan. The survey will be detailed in a Written Scheme of Investigation (WSI) which will be approved by the Lincolnshire Historic Environment Manager prior to the survey being undertaken.

#### *Historic Landscapes*

12.6.15 It is proposed that an English Heritage level 1 photographic survey of the landscape is prepared prior to the commencement of construction works. This will involve a general photographic record of the site and mapping of any landscape features (i.e. field boundaries).

12.6.16 Landscaping and planting as described in Chapter 9 will soften the appearance of the new scheme within its wider landscape setting.

## 12.7 Conclusions and Effects

12.7.1 A number of known archaeological assets have been identified within the Proposed Scheme boundary and will be damaged or destroyed as part of the construction works. The proposed mitigation includes detailed excavation, Strip, Map and Sample and archaeological monitoring. This will be carried out prior to or during the construction programme and will be secured by a planning condition.

12.7.2 The railway underpass will be removed as part of the scheme construction. It is proposed that a programme of building recording is undertaken on this monument prior to the commencement of construction works.

12.7.3 The Proposed Scheme is expected to impact upon the setting of a number of archaeological and built heritage assets as well as the historic landscape itself. It is recommended that a level 1 landscape survey will be undertaken of the landscape and its setting prior to the commencement of construction works.

12.7.4 The appearance of the road scheme will be softened to a certain extent in order to reduce the impact on long distance views and the setting of cultural heritage assets. This is further detailed in Chapter 9.

#### *Archaeology*

12.7.5 Following implementation of the mitigation outlined above, the impact on buried remains will still ultimately lead to their damage or destruction through intrusive

archaeological evaluation. Preservation by record goes some way to mitigating this loss but the residual effects remain minor to moderate depending on the value of the site. The significance of effects upon buried remains is therefore neutral to slight. The unmitigated and mitigated impacts and the significance of effects for each asset can be seen in Volume 2 – Supporting Information

12.7.6 Where the value of an asset is unknown due to lack of information about the asset, the significance of effects have also been assessed as unknown.

12.7.7 The landscape planting intended to soften the appearance of the road will not significantly change the impact rating on Greetwell Medieval Village (Reference 2) since the impact on the setting of the monument remains. The impact rating on the setting will, therefore, be minor and the significance of effects will be slight.

12.7.8 The survey of the barrow cemeteries will also not completely mitigate against the impact on these monuments therefore the impact rating following mitigation will be minor with a significance of effects rating of slight.

### *Built Heritage*

12.7.9 Following implementation of the mitigation, the impact on the setting of All Saints Church (Reference 15) is expected to be minor given that the relationship between the city and the cathedral and its wider post-medieval landscape will be obscured. Despite landscape planting, the road scheme will still remain visible within the setting of built heritage assets and will change an existing rural context. The impact upon Sheepwash Grange (Reference 5); Manor Farm, farm buildings and gates and walls (Reference 12, 14 and 99); Monument to Thomas Winn (Reference 17); Monument To Thomas Straw (Reference 20); Canwick Heath Farm (Reference 60); Halfway House (Reference 61) and Foreman's House and Workers' Cottages (Reference 92) will, therefore, be minor to negligible with a significance of effect of slight to neutral.

12.7.10 The completed scheme will still also be visible on the approach to Greetwell Lodge (Reference 16); Stable Block at Greetwell Hall (Reference 19); Greetwell Hall (Reference 18); Ashfield House (Reference 21); Glebe Farmhouse (Reference 6); Branston Heath Farmhouse (Reference 13) and Bracebridge Heath Airfield (Reference 98) and will again introduce infrastructure elements into a rural setting. This impact has been assessed as minor to negligible with a significance of effect of slight to neutral.

12.7.11 Again, the completed scheme will still remain visible in long distance views to and from the Cathedral (Reference 222); Lincoln Castle (Reference 223); and the Bishop's Palace (Reference 224). It will also introduce new and permanent infrastructure into an existing rural landscape. This impact has, therefore, been assessed as minor following mitigation.

### *Historic Landscapes*

12.7.12 Whilst the landscape survey aims to mitigate the impact on the historic landscape, the Proposed Scheme will still have an adverse effect. Landscape planting will go some way to reducing the visual impacts on the wider setting but will not be able totally screen this. The impact following mitigation is, therefore, moderate.

# 13 Nature Conservation

## 13.1 Scope of the Assessment

13.1.1 This section summarises the findings of the ecological assessment undertaken for the Proposed Scheme. It describes recommended mitigation measures and the potential for residual effects to occur upon biodiversity resources. The ecological assessment has been informed by desk studies and field surveys which identified designated wildlife sites and other habitats, and species that are protected by law or otherwise of particular nature conservation importance.

13.1.2 Field surveys focussed on the semi-natural habitats within the Proposed Scheme boundary, but also considered adjacent habitats where appropriate (e.g. ponds and water courses located off-site but within the study area).

13.1.3 The assessment of effects was based on the design provided in September 2012. At the time of assessment full details of the final construction methodology were not available

13.1.4 The study areas adopted are as follows:

- Statutory designated sites- 2km corridor;
- All other designated sites-1km; and
- Water bodies-250m.

13.1.5 The following receptors were scoped into the assessment:

- Statutory and non-statutory designated sites.
- Habitats (Phase 1 classification): Scrub, scattered mature broad-leaved trees, species-poor hedgerows, amenity grassland, semi-improved grassland, tall-ruderal vegetation, running and open water.
- Mammals: badger, bats, water vole, otters.
- Herpetofauna: Common reptiles.
- Birds: Breeding bird community, kingfisher, barn owl.

## 13.2 Statutory and Planning Context

13.2.1 Legislation and planning policy relevant to the Proposed Scheme has been identified following determination of ecological receptors by means of a desk study (see Volume 3 – Technical Appendices – Phase 1 Habitat Survey).

### *European Directives*

13.2.2 The following European legislation is relevant to the Proposed Scheme.

- Water Framework Directive 2000.
- EC Habitats Directive (Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora).
- EC Birds Directive (Council Directive 2009/147/EC 2009 on the conservation of wild birds).
- Bern Convention on the conservation of European wildlife and natural habitats (1979).
- Bonn Convention on the conservation of migratory species of wild animals (1979).
- Convention on biological diversity (1992).

### *National Legislation*

13.2.3 The following UK legislation is likely to be relevant to the Proposed Scheme. This is discussed in more detail in Volume 2 – Supporting Information.

- The Conservation of Habitats and Species Regulations 2010.
- Wildlife and Countryside Act 1981 (as amended).
- National Parks and Access to Countryside Act 1949 (as amended).
- Protection of Badgers Act 1992.
- Wild Mammals (Protection) Act 1996.
- Hedgerow Regulations 1997
- Natural Environment and Rural Communities (NERC) Act 2006.
- Countryside and Rights of Way (CROW) Act 2000.
- Water Resources Act 1991.
- Weeds Act 1959.
- Environmental Protection Act 1990.
- Environment Act 1995

### *National and Regional Policy*

13.2.4 National and regional policy is implemented by The National Planning Policy Framework 2012 and The East Midlands Regional Plan 2009[12]. This is summarised in Volume 2 – Supporting Information (Summary of National and Regional Planning Policy).

- [12] The East Midlands Regional Plan (2009). Government Office for the East Midlands.

### *Local Policy*

13.2.5 In a planning context, the study area spans the boundaries of North Kesteven District Council, City of Lincoln Council and West Lindsey District Council and is covered their corresponding local plans. The plans contain relevant policies that are applicable to biodiversity and conservation. The policies are summarised in Volume 2 – Supporting Information (Summary of Local Planning Policies)

### *National and Local Biodiversity Action Plans*

13.2.6 Many species are included on lists of UK BAP priority species and habitats. Government agencies and local authorities are obliged to have regard to these as features of principal conservation importance in exercising their functions (Section 74 CROW Act, 2000, Section 40 NERC Act, 2006). They are also obliged to implement measures to further the conservation interest of such species and to restore or enhance their populations or habitats.

13.2.7 The third edition of the Lincolnshire Biodiversity Action Plan (2011-2020) includes 41 action plans: These are summarised in Volume 2 – Supporting Information (Lincolnshire Biodiversity Action Plans).

## 13.3 Method of Assessment

13.3.1 A desk study and ecological surveys were undertaken in accordance with the framework outlined in DMRB Volume 11, Section 2, Part 2 Ecology and Nature Conservation and IAN 130/10. Assessment of effects followed the method recommended within the Institute of Ecological and Environmental Management's (IEEM) Ecological Impact Assessment (EcIA) guidance[13].

13.3.2 DMRB Volume 11, Section 2, Part 5, HA205/08 states that "the significance of the effect is formulated as a function of the receptor or resource environmental values (or sensitivity) and the magnitude of project impact (change)". This assessment is made by :

- Assigning a Nature Conservation Value (Sensitivity).
- Assigning a magnitude of impact (Change).
- Assigning a significance level (Impact).

13.3.3 The habitats and species present were attributed a value of likely importance according to a geographical scale based on information from the Extended Phase 1 Habitat Survey and specialist species survey reports provided in Volume 3 – Technical Appendices.

13 The Institute of Ecology and Environmental Management (IEEM) (2006). Guidelines for Ecological Impact Assessment, IEEM.

13.3.4 A description of potentially valuable ecological features identified through desk study and field surveys is presented in this chapter. Descriptions of individual sites of nature conservation value are provided in Phase 1 Habitat Survey (Volume 3- Technical Appendices).

### *Desk Study*

13.3.5 Ecological data for the study area was collected from the sources listed in Table 13-1.

*Table 13-1 Sources of Data*

| Data Source | Description | Limitations |
|---|---|---|
| Multi-agency geographic information centre - magic.defra.gov.uk | Online data source providing the locations and extents of statutory designated sites and habitats listed on national inventories (e.g. ancient woodlands) within the UK. | Provides data on statutory sites only, does not cover non-statutory sites. |
| Ordnance survey 1:25,000 scale maps | Provide locations of ponds and other distinctive habitat features (e.g. woodlands). | Provides no details about the potential ecological value of specific features |
| Lincolnshire Environmental Records centre. | Historical data from ecological surveys of the local area. | Data can be patchy with some areas not covered and out of date |
| Environmental Statement produced in 2009 | Provides baseline data accurate up to October 2009. | Data out of date |

## 13.4 Existing Environment

13.4.1 Biological records obtained during the desk study are summarised in Table 13-2 Ecological Species Data

*Table 13-2 Ecological Species Data*

| Species | Most Recent Record | Number of Records |
|---|---|---|
| Common lizard, *Zootoca vivipara* | 1981 | 3 |
| Grass snake, *Natrix natrix* | 2009 | 18 |
| Slow worm, *Anguis fragilis* | 1977 | 2 |
| Common toad, *Bufo bufo* | 2009 | 15 |
| Great crested newt, *Triturus cristatus* | 2001 | 7 |
| Badger, *Meles meles* | 2011 | 3 |
| Brown hare, *Lepus europaeus* | 2012 | 47 |
| Brown long-eared bat, *Plecotus auritus* | 2009 | 9 |
| Common pipistrelle, *Pipistrellus pipistrellus* | 2005 | 23 |
| Harvest mouse, *Micromys minutus* | 1977 | 2 |
| Hedgehog, *Erinaceus europeaus* | 2011 | 38 |
| Otter, *Lutra lutra* | 2002 | 3 |
| Soprano pipistrelle, *Pipistrellus pygmaeus* | 2005 | 2 |
| Water vole, *Arvicola terrestris* | 2009 | 17 |

| Species | Most Recent Record | Number of Records |
|---|---|---|
| Barn owl, *Tyto alba* | 2009 | 3 |
| Bullfinch, *Pyrrhula pyrrhula* | 2006 | 5 |
| Cuckoo, *Cuculus canorus* | 2009 | 5 |
| Fieldfare, *Turdus pilaris* | 2009 | 6 |
| Grey partridge, *Perdix perdix* | 2009 | 5 |
| Hedge accentor / Dunnock, *Prunella modularis* | 2008 | 26 |
| Herring gull, *Larus argentatus* | 2001 | 3 |
| House sparrow, *Passer domesticus* | 2009 | 12 |
| Kingfisher, *Alcedo atthis* | 2009 | 13 |
| Lapwing, *Vanellus vanellus* | 2009 | 12 |
| Linnet, *Carduelis cannabina* | 2008 | 7 |
| Reed bunting, *Emberiza schoeniclus* | 2007 | 10 |
| Redwing, *Turdus iliacus* | 2004 | 5 |
| Skylark, *Alauda arvensis* | 2009 | 9 |
| Song thrush, *Turdus philomelos* | 2009 | 8 |
| Spotted flycatcher, *Muscicapa striata* | 1977 | 1 |
| Starling, *Sturnus vulgaris* | 2009 | 23 |
| Tree pipit, *Anthus trivialis* | 2001 | 1 |
| Tree sparrow, *Passer montanus* | 2008 | 3 |
| Turtle dove, *Streptopelia turtur* | 2001 | 2 |
| Willow tit, *Poecile montanus* | 2003 | 1 |
| Yellowhammer, *Emberiza citrinella* | 2009 | 11 |

### *Survey of Habitats*

13.4.2 An extended Phase 1 Habitat Survey was conducted for the whole route in line with the JNCC methodology[14]. The results of this survey and the desk-based study were used to define the scope of additional surveys that were required.

13.4.3 The findings of the Phase 1 Habitat Survey are reported in Phase 1 Habitat Survey Report (Volume 3 – Technical Appendices).

### *Protected Species Surveys*

13.4.4 Desk studies and habitat surveys informed the scope of field surveys for protected species which may be present within the Proposed Scheme area. Surveys undertaken and methods used are outlined in

[14] Joint Nature Conservancy Council (JNCC) (2003). Handbook for Phase 1 Habitat Survey - A Technique for Environmental Audit, Peterborough, UK.

Table 13-3 below.

*Table 13-3 Surveys*

| Species | Date | Surveys Completed |
|---|---|---|
| Phase 1 Habitat Survey | July 2012 | A desk study and Phase 1 habitat survey were undertaken in order to assess the value of habitats present within the survey area and the likelihood of the area to support protected species. |
| Bats (various species) | 2012 | Surveys of the River Witham and adjacent watercourses, Greetwell Hollow Quarry and trees using bat detectors to determine the usage of these features by bats. |
| Badger | 2012 | Survey of suitable habitat within and adjacent to the scheme for signs of badger use or activity. |
| Kingfisher | July 2012 | Survey of a 500m corridor with the new route alignment of the bypass to the centre. |
| Barn Owl | July- 2012 | Appraisal of the use of the site by barn owl |
| Otter | July-August 2012 | Survey of a 500m corridor with the new route alignment of the bypass to the centre. |
| Water Vole | July-August 2012 | Survey of a 500m corridor with the new route alignment of the bypass to the centre. |
| Hedgerow | September 2012 | Walkover survey of woody species within a 50m section. |

13.4.5 The detailed methodologies and findings of the above surveys are reported in Volume 3 – Technical Appendices: Phase 1 Habitat Survey; Bat Survey Report; Kingfisher Report; Water Vole and Otter Report, and Hedgerow Report.

## 13.5 Study Area and Baseline Environment

13.5.1 This section summarises the ecological resources within the Proposed Scheme study area and provides an evaluation of biodiversity receptors. The reports identified in section 13.4.5 should be consulted for full baseline conditions.

### *Statutory Designated Sites*

13.5.2 There is one statutory designated site that the Proposed Scheme will cross through. Greetwell Hollow Quarry Site of Special Scientific Interest (SSSI) is a 58.2 ha site designated for its geological features and is considered of national importance for its exposures of Lincolnshire Limestone. The quarry is no longer active as the last works were undertaken at the site in 2003. It appears to be used as an informal recreation area. There are areas of dense scrub and rough grassland that surround a pond at the base of the quarry. Sections of the quarry face are exposed, with cracks and crevices on several of the faces.

13.5.3 Swanholme Lakes Local Nature Reserve (LNR), a 57.5 ha site, comprising flooded sand and gravel pits, sandy heath, willow carr and sphagnum bog and lies approximately 3.6km to the west. The site is designated as an important area

for amphibians, reptiles, dragonflies, grasshoppers and crickets, bumblebees and solitary wasps.

13.5.4 These sites are legally protected under the Wildlife and Countryside Act 1981 (as amended) and the Natural Environment and Rural Communities Act Designated (NERC) Act 2006 and have been assessed as of National value.

### *Non -Statutory Designated Sites*

13.5.5 The following non-statutory sites are present in the study area:

- Greetwell Wood Site of Nature Conservation Interest (SNCI), comprising mature broad-leaved woodland;
- Canwick Hall Wood SNCI, a former quarry with plantation woodland, improved grassland and arable habitats;
- Washingborough Junction SNCI; a site adjacent to the River Witham and South Delph with tussocky vegetation, seasonally wet or damp areas, deep ditches and species rich hedgerows;
- Bloxholm Lane Local Wildlife Site (LWS); a calcareous grassland verge;
- Canwick Park Golf Course LWS, a golf course with parkland and semi-improved grassland;
- Cliff Farm Footpaths LWS. the verges of a footpath or farm track which runs east-west between the B1188, just south of Ashfield Cottage Farm (TF007681) to Washingborough Top Farm, then on through Cliff Farm (TF018689) and east to Branston Road (length 1.5 km), There is also a short stretch of path edged by a stream which runs from Cliff Farm south to TF019683);
- Cow Paddle Railway Embankment East LWS. This land comprises: 750 m of disused railway embankment; a flat triangular area to the north-west; and a strip of wetland to the south-east ;
- Fox Covert, Cherry Willingham LWS.Ash dominated woodland with an understorey of hawthorn and elder;
- Greetwell Junction Railway Embankment LWS, a 1.4 ha site characterised by sparse vegetation and scattered scrub.
- Witham Corridor Local Wildlife Site (LWS); comprising the River Witham and adjacent watercourses. Characterised by running water, neutral grassland, dense and scattered scrub, acid grassland and ruderal communities; and
- Willingham Fen LWS. An area of neutral grassland and wetland. This expanse of floodplain is bounded to the north by an embanked railway line, to the south by the River Witham and the North Delph, to the west by industrial land, and to the east by arable fields;
- Canwick Hall Wood SNCI, a former quarry with plantation woodland, improved grassland and arable habitats;

- Witham Corridor Local Wildlife Site (LWS); comprising the River Witham and adjacent watercourses. Characterised by running water, neutral grassland, dense and scattered scrub, acid grassland and ruderal communities;
- Washingborough Junction SNCI; a site adjacent to the River Witham and South Delph with tussocky vegetation, seasonally wet or damp areas, deep ditches and species rich hedgerows; and
- Greetwell Junction Railway Embankment LWS, a 1.4 ha site characterised by sparse vegetation and scattered scrub.

13.5.6 These sites are not afforded any legal protection, however, policies in Regional and Local Plans relate directly to the protection of locally designated sites. These sites have been assessed as of County value.

### *Habitats*

13.5.7 The following habitat types were recorded within the study area:

- Improved grassland;
- Species-rich, semi-improved grassland;
- Marshy acid grassland;
- Amenity grassland;
- Broadleaved woodland;
- Broadleaved plantation;
- Mixed plantation;
- Dense scrub;
- Species-rich hedgerows;
- Species-poor hedgerows;
- Standing water;
- Running water;
- Arable and
- Bare ground, hard standing and travel infrastructure including rail lines, underpasses and bridges.

13.5.8 Each habitat type is summarised in the Phase 1 Habitat Survey Report (Volume 3 – Technical Appendices).

13.5.9 The majority of habitat within the zone of influence of the Proposed Scheme (approximately within 250m of the route) consists of arable land. Other open habitats include improved and semi-improved neutral grassland, which is mostly restricted to land directly to the north and south of the River Witham. Several small patches of marshy grassland also occur within close proximity of the river and adjacent drains.

13.5.10 There are several small patches of broad-leaved semi-natural woodland within the survey area including one area within the footprint of the Proposed Scheme, Greetwell Wood located between the railway line and the River Witham. The presence of pheasant pens, game feeders and mammal traps indicates that Greetwell Wood is used for extensive game rearing.

13.5.11 Thin lines of dense continuous scrub are present along the railway embankment and between the River Witham and South Delph, both of which are bisected by the proposed route.

13.5.12 Hedgerows are present throughout the survey area, many of which are bisected by the Proposed Scheme. The majority of hedgerows are species-poor, mostly consisting of hawthorn *Crataegus monogyna,* but several hedgerows to the north of the Proposed Scheme are more diverse and appear to have had gaps recently planted-up with other native species including hazel *Corylus avellana,* spindle *Euonymus europaeus*, field maple *Acer campestre* and dogwood *Cornus sanguinea.*

13.5.13 Aquatic habitats include ten ponds located within 250m of the Proposed Scheme, the River Witham, South Delph, North Delph and Longstongs Delph, and ten small un-named streams and ditches. Aquatic habitats are of low ecological value.

13.5.14 The River Witham, South Delph and North Delph are a LWS and of ecological interest because of their vegetation, the presence of breeding kingfisher and the possible presence of water voles. These watercourses are also used by commuting and feeding bats.

13.5.15 The most notable area of bare ground is Greetwell Hollow Quarry, designated for its geological interest. Extensive areas of exposed quarry face contain cracks and crevices suitable for use as bat roosts and ledges suitable for use by breeding birds. The quarry floor contains areas of rough grassland and a pond.

13.5.16 Other areas of bare ground and hard standing include the access roads and infrastructure associated with the railway lines such as underpasses and bridges.

### *Protected Species and Habitats*

13.5.17 A summary of the legal protection afforded to ecological receptors within the study area is provided in Volume 2 – Supporting Information.

### *Bats*

13.5.18 The findings of the bat surveys are provided in Volume 3 – Technical Appendices.

13.5.19 The surveys determined that the area through which the scheme passes is used by foraging and commuting bats, and that levels of bat activity observed were typical for these habitat types. Habitat linkages of particular value to bats include the corridor of the River Witham and associated watercourses.

13.5.20 Surveys undertaken in 2010 have shown that Greetwell Quarry does not support roosting bats in summer. Behaviour typical of swarming was shown by two pipistrelle bats indicating that bats may roost in crevices within exposed cliff faces at the quarry in winter, although evidence of roosting was not found during surveys. It is concluded that if pipistrelles do roost at the quarry, they are likely to be present in low numbers.

13.5.21 Cracks and crevices in the quarry face, the entire eastern, south eastern and north eastern faces of Greetwell Hollow Quarry that may to support small numbers of roosting pipistrelles during winter have been assessed as of district level conservation value for bats.

### *Badgers*

13.5.22 The findings of the badger surveys can be found in the Phase 1 Habitat Report- (Volume 3 – Technical Appendices). Surveys have identified that there are badgers within the survey area.

13.5.23 At the time of the surveys there was one main badger sett in use, one unused badger sett and one outlier sett. Badger digging, footprints and badger paths were observed within the study area.

13.5.24 Badgers are relatively abundant locally and nationally and have been assessed as having local conservation value.

### *Water Vole and Otter*

13.5.25 The findings of the otter and water vole survey can be found in Volume 3 – Technical Appendices. The Lincolnshire Environmental Records Centre returned records of water vole from the River Witham Corridor, east of Lincoln city centre near Washingborough and from the Greetwell Hollow Quarry area. Previous surveys[15] ,had found signs of water vole activity including feeding signs, latrines and burrows at the River Witham, North Delph, South Delph and Canwick Fen Drain. No signs of mink have been recorded.

13.5.26 Although highly modified, the River Witham, North Delph and South Delph, provide suitable habitat for water voles and otter. They vary in size from large rivers with boat traffic to large field drains but possess bank structures suitable

[15] Jacobs (2009). Lincoln Eastern Bypass Environmental Statement. Lincolnshire County Council.

for burrowing by water voles, marginal vegetation providing cover and a food source and connectivity with adjacent habitats facilitating passage of otters along the river corridor.

13.5.27 The field drains to the south of the South Delph were considered to have moderate to high potential to support water voles as they contain water and have suitable marginal vegetation and bank side structures.

13.5.28 The field drain that runs parallel with and to the north of the B1188 Lincoln Road has moderate to high potential to support water vole as it contains water and has suitable vegetation and bank side structure.

13.5.29 A single otter record was found within 1 km of the Proposed Scheme and reported after 2002, although studies in 2008 (Jacobs, 2009) did not record any evidence of otter within watercourses within the study area. No otter field signs were found during the habitat suitability survey, although suitable otter feeding habitat exists along watercourses throughout the study area, particularly along the River Witham corridor and associated Delphs and drains.

13.5.30 Because of the presence of habitat suitable to support otters along several watercourses it is concluded that otters are likely to be present within the study area. However, no breeding sites have been identified in the vicinity of the proposals.

13.5.31 The River Witham and adjacent watercourses form a key corridor for these species and the River Witham corridor is likely to be the principal feature water voles use for dispersal. This river corridor is likely to be important in maintaining the connectivity between water vole colonies outside the study area but within the same catchment, and is therefore considered to be of county level conservation value.

### *Kingfisher*

13.5.32 A kingfisher habitat suitability survey was undertaken as part of the Extended Phase 1 Habitat Survey on the 30th July 2012, to assess the potential of watercourses, to support populations of kingfisher. A data search was undertaken for records of kingfisher within the vicinity of the Proposed Scheme with one record of Kingfisher hunting along the River Witham in 2008.

13.5.33 The River Witham provides habitat suitable for supporting kingfisher. South Delph was assessed as providing suitable kingfisher nesting and feeding habitat. All other watercourses within the survey area were found to be unsuitable. No kingfishers were observed during the survey.

13.5.34 The River Witham and South Delph contain bank structures suitable for use by kingfisher as nest burrows as well as open areas with some suitable vegetation

cover and branches and other perches for use by hunting kingfisher. The River Witham is therefore considered to be of district level conservation value for kingfisher.

13.5.35 The findings of the kingfisher survey can be found in Volume 3 – Technical Appendices.

### *Barn Owl*

13.5.36 Barn owl breeding sites occur either side of the point at which the Proposed Scheme would cross the River Witham. Barn owls have also been observed flying over and hunting in the area around Greetwell Hollow Quarry and the River Witham.

13.5.37 During the breeding season, barn owl foraging principally takes place within a 1km radius of the nest, extending up to a 3-5km radius outside of the breeding season (The Barn Owl Trust 2005). In a mixed landscape, it is estimated that in the breeding season a pair of barn owls require the equivalent of 17-26ha of suitable foraging habitat, to rear their young successfully. Suitable habitat includes rough grassland and arable field margins, similar to that found within the study area, which are able to support field voles (the main prey item for barn owls).

13.5.38 The River Witham corridor is considered to be an important feature for barn owls as it supports multiple breeding sites, and adjacent grassland habitats are likely to support larger numbers of small mammal prey than areas of arable habitat.

13.5.39 Barn owls were confirmed nesting at Greetwell Hollow Quarry in 2010. A barn owl was also seen hunting in the River Witham corridor during the October 2012 bat survey. Barn owls have been assessed as of district level conservation value.

### *Breeding Bird Community*

13.5.40 Arable land is the dominant habitat type within the study area. This provides suitable habitat for ground nesting birds such as skylark and lapwing. Arable field margins and hedgerows provide nesting and foraging resources for birds such as grey partridge whilst woodland areas are important for many birds.

13.5.41 During the 2010 bat surveys at Greetwell Hollow Quarry SSSI, the following species were observed: A pair of kestrel, linnet, lapwing, skylark, yellow hammer, dunnock, swift, song thrush and grey partridge.

13.5.42 Typical farmland birds are present and likely to breed in the study area. These species have been assessed as of local conservation value.

## 13.6 Predicted Impacts

13.6.1 This section outlines the likely impacts on features, protected species and habitats and their significance in the absence of mitigation. Detailed impact tables are available in Volume 2 – Supporting Information. Residual impacts after mitigation are considered in Section 13.8

13.6.2 Likely impacts on habitat features such as hedgerows and ponds are assessed in terms of their potential to support protected or notable, species unless that receptor has a specific nature conservation designation.

13.6.3 Temporary impacts associated with structures and access routes for construction have not been fully determined at this stage. However, likely impacts have been considered and measures that would mitigate adverse effects have been recommended.

13.6.4 Impacts are divided into Construction and Operational impacts for Designated Sites and Species.

### *Impacts on Designated Sites*

#### *Construction Impacts*

13.6.5 The potential impacts on the geological features of Greetwell Hollow Quarry SSSI are described in Chapter 8. Loss of habitats within the quarry are likely to have effects from Moderate to Major Negative on recources from local to County value.

13.6.6 The likely impacts on the Greetwell Wood SNCI, the River Witham LWS and the Greetwell Junction Railway Embankment LWS are considered to be Moderate Negative and significant at a County scale.

13.6.7 The likely impacts on the Willingham Fen West LWS are considered to be Moderate Negative and significant at a Local scale.

#### *Operational Impacts*

13.6.8 The likely impacts on Greetwell Hollow Quarry SSSI's Geological features are described in Chapter 8. The Impact on the habitats within the SSSI are considered to be Moderate Negative and significant at a Local scale.

13.6.9 The potential impact on the Greetwell Wood SNCI and the River Witham LWS are considered to be Moderate Negative and significant at a Local scale.

### *Impacts on Species*

#### *Construction and Operational Impacts*

13.6.10 Land take has the potential to give rise to impacts on bats, ranging from Moderate to Major Negative, significant from local to County scale. .

13.6.11 The likely impacts on badgers are considered to be Moderate Negative and significant at a County scale. There is a single active badger sett in the area which could be affected by the scheme and a licence may be required if the detailed construction methods requires works to be undertaken in close proximity,.

13.6.12 The likely impacts on water voles, otters, kingfisher, barn owls and other birds are considered to be Moderate Negative and significant at a local scale, due to potential habitat loss and disturbance.

### *Impacts on Habitats*

#### *Construction and Operational Impacts*

13.6.13 The potential impacts on broadleaved woodland are considered to be Intermediate/Moderate Negative and Moderate Adverse due to the loss of areas of woodland due to the scheme.

13.6.14 The potential impacts on semi-improved species-rich grassland are considered to be Moderate Negative and Moderate Adverse due to the loss of areas of woodland due to the scheme.

13.6.15 The potential impacts on running water are considered to be Intermediate Negative and Moderate Adverse, predominantly due to the potential unmitigated risk of sediment or pollution entering the watercourses during construction and/or operation.

## 13.7 Proposed mitigation

13.7.1 The following general measures are recommended to avoid predicted impacts of degradation of terrestrial habitats, watercourses and species adjacent to work sites:

- Works will be carried out in accordance with best environmental working practices such as those documented in CIRIA publications.
- Polluting materials will not be stored in works areas located within areas of significant biodiversity value or within 50m of watercourses.
- Methods to minimise the risk of pollution of watercourses during construction works will be implemented. The recommendations of Pollution Prevention

Guidance (PPG) Note 5 will be applied in order to minimise risk of damage or pollution of aquatic habitats.

- Trees will be retained where possible and essential tree surgery to the crown or roots of trees will be carried out in accordance with British Standard (BS) 3998:2010 Tree Work Recommendations and appropriate Arboricultural Association advice notes, BS 5837:2005 Trees in Relation to Construction Recommendations, Arboricultural Association and Forestry Authority Advice Notes, and the National Joint Utilities Group Guidelines for the Planning, Installation and Maintenance of Utility Services in Proximity to Trees.
- If drainage features are affected by works, they will be reinstated following completion of works so that they retain their function.
- Vegetation clearance will ideally be undertaken outside the period March to July when breeding birds are most likely to be active, for example.
- Trenches and excavations will be covered overnight or fenced off to prevent animals falling in, or open trenches will include an earth ramp that allows animals that may fall in to climb out.
- An Ecological Clerk of Works will be available to the construction team to advise on unexpected ecological issues that may arise during the course of works. The Ecological Clerk of Works will advise construction personnel of likely ecological risks and will advise as to best practice that can be employed to manage these issues.
- Post construction planting will seek to enhance ecological value.

13.7.2 A landscape and ecological mitigation plan will be designed and put in place to protect designated sites and ensure that the sites overall integrity and conservation objectives are maintained. This will include planting with appropriate species compositions within the extents of the designated sites and the establishment of new habitat to replace affected areas of woodland, grassland and scrub.

### *Species Specific Mitigation Measures*

### *Bats*

13.7.3 All works affecting areas that may provide bat roosts or hibernacula will be mitigated. Although no confirmed roost sites would be affected, the Ecological Clerk of Works for the scheme would ensure that all potential roost sites were checked immediately prior to construction works to ensure that adverse effects are avoided.

13.7.4 Mitigation in respect of the loss of potential roosting sites would include the provision of bat boxes and bat bricks on trees and structures within the completed scheme. Landscape planting would consider features of value to foraging bats, in particular interfaces between habitats such as woodland and

pond edges. New planting would seek to maintain and enhance continuity of linear features potentially used by commuting bats.

13.7.5 To minimise the risk of affecting bats, tree felling should preferentially be undertaken in autumn, between late August and early November. At this time bats do not have dependent young and are not hibernating and should therefore be active enough to escape harm if proper precautions are taken.

13.7.6 Where possible, existing hedgerows will be retained, and newly planted hedgerows containing native species provided to maintain continuity of flight lines and minimise the effects of severance, This is particularly important where hedgerows link to known crossing points of the road used by bats, such as the River Witham.

13.7.7 New hedgerows will include a proportion of standard trees so as to enhance foraging resources and provide potential future roosting sites, Hedgerows should ideally be cut on rotation, and not more frequently than once every two or three years.

13.7.8 Bats have been confirmed using features such as hedgerows, tree lines, footpaths, watercourses and woodlands throughout the study area. Some these features will be removed and therefore mitigation, in the form of underpasses and hop-overs along the routes of bat flight paths is recommended in order to reduce the impacts of habitat fragmentation.

13.7.9 Hop-overs aim to guide bats over highways at suitable locations and at a safe height to reduce the chances of mortality from traffic. This can be achieved by planting hedgerows and trees either side of the point of the highway crossing, increasing in height towards the highway to allow bats to cross the road at height. During construction, at locations where hedgerows or linear habitat features used by bats have been removed, camouflage netting may be erected to maintain the continuity of these features before the construction of the hop-overs.

13.7.10 Hop-overs are recommended for consideration at the following three locations:

- The river corridor formed by the North Delph, River Witham and South Delph; the proposed five span bridge over this river corridor would function as a bat underpass in this location.
- The linear woodland north of the southern railway.
- Greetwell Road.

13.7.11 Lighting has potential to disturb local bats both during and after completion of construction works. Bats tend to exit their roosts to feed only after the sun has set, so the placement and use of lighting during construction and operation of the scheme will be considered at specific locations in relation to bat activity in these

areas. In proximity to confirmed roosts and hop-over locations, works within 30m of features used by bats will not take place at night. All night works will employ directional lighting which directs light towards areas where works are taking place and reduces light spillage.

13.7.12 At Greetwell Quarry, the following mitigation is recommended:

- As much as possible of the existing quarry face will be left undisturbed and intact.
- Bat hibernation boxes such as masonry boxes or Schwegler 1FW bat hibernation boxes will be provided. Masonry bat boxes can be built into the new embankment or retaining wall.
- An Ecological Clerk of Works who is also a licensed bat worker will oversee works at the quarry face.
- Within the area of the proposed works, any features (cracks) identified as potential bat hibernacula will be checked for bats. Once confirmed empty, hibernacula would be sealed. If evidence of bat roosting is present, this work may require a licence from Natural England. Where access permits, this could be completed in advance of construction, but access is likely to be made possible only once the embankment is under construction.
- Lighting at the proposed roundabout will consider incorporation of features designed to reduce disturbance to bats, such as illuminated road studs instead of light columns, glass lantern covers to filter UV light, reduced brightness of lights, and use of directional lighting.

### *Badgers*

#### *Pre-construction*

13.7.13 At least one active badger sett is present within the study area. If works occur within 30m of any of the entrances to this sett, specific mitigation will be required. Furthermore, badgers are known to move between territories and establish new setts from year to year. For this reason, it is recommended that badger surveys are repeated throughout the entire study area during the year and at least three months prior to the commencement of works. Confirmatory checks will also be made within the footprint of the works and up to 30m distance immediately prior to works. This will confirm the locations and status of any badger setts potentially affected by the scheme. If works occur within 30m of a sett, specific mitigation is likely to be necessary and this may require a licence from Natural England to be obtained. Works affecting badger setts undertaken under licence are likely to be restricted to the period 1st Nov – 30th June.

#### *During construction*

13.7.14 Contractors will be vigilant for the presence of badgers as they may enter the works area. If badgers or setts are found, an ecologist will be notified for advice to offset potential impacts.

13.7.15 Works undertaken under a badger licence, and works close to known setts will be completed under ecological supervision.

13.7.16 Vegetation clearance close to badger setts will be undertaken in a sensitive manner with regard for potential effects of such work on badgers. Badger paths will be cleared of any felled trees or scrub.

13.7.17 Badger fencing and mammal tunnels will be installed to enable badgers to have access to foraging areas without the need to cross the highway.

13.7.18 Works close to setts will be restricted at night to reduce disturbance of any badgers which may be leaving or returning. If night works in such areas are essential then they will be completed under ecological supervision.

13.7.19 Toolbox talks to be given to contractors to make them aware of the presence of badgers nearby, and the legal implications of their presence. Site workers will be instructed to stop works and consult an ecologist if they see or disturb a badger while working on site.

### *Water Voles*

13.7.20 It is likely that water voles are present along watercourses which are crossed by the proposed route. Water voles regularly move between sections of a river and may recolonise areas in which they are currently absent at any time. Exclusion is a method of mitigation which persuades water voles to leave a stretch of water course to allow development to go ahead. It is carried out by removing the vegetation along stretches inhabited by water voles in advance of works commencement. Vegetation removal will continue at regular intervals throughout the construction period to discourage voles from occupying these areas prior to works.

### *Otters*

13.7.21 Consideration will be given to the provision of measures that would facilitate otter movements, such as provision of oversize culverts or specific mammal tunnels, and ledges beneath bridges and within culverts. Mitigation during the construction phase is not considered necessary.

### *Kingfishers*

13.7.22 The operational phase of the Proposed Scheme is likely to have negligible impact on kingfisher but adverse effects could arise during construction if kingfishers choose to nest in burrows within the works area at this time. Pre-construction checks for this species in suitable areas within the works area will be undertaken prior to works by an ecologist.

### *Other Breeding Birds*

13.7.23 Vegetation clearance will be undertaken outside the main bird breeding season (typically March to July) where possible, as this will minimise the risk of adverse effects on breeding birds and makes delays to works because of their presence less likely. Should clearance works need to take place during these dates, an ecologist will be present to check for the presence of breeding birds within vegetation prior to the commencement of works and to recommend appropriate action to avoid adverse effects.

### *Reptiles*

13.7.24 Areas providing habitats of likely value to reptiles within the works area will be prepared in advance to minimise risk of adverse effects. It is recommended that in these areas, vegetation is strimmed to a height of 10-15cm, and hand searches of refugia and potential shelters are undertaken to remove any reptiles present. Reptiles that are found will be moved into adjacent areas of suitable habitat outside the works area. Following completion of construction, areas of vegetation could be enhanced for reptiles by creating artificial hibernacula such as piles of wood and stone.

### *Phase 1 Habitats*

13.7.25 Impacts during the construction phase can be minimised by compliance with appropriate environmental regulations, particularly those relating to working beside watercourses to minimise the risk of sediment or chemical pollutants entering any of the watercourses comprising the River Witham corridor. Operational phase impacts can be mitigated by compensating for lost areas of valuable habitat such as woodland, hedgerows and waterbodies, through habitat creation measures.

13.7.26 Where hedgerows containing predominantly native shrubs and trees are removed, a similar linear length of new hedgerow will be planted adjacent to, or as near as possible to the new road. This may involve creating hedgerows along the verges of the new road, planting-up discontinuous sections of existing hedge or planting native hedgerow species along current fence lines. The loss of ponds or wetland areas could be redressed by incorporating new wetlands, ponds or swales into sustainable drainage measures along the route of the new road. The area of newly created wetlands would not need to be extensive as only small areas of wetland habitat loss will occur during construction and newly created areas could all be contained within the highway verge. The loss of mature trees, which may be felled during construction, cannot be fully compensated but mitigation will include the planting of new native trees and shrubs, close to the location of those lost.

## 13.8 Residual Effects

13.8.1 This section outlines the main residual effects on features, protected species and habitats and their significance following the implementation of mitigation measures. Detailed residual effects tables are available in Volume 2 – Supporting Information.

13.8.2 All assessments of residual potential impacts are based on, and dependent upon, adoption of the mitigation measures outlined in previous sections.

### *Residual Effects on Designated Sites*

13.8.3 The residual effects on Greetwell Wood SNCI in the short term are considered to Moderate Negative impact and significant at a Local scale. Once replacement habitat is established, the residual effects are expected to be Negligible.

13.8.4 The residual effects on Greetwell Junction Railway Embankment LWS in the short term are considered to Moderate Negative impact and significant at a County scale. Once replacement habitat is established, the residual effects are expected to be Negligible.

### *Residual Effects on Species*

13.8.5 The residual effects on bats in the short term are considered to be Moderate Negative impact and significant at a District scale. Once bat boxes are in place, the residual effects are expected to be Minor Negative to Negligible.

### *Residual Effects on Habitats*

13.8.6 Following mitigation the residual effects on Habitats are expected to be Negligible.

## 13.9 Summary and Conclusions

13.9.1 Construction of the Proposed Scheme is likely to affect ecological resources within Greetwell Hollow Quarry, Greetwell Wood SNCI; the River Witham Corridor LWS and Willingham Fen West LWS.

13.9.2 The Proposed Scheme also has the potential affect legally protected species. The residual effects of the scheme have been assessed as likely to be minor adverse for bats and negligible for all other resources. It is likely that, with appropriate mitigation, residual effects could be reduced to negligible in all cases.

# 14 Land Use, Community and Private Assets

## 14.1 Scope of the Assessment

14.1.1 This assessment will identifies relevant policy considerations, and determines the impacts and effects arising during the construction and operation of the proposed development on the existing environment, set out under the following themes:

- Land use (comprising demolition of private property, loss of land used by the community, effects on development land, and effects on agricultural land);
- Community services, facilities and open space; and
- Community.

14.1.2 Baseline information has been sourced from an Environmental Statement previously completed for the dual carriageway[16] and information obtained by Mouchel from public sources. Landowners were also contacted to collect information about current land ownership boundaries within the scheme footprint and immediately adjacent to it.

14.1.3 The study area for this assessment encompasses all land and buildings within the defined 1km buffer zone as shown on the key plan (Volume 2 – Supporting Information - 1030171-LEB-EIA-SOC-001) which will be taken to accommodate the construction and operation of the proposed scheme.

## 14.2 Statutory and Planning Context

14.2.1 Reference has been made to the following statues, policies and plans:

- National Planning Policy Framework (NPPF)[17]: The Government published the NPPF in March 2012 to replace the suite of national Planning Policy Statements (PPSs), Planning Policy Guidance (PPG) notes and some Circulars with a single, streamlined document. The NPPF sets out the Government's economic, environmental and social planning policies for England.
- Local Plans identified within the City of Lincoln, North Kesteven District Council (NKDC) and West Lindsey District Council as follows:
    - Policy C2 – Development in the countryside (NKDC 2007);
    - Policy C5 – Effects upon amenities (NKDC 2007);
    - STRAT 12 – Development in Open Countryside (West Lindsey DC 2006);

[16] *Jacobs, Lincoln Eastern Bypass, Environmental Statement, Rev.:0, Issued: 11/08/09.*

[17] *National Planning Policy Framework, Department for Communities and Local Government, March 2012.*

- ECON 3 – Protection of Agricultural Land (West Lindsey DC 2006);
- CRT 3 – Loss of Recreation and Community Facilities (West Lindsey DC 2006);
- NBE 11 – Development affecting SSSIs and NNRs (West Lindsey DC 2006);
- NBE 20 – Development on the Edge of Settlements (West Lindsey DC 2006);
- Sites of Special Scientific Interest and other Critical Natural Assets (Lincoln City 1998); and
- Land North of Greetwell Quarry (Lincoln City 1998).

## 14.3 Method of Assessment

14.3.1 The following guidance has been used for this assessment:

- Highways Agency – Design Manual For Roads and Bridges (DMRB) (2008) Volume 11, Section 3, Parts 3, 6 Land Use (incorporating Amendment No.1 dated August 2001), and Part 8; and
- Interim Advice Note (IAN) 125/09: Supplementary Guidance for Users of DMRB Volume 11 "Environmental Assessment" (October 2009).

14.3.2 The community and private assets assessment has identified the impact of the development on existing conditions and its relevance to policy considerations, at a local and national level.

### *Consultation*

14.3.3 Lincolnshire County Council carried out a consultation on three possible routes for the Lincoln Eastern Bypass in early 2008. Relevant responses on agriculture and land quality were reviewed for the 2009 assessment.

14.3.4 Most of the agricultural land owners and occupiers potentially affected by the Proposed Scheme were interviewed during the site visit in September 2008 and comments about the proposals noted. Where land take is likely to be very small or nil, agricultural occupiers were contacted by telephone.

14.3.5 For this stage of assessment, land owners affected by the Proposed Scheme have been contacted by telephone to confirm and or update land ownership details of the various land parcels within the Proposed Scheme study area.

### *Baseline Data Collection*

14.3.6 The baseline data was gathered by undertaking a desk study which included reviewing available information from the following sources:

- Jacobs, Lincoln Eastern Bypass – Environmental Statement, Rev:0, Issued 11/08/09;
- Local Plans and proposal maps identified within the City of Lincoln, North Kesteven and West Lindsey;
- Office for National Statistics (ONS) website;
- Department for Environment, Food and Rural Affairs' (DEFRA) interactive mapping website; the Multi Agency Geographic Information for the Countryside (MAGIC);
- DEFRA Agricultural Land Classification (ALC) maps;
- Ordinance Survey Open OS mapping;
- Land ownership details obtained from consultation between Lincolnshire County Council (LCC) and private land owners;
- Information obtained from consultation with other interest groups or organisations; and
- Quantification of land take.

14.3.7 In terms of existing land use, it should be noted that baseline data relates only to land owners and the immediate land parcels to be affected by the proposed scheme. Information about tenancy arrangements, total land holdings, exact agricultural use and access arrangements is not currently available.

### *Overall Approach to Assessment*

14.3.8 The assessment has involved:

#### *Land Use and Private Assets*

- Identification/classification of the types of properties and land that will be directly or indirectly impacted by the proposed scheme and evaluation of the impact on land take on the existing use;
- Evaluation of the potential impact of the proposed scheme on private land and property not directly affected by the scheme's footprint;
- Identification of mitigation measures where impacts would be likely to have a significant effect on existing land use; and
- Assessment of the significance of residual impacts.

#### *Community Land and Facilities*

- Identification of land and facilities currently used by the community which would be required for construction of the proposed scheme;
- Evaluation of the proposed scheme to establish the potential direct impact on land and facilities used by the community and propose appropriate design and mitigation measures, where necessary; and

- Assessment of the significance of residual impacts on community land and facilities.

### *Development Land*

- A review of development plan documentation and local planning registers to identify and quantify development land and its intended future use within and close to the scheme footprint. This has involved a review of relevant local policy and the local planning registers for Lincoln City Council.
- Identification of the potential impacts on development land.
- The evaluation of the significance of impacts on development land has been informed by an analysis of the proportion of land that would be taken in the context of the overall extent of each area and areas nearby. Consideration has also been given to the type of land use proposed, the effect of the proposed scheme on access arrangements and the potential compatibility or conflict with the presence of the proposed scheme.

### *Impact Assessment*

14.3.9 The magnitude of impacts has been assessed in a qualitative manner based on the predicted nature (beneficial / adverse) of the change, the magnitude of the change (negligible, minor, moderate or major) and the sensitivity or value of the resource or receptor (negligible, low, medium, high or very high). The duration (temporary/ permanent) of the impact has also been considered.

14.3.10 Construction impacts are those relating to the actual building of the scheme and any temporary land-take required. Impacts resulting from the permanent direct loss of facilities/land uses are considered in the Operational Impacts section. Temporary land-take results from the need for a site compound and a working corridor that is wider than the permanent area of land take.

14.3.11 Table 14-1 presents the significance criteria that have been used for the assessment of impacts.

*Table 14-1 Significance criteria for the assessment of the impact on private assets*

| Impact Rating | Definition |
|---|---|
| Major adverse impact | Land take that precludes existing or intended use.<br>Activity that permanently compromises or precludes use or attraction.<br>Loss of amenity that precludes use or activity.<br>Large numbers of the population affected. |
| Moderate adverse impact | Land takes that compromises but does not preclude existing or intended use.<br>Activity that compromises or precludes use or attraction for a protracted period.<br>Loss of amenity that compromises but does not preclude use or activity.<br>Small numbers of the population affected. |

| Impact Rating | Definition |
|---|---|
| Minor adverse impact | Land take that is peripheral to existing or intended use or attraction.<br>Activity that temporarily compromises or precludes use.<br>Loss of amenity that does not preclude use or activity. |
| Negligible | No discernible impact. |
| Neutral | No change. |
| Beneficial impact | Beneficial impact on socio-economic factors, land use or recreation. |

## 14.4 Baseline Environment

### *Land Use and Private Assets*

#### *Private Assets*

14.4.1 There are a number of residential dwellings located within the proposed scheme boundary. These are located within North Greetwell, Canwick, Washingborough, Branston, Cherry Willingham, Bracebridge Heath and the eastern edge of Lincoln. In addition, there are a number of farm units located within a 1 kilometre (km) radius of the scheme (hereafter referred to as the 'study area').

14.4.2 Other private properties in the study area include:

- Royal Air Force (RAF) Waddington situated to the south of Bracebridge Heath on the southern edge of the study area;
- Canwick Waste Treatment Centre; operated by Alpheus Environmental Limited and situated just off Washingborough Road in Washingborough;
- Greetwell Hollow located on the north eastern edge of Lincoln and designated as a Site of Special Scientific Interest (SSSI) for the historically important exposures of the Lincolnshire Limestone Formation; and
- Fox Covert woodland situated approximately 800m east of the route, situated west of Cherry Willingham and south of Hawthorn Road.

14.4.3 Part of the HM Prisons situated to the east of Lincoln is also located on the western boundary of the study area.

### *Agricultural Land*

14.4.4 Most of the land affected by the proposed scheme is arable farmland, with some grazing land alongside and north of the River Witham.

14.4.5 Agricultural land along the proposed scheme corridor is mainly owned by institutions such as the Church Commissioners for England (No. on figure 3, 4, 8, 9, 10, 11, 12, 13, 14, 16, 17,18, 19, 23, 26, 28, 35, 36 and 37), the City of Lincoln Council (No. on figure 27) and an Oxford College (No. on plan 32 and 34). The land is let to farmers on a mix of traditional agricultural tenancies and modern farm business tenancies. There are also some owner-occupied land areas (e.g.

No. on figure 29, 30 and 31). Table 14-2 outlines land ownership affected by the Proposed Scheme.

14.4.6 The quality and versatility of agricultural land is classified from Grade 1 to Grade 5, with Grade 3 subdivided into 3a and 3b. Land in Grades 1, 2 or 3a is defined as the 'best and most versatile land' (BMV land) and benefits from a higher degree of protection under national and local planning policy. Nearly all of the agricultural land in the vicinity of the proposed scheme fall within Grades 2 and 3a (BMV agricultural land category). A small area of Grade 4 land is also present in the River Witham floodplain.

14.4.7 Most of the farm holdings have entered the Natural England Entry Level Stewardship Scheme, and Greetwell Hall Farm is in the Countryside Stewardship Scheme.

### *Other land use*

14.4.8 The other major land use within the study area is a former quarry (which also contains a SSSI) located north of Greetwell Road and known as the Greetwell Hollow Quarry. This feature is shown on *Figure 2*.

#### *Community Land and Facilities*

14.4.9 The communities within the study area include: North Greetwell, Cherry Willingham, Washingborough, Heighington, Branston, Bracebridge Heath.

14.4.10 Apart from Washingborough, the built up residential areas of these communities are located on the outer fringes of the study area. Most of the communities are fairly self-contained, in that most of the necessary local community facilities such as local shops, GP/Dental surgeries, post offices, schools, libraries and recreational areas are available within their own built-up areas.

14.4.11 Specific information relating to the individual communities is summarised below:

- North Greetwell: This community is located to the east of the proposed scheme, along the southern side of A158 Wragby Road. This is the smallest community within the study area. As community facilities do not exist within North Greetwell, people either travel into Lincoln or into neighbouring Cherry Willingham to access facilities.
- Cherry Willingham: This community is located to the east of the proposed scheme, north of the River Witham. Community facilities within Cherry Willingham include schools, post office, recreation grounds, and a library. It has the lowest population of the communities considered for this assessment but has the highest percentage of population that are over 60 years of age.
- Washingborough and Heighington: These two communities are located to the east of the proposed scheme, south of the River Witham and quite close to each other. The residential development to the west of Washingborough is located at

close proximity to the scheme. The community facilities within Washingborough and Heighington include schools, post offices, recreation grounds, a library, general practice surgeries, and a public house.

- Branston: This community is also located to the east of the proposed scheme, south of the River Witham. Community facilities within Branston include a school, a college, a post office, a recreation ground, and a library.
- Bracebridge Heath: Bracebridge Heath is located to the west of the proposed scheme. Community facilities within Bracebridge Heath include a school, post office, and a recreation ground.

14.4.12 Community land in the study area is shown on Drawing 1030171-LEB-EIA-SOC-002 (Volume 2 – Supporting Information) and includes:

- Canwick Recreation Ground approximately 800m to the west of the proposed scheme on the southern edge of Heighington Road and comprising a bowling green and tennis courts.

14.4.13 Community facilities located within the study area are shown on Drawing 1030171-LEB-EIA-SOC-002 (Volume 2 – Supporting Information) and include:

- Canwick Park Golf Club and Canwick Riding Club are located within the Canwick community, to the west of the Proposed Scheme and south of the River Witham. Although these two facilities are immediately adjacent to the proposed scheme study area, they are important as users may access them from other surrounding communities to the east, south and or north of the Proposed Scheme.
- Within the village of Bracebridge Heath there is a post office and a place of worship within the study area of the Proposed Scheme.
- South of Greetwell, east of the Proposed Scheme there is a place of worship north of the River Witham.
- Within the City of Lincoln there are two doctor's surgeries and one dental surgery within the Proposed Scheme study area.
- Lincoln County Hospital is located immediately adjacent to the western boundary of the Proposed Scheme study area and north of the River Witham.
- Shops are mainly located in Lincoln, with a parade of shops and commercial properties located around the Outer Circle Road; within the Proposed Scheme study area.

### *Development Land*

14.4.14 There are a number of sites allocated for development within the study area[18]. These include:

- Land North of Greetwell Quarry: allocated for a district mixed-use centre /business use at the western edge of the site, and housing or non-residential

[18] http://www.ourcityourfuture.co.uk/Info_page_two_pic_2_det.asp?art_id=5786&sec_id=2938(12.11.12)

institutions on the remainder of the site as stated in Policy 92 of the City of Lincoln Local Plan.

- Land East of the Tower Works: allocated for industrial/business development with particular emphasis on developments which make use of the railway network and/or waterways as stated in Policy 102 of the City of Lincoln Local Plan.
- Land South of Hawthorn Road: allocated for a major residential proposal in the City of Lincoln Local Plan Policy 38E.
- Greetwell Quarry : allocated for business and general industrial uses (within Class B1 and B2), for public open space, for storage and distribution (Class B8), and for a Park and Ride. It must be noted that Greetwell Quarry is designated as a geological SSSI as highlighted in Policy 70: Greetwell Quarry in the City of Lincoln Local Plan.
- North East Quadrant (NEQ): This strategic development area is situated to the west of the LEB, north of the River Witham and east of the current housing extents.
- South East Quadrant (SEQ): The strategic development area known as SEQ is to the north and east of Bracebridge Heath. The area has yet to be determined in terms of size, number of dwellings, commercial, schools, etc. However, it is likely to be a significant urban expansion of Lincoln.

14.4.15 Also present within the study area are a number of industrial estates between Greetwell Quarry and the Market Rasen railway line. Development opportunities exist to extend this area as part of the Lincoln Eastern Growth Corridor which includes: an extension of the existing employment land (particularly on the Land East of Tower Works); residential development; some recreational space; and road access improvements which connect to the approved Proposed Scheme.

## 14.5 Predicted Impacts

### *Land Use and Private Assets*

#### *Construction Impacts*

14.5.1 Measures to reduce the impact of the road have been considered throughout the development of the proposed scheme as the proximity of the proposals to local housing has been considered. As a result, there will be no direct loss of residential buildings, farm buildings or commercial properties during the construction of the Proposed Scheme.

14.5.2 The areas required during construction for contractor's compound sites, haul routes and temporary storage of topsoil would be out of production during the construction period but would be returned to agriculture on completion of the works. Measures would be taken to ensure careful stewarding of the soil resources during the construction period, proper restoration of the land and

subsequent aftercare. The long term significance of effect of these temporary uses of land is therefore categorised as Neutral.

### *Operational Impacts*

14.5.3 Table 14-2 below summarises the predicted impacts on land owners affected by land take by the Proposed Scheme.

*Table 14-2 Predicted Impacts - Land Owners Affected by Land-Take*

| Land Owner (LO) | No. on Figure | Land Use | Approx. Total Area (ha) | Approx. Total Area of Land-take (ha) | Description of potential impact | Impact Rating |
|---|---|---|---|---|---|---|
| LO1 | 2 | Unknown | 3 | 0.36 | Land take is peripheral to existing use and loss does not preclude use. | Minor Adverse |
| LO2 | 3, 4, 8, 9, 10, 11, 12, 13, 14, 16, 17,18, 19, 23, 26, 28, 35, 36 and 37 | Mainly agricultural land | 670 | 61 | Major Adverse - Land take permanently compromises existing use.<br>Moderate Adverse – Land take compromises but does not preclude existing.<br>Minor Adverse – Land take is peripheral to existing use and loss does not preclude use.<br>Negligible – land take relative to total area has no perceptible impact.<br>No Change – Neutral impact. | Major Adverse for Nos. 8, 14, 17 and 23.<br>Moderate Adverse for Nos. 4, 12 and 18.<br>Minor Adverse for Nos. 9, 11, 13, 19, 26, 28, 35 and 36.<br>Negligible for No. 10; and<br>No Change for Nos. 3, 16 and 37.<br>Overall, Moderate Adverse. |
| LO3 | 5 | Unknown | 0.49 | 0.03 | Land take relative to total area has no perceptible impact. | Negligible |
| LO4 | 6 | Unknown | 1 | 0.03 | Land take relative to total area has no perceptible impact. | Negligible |
| LO5 | 7 | Unknown | 0.08 | 0.02 | Land take is peripheral to existing use and loss does not preclude use. | Minor Adverse |
| LO6<br><br>LO7 | 20 and 22<br><br>22 | 20 (Unknown)<br><br>Land forming part of the former Lincoln to Boston Railway Line. | 5.1 | 1.37 | Land take is peripheral to existing use and loss does not preclude use. | Minor Adverse |
| LO8 | 21 | Land is part of River Witham | 1.7 | 0.31 | Land take is peripheral to existing use and loss does not preclude use. | Minor Adverse |

| Land Owner (LO) | No. on Figure | Land Use | Approx. Total Area (ha) | Approx. Total Area of Land-take (ha) | Description of potential impact | Impact Rating |
|---|---|---|---|---|---|---|
| LO9 | 24 | Sewage Treatment Works | 40 | 0.15 | Land take relative to total area has no perceptible impact. | Negligible |
| LO10 | 25 | Unknown | 3 | 0.3 | Land take is peripheral to existing use and loss does not preclude use. | Minor Adverse |
| LO11<br><br>LO9 | 27 | Mainly agricultural land<br>Ownership of a small parcel LL81568 to the north of No. 27 on Plan | 21 | 3.29 | Land take is peripheral to existing use and loss does not preclude use. | Minor Adverse |
| LO12 | 29, 30 and 31 | Mainly agricultural land | 67 | 7.67 | Moderate Adverse – Land take compromises but does not preclude existing.<br>Negligible - Land take relative to total area has no perceptible impact.<br>No Change – Neutral impact. | Moderate Adverse for No. 29.<br><br>Negligible for No. 31<br><br>No Change for No. 30. |
| LO13 | 32 and 34 | Mainly agricultural land | 368 | 17.15 | Land take compromises but does not preclude existing. | Moderate Adverse |
| LO14 | 33 | Mainly agricultural land | 26.28 | 0.05 | Land take relative to total area has no perceptible impact. | Negligible |

14.5.4 A tally of the overall impact rating from Table 1-2 shows that there are three moderate adverse, six minor adverse and six negligible impact ratings on landowners affected by land take for the proposed scheme.

14.5.5 Loss of arable land and severance of plots has been assessed as ranging from a ***minor to major adverse*** impact on landowners directly affected and an overall ***minor adverse*** effect on the amount of agricultural land in the area as indicated in Table 1-2 above.

14.5.6 As summarised in the Table 14-3 below, there will be no direct loss of residential buildings, farm buildings or commercial properties resulting from demolition due to the construction or operation of the proposed scheme. Therefore, the overall impact on these assets is ***Neutral/No Change***.

*Table 14-3 Impact on Private Assets*

| Land/Facilities | Description of Potential Impact | Impact Rating |
|---|---|---|
| Royal Air Force (RAF) Waddington | No land-take required. Proposed Scheme does not compromise land use. | Neutral |
| Canwick Waste Treatment Centre (CWTC) | No land-take required. Proposed Scheme does not compromise use of the CWTC. | Neutral |
| Greetwell Hollow Quarry and SSSI | Peripheral land-take required. Impact does not preclude land use allocation. | Negligible |
| HM Prisons | No land-take required. Proposed Scheme does not compromise use of facility. | Neutral |
| Fox Covert Woodland | No land take required Proposed Scheme does not compromise use of facility. | Neutral |

### *Community Land and Facilities*

#### *Construction Impacts*

14.5.7 The construction phase impacts on Community and Private Assets relate to factors such as Air Quality, Noise, Landscape and Traveller impacts. These factors have been assessed and reported in other relevant chapters of this ES.

#### *Operational Impacts*

*Table 14-4 Impact on Community Land and Facilities*

| Land/Facilities | Description of Potential Impact | Impact Rating |
|---|---|---|
| Canwick Recreation Ground | No land-take required. Use of facility is not precluded by the Proposed Scheme. Amenity value is not lost. | Neutral |

| Land/Facilities | Description of Potential Impact | Impact Rating |
|---|---|---|
| Canwick Park Golf Club and Canwick Riding Club | No land-take required. Use of facility is not precluded by the Proposed Scheme. Amenity value is not lost. | Neutral |
| Facilities in Lincoln including Doctors, Dentists, Shops, Hospital and Post Office | No land-take required. Use of facilities is not precluded by the Proposed Scheme. | Neutral |
| Post Office and Place of Worship in Bracebridge Heath | No land-take required. Use of facilities is not precluded by the Proposed Scheme. | Neutral |
| Place of Worship south of Greetwell | No land-take required. Use of facility is not precluded by the Proposed Scheme. | Neutral |

14.5.8 As shown in Table 14-4 above, the proposed scheme will not result in any loss of community land or facilities and therefore the overall impact is assessed as ***no change***. However, public access to these community facilities may be impacted and these impacts are discussed in the "Effects on All Travellers" Chapter.

### *Development Land*

#### *Construction Impacts*

14.5.9 It is anticipated that land with development potential will be used for construction facilities (site compounds, materials storage, etc.), alleviating the need for temporary land take involving other facilities. Short term construction phase impacts will not effect the future potential of allocated development land and as such predicted construction phase impacts are assessed as neutral.

#### *Operational Impacts*

14.5.10 The northern section of the proposed route would traverse the south eastern corner of Greetwell Quarry SSSI with an estimated land-take of approximately 3ha. The quarry has now been closed. This land take would impact upon the SSSI status of the site as discussed in Chapter 8 and Chapter 13. It would not however, impact upon the land use allocation.

14.5.11 The proposed scheme would not have any impact on land currently allocated for development. However, future allocations are set out in the East Midlands Regional Plan. This includes the south east quadrant between Bracebridge Heath and Canwick where up to 3000 homes may be allocated until 2026 and 8000 homes beyond this. However, this precise land area will not be defined until new LDFs are adopted and as such has not been included in this study. Therefore, the overall impact of the proposed scheme on development land is assessed as ***Neutral/No Change***.

## 14.6 Proposed Mitigation

### *Construction Mitigation*

14.6.1 Construction phase mitigation will involve a number of best practice methods and procedures. All construction phase mitigation will be managed using a Construction Environmental Management Plan (CEMP).

14.6.2 To minimise the impacts on land use, consultation with all landowners should be considered as part of the execution of the proposed scheme.

14.6.3 Appropriate scheduling of construction tasks and activities with respect to each landowner and their various land uses should be considered.

14.6.4 Mitigation measures for construction phase impacts on private land and property will be led by health and safety concerns and will include:

- Controlled operational hours to minimise disruptions due to construction traffic at peak times; and
- Temporary fenced-off pedestrian routes and clear signage to ensure safe pedestrian routes across working area.

### *Operational Mitigation*

14.6.5 Where the proposed scheme would involve land-take on the boundary of private properties, boundaries would be reinstated as part of the accommodation works for the proposed scheme.

14.6.6 Accommodation works would be provided to maintain access (where economically viable), services and a secure boundary. These works would be agreed with the individual landowners prior to the construction phase.

14.6.7 Similarly, the contractors would ensure that access to severed land is maintained during the construction phase.

14.6.8 There are no proposals for mitigation in relation to community and development land as the impacts have been assessed as Neutral/No change respectively.

## 14.7 Conclusions and Effects

14.7.1 Overall, impacts on land use, community and private assets are considered to be neutral. Residual adverse impacts are expected as a result of the loss of agricultural land and severance of these farm lands.

# 15 Effects on all Travellers

## 15.1 Scope of the Assessment

15.1.1 This chapter assesses the potential impacts of the proposed scheme on all travellers. By definition, “All Travellers” in this context refers to pedestrians, cyclists, equestrians (collectively referred to as Non Motorised Users (NMUs)) and vehicle users (also referred to as Motorised Users MU).

15.1.2 This assessment will identify relevant policy considerations and determine the impacts and effects arising during the construction and operation of the proposed development on:

- journeys that people make on foot, bicycle or on horses, using Public Rights of Way (PRoW) and local roads, in relation to changes in journey distance and the time associated with access to facilities used by communities (severance), and the recreational and amenity value of existing access;
- evaluation of driver stress relative to the proposed scheme; and
- the drivers’ experience in terms of the view from the road which would be available for users of the proposed scheme.

15.1.3 PRoW considered during the assessment comprise: long distance footpaths, public footpaths, bridleways, cycle routes, scenic routes and local roads which are used by local communities, visitors to the area and tourists. Receptors include non-motorised users and motorists using local roads.

15.1.4 Communal facilities include schools, hospitals, churches, libraries, leisure and recreational facilities, local shops and village halls.

15.1.5 The study area for this assessment encompasses all PRoW and other non-designated access paths and tracks within a 1km buffer as shown on Volume 2 – Supporting Information and links/accesses to and from the immediate surrounding communities of North Greetwell, Cherry Willingham, Washingborough, Branston, Bracebridge Heath, Canwick and Lincoln.

## 15.2 Statutory and Planning Context

15.2.1 Reference has been made to the following statutes, policies and plans:

- The Countryside and Rights of Way Act 2000 which relates to Public Rights of Way and access areas. The Act details obligations, powers and rights required of and available to Local Authorities and landowners in relation to the establishment, maintenance, and extinguishment of Public Rights of Way, long distance routes and countryside access areas.

- National Planning Policy Framework (NPPF)[19]: The Government published the NPPF in March 2012 to replace the suite of national Planning Policy Statements (PPSs), Planning Policy Guidance (PPG) notes and some Circulars with a single, streamlined document. The NPPF sets out the Government's economic, environmental and social planning policies for England.
- Transport White Paper: The future of Transport – A Network for 2030 (Jul 2004).
- Encouraging Sustainable Travel – Highways Agency's Strategic Plan for Accessibility.
- Local Plans identified within the City of Lincoln, North Kesteven and West Lindsey as follows:
    - Local Transport Plan for Lincolnshire County Council (LCC), 20011/12 to 2012/13 (April 2011);
    - Policy 5 Strategic Network of Cycleways, Footpaths and Bridleways from the Lincoln City Council Local Plan (1998 - Saved);
    - Policy RST2 – Protection of Existing Public Rights of Way from the North Kesteven District Council Local Plan (2007 - Saved)
    - Policy Sus 4 – Cycle and Pedestrian Routes in Development Proposals; and
    - Policy CRT 9 – Public Rights of Way, both from the West Lindsey District Council Local Plan (2006)

## 15.3 Method of Assessment

15.3.1 This section adopts the DMRB heading of 'Effects on All Travellers' as it appears in Volume 11, Section 1. Due to the current transitional stage of the DMRB, it combines the Non-Motorised Travellers (NMU) component of Volume 11, Section 3, Part 8 (Pedestrians, Cyclists, Equestrians and Community Effects) and Part 9 (Vehicle Travellers).

15.3.2 In terms of MUs, the assessment considers changes in journey lengths and times, impact on view from the road and driver stress. Magnitude, sensitivity and significance have also been assessed which takes into account factors such as driver's fear of accidents, route uncertainty, and frustration.

15.3.3 For NMUs, the assessment focuses upon changes in journey lengths and times, the effect on the amenity value of journeys, and changes in community severance. The assessment methodology involves a baseline assessment of PRoW routes and facilities to observe NMU activity.

[19] *National Planning Policy Framework, Department for Communities and Local Government, March 2012.*

15.3.4 New guidance set out in DMRB Volume 11 Section 2 Part 5 (August 2008) sets out methods for the establishment of significant effects, and this has been used as guidance for the assessment.

### *Traffic Data*

15.3.5 For the purposes of this chapter, Average Peak Hourly Flows have been obtained from a recent traffic data study and used to inform this assessment. The scenarios which have been considered include:

- the Do Minimum; and
- LEB Single Carriageway Do Something scenarios at 2017 and 2032.

### *Consultation with NMU Groups*

15.3.6 For this stage of the assessment, telephone consultations were held with local interest groups and organisations and a summary of this consultation is provided in Volume 2 – Supporting Information.

### *Baseline Data Collection*

15.3.7 The baseline data was gathered by undertaking a desk study which included reviewing available information from the following sources:

- Jacobs, Lincoln Eastern Bypass, Environmental Statement, Rev:0, Issued 11/08/09;
- Local Plans and proposal maps identified within the City of Lincoln, North Kesteven and West Lindsey;
- Definitive maps online for Lincolnshire County Council Rights of Way (Lincolnshire Countryside Access Mapping). Date Reviewed: 01.11.12;
- 3rd Lincolnshire Local transport Plan for Lincolnshire (LTP3);
- Office for National Statistics (ONS) website (accessed 05.11.12);
- Department for Environment, Food and Rural Affairs' (DEFRA) interactive mapping webiste; the Multi Agency Geographic Information for the Countryside (MAGIC);
- Ordnance Survey Open OS mapping;
- Accident Statistics information obtained from www.lincs.police.uk; and
- Information obtained from consultation with local interest groups or organisations.

### *Users of Public Rights of Way (PRoW) and Local Roads*

15.3.8 The evaluation of increased journey distances, times travelled and severance has involved:

- A review of the location of the principal communal facilities in the vicinity of the proposed scheme;

- Identification of important routes comprising PRoW and local roads currently used to gain access to the facilities and used as recreational/leisure routes;
- An estimation of distance travelled and travel time for identified journeys and routes;
- An estimation of distance travelled and travel time for alternative routes required as a result of the introduction of the proposed scheme into the existing environment;
- An evaluation of the significance of new severance based on combinations of criteria related to vehicle flows on new sections of road, the form of crossing provided and increases in journey length;
- An evaluation of the significance of reduced severance based on consideration of the percentage reduction in traffic flows on existing roads; and
- A description of changes in amenity associated with the identified routes.

15.3.9 The identification of community facilities and routes used by NMUs and motorists using local roads has involved reference to the LCC Definitive mapping and Ordnance Survey Mapping.

15.3.10 The estimation of travel times has been based on the following assumptions for travel speeds as prescribed in the DMRB, Volume 11, Section 3, Part 8: 5 kilometres (km)/hr for people on foot, 10 km/hr for equestrians and 20 km/hr for cyclists.

*The impact ratings and criteria adopted for the assessment of new severance and the assessment of reduced severance are based on the guidance obtained from the DMRB and these are detailed in Table 15-1 and*

15.3.11 Table 15-2 below.

*Table 15-1 New Severance Impact Rating*

| Severance | Criteria |
|---|---|
| Slight | Pedestrian at-grade crossing of a new road carrying below 8,000 vehicles per day (AADT); or<br>A new bridge needing to be climbed or a subway traversed; or<br>Journeys being increased by 250m. |
| Moderate | Pedestrian at-grade crossing of a new road carrying 8,000-16,000 vehicles per day (AADT) in the opening year; or<br>Two or more of the hindrances set out under 'slight' applying to single trips; or<br>Journeys being increased by 250-500m. |
| Severe | Pedestrian at-grade crossing of a new road carrying over 16,000 vehicles per day (AADT) in the opening year; or<br>Three or more of the hindrances set out under 'slight' or two or more set out under 'moderate'.<br>Journeys being increased by over 500m. |

*Table 15-2 Relief from Existing Severance Impact Ratings*

| | Level of Relief from Severance (% Reduction in Existing Traffic levels) | | |
|---|---|---|---|
| | Slight | Moderate | Substantial |
| Built-up Area | c. 30% | 30-60% | 60%+ |
| Rural Area | 60-75% | 75-90% | 90%+ |

### *Driver Stress*

15.3.12 The assessment of driver stress has been based on the traffic and road conditions likely to be encountered and the certainty of the route for travellers. Table 15-3 below outlines the three main components considered.

*Table 15-3 Driver Stress Components*

| Driver Stress Component | Description |
|---|---|
| Frustration | The inability to drive at a speed consistent with the driver's wishes in relation to the general standard of the road. |
| Fear of potential accidents | The potential for accidents due to the presence of other vehicles, poor road standards and the possibility of pedestrians stepping into the road |
| Route Uncertainty | Primarily due to signing that is inadequate for the driver's purpose. Additionally, drivers' familiarity with the route can also have an impact on the level of driver stress experienced. |

15.3.13 In relation to traffic flows and journey speed, the DMRB provides guidance relating levels of driver stress to the average hourly flow per lane, average journey speed, the urban or rural location of the road, and taking account of the type of road (motorway, dual carriageway or single carriageway). The effects of driver stress can be described as low, moderate or high. The proposed scheme is a single carriageway, which is designed to accommodate a future proposed dual carriageway. Table 15-4 details the DMRB ratings for a single carriageway.

*Table 15-4 Stress Ratings for Single Carriageway Roads*

| Average Hourly Flow Per Lane (Flow Units/hr) | Average Journey Speed – km/hr | | |
|---|---|---|---|
| | Under 50 | 50-70 | Over 70 |
| Under 600 | High (Moderate in urban areas) | Moderate | Low |
| 600-800 | High | Moderate | Moderate |
| Over 800 | High | High | High |

15.3.14 The assessment years and scenarios used are as follows:

- Do-Minimum (2017); and
- Do-Something (2017 and 2032).

### *View from the Road*

15.3.15 The assessment of views from the road has considered:

- The types of scenery or the landscape character as described and assessed for the baseline studies;
- The extent to which travellers may be able to view the scene;
- The quality of the landscape as assessed for the baseline studies; and
- Features of particular interest or prominence in the view.

15.3.16 Views have been categorised as prescribed in the DMRB Volume 11 Section 3 Part 9 on Table 15-5 as follows:

*Table 15-5A DMRB Categories for Assessing Travellers' Ability to See the Landscape and Associated Sensitivity / Value*

| DMRB 'View' Category | Description | Sensitivity / Value |
|---|---|---|
| No view | Road in deep cutting or contained by earth mounds, environmental barriers or adjacent structures | Negligible |
| Restricted view | Frequent cuttings or structures blocking the view | Low |
| Intermittent view | Road generally at ground level but with shallow cuttings or barriers at intervals | Moderate |
| Open view | View extending over many miles, or only restricted by existing landscape features | High |

15.3.17 Table 15-6 has been generated to provide a framework to assess the magnitude of the impact for the 'View from the Road' – in this case the existing A15 - as a result of the proposed scheme. The table indicates the change in views, for example if the view changes from 'Intermediate' to 'Open', it would result in a Minor Beneficial Impact.

*Table 15-6 Magnitude of Impact on Views from the Road*

| Magnitude of Impact | Beneficial | Adverse |
|---|---|---|
| No change | View remains the same | |
| Minor | No view – Restricted | Restricted – No view |
| | Restricted - Intermediate | Intermediate – Restricted |
| | Intermediate - Open | Open – Intermediate |
| Moderate | No view – Intermediate | Intermediate – No view |
| | Restricted – Open | Open - Restricted |
| Major | No view - Open | Open – No view |

## 15.4 Baseline Environment

### *Users of Public Rights of Way, Public Rights of Way (PRoW) and Local Roads*

15.4.1 PRoW are minor public highways that exist for the benefit of the community at large, in much the same way as the public road network. PRoWs include:

### *Public Footpaths and Pedestrian Routes*

15.4.2 Footpaths are PRoWs over which the right of way is on foot only. The following footpaths and pedestrian routes (routes that are not PRoW but used by pedestrians) within the study area include:

- Gtwl/140/1 – runs between Wragby Road (50-60m east of the existing Wragby Road roundabout) and Hawthorn Road (opposite the Greetwell fields turning).
- Gtwl/131/2 – runs off Wragby Road East into North Greetwell via Westfield Approach then Westfield Drive.
- Gtwl/131/3 – connects to Gtwl/131/2 running further south of North Greetwell via Westfield Avenue.
- Gtwl/131/4 – short footpath connecting Gtwl/131/3 to Reep/131/1, south of North Greetwell.
- Reep/131/1 – runs south of North Greetwell connecting to Hawthorn Road.
- Gtwl/139/2 – runs from a point on a minor road south of Hawthorn Road and runs southeast connecting to footpath Linc/57/1.
- Linc/57/1 – connects from Gtwl/139/1 and runs southeast before connecting into Greetwell Road.
- Linc/58/2 – a short footpath connecting Greetwell Road to Linc/59/4 to the east of the Allenby Road industrial estate.
- Linc/58/1 – a footpath connecting Allenby Road to the entrance of the Allenby Road industrial park to Crofton Road, at the east of the Allenby Road industrial estate.
- Linc/59/1 – a short footpath connecting Crofton Road to Linc/59/3 to the east of the Allenby Road industrial estate.
- Viking Way – is a long walking route, a section of which passes through the Proposed Scheme corridor. It runs along the northern bank of the River Witham between Greetwell Hall and Fiskerton. From a point southeast of Greetwell Hall along the river bank, it runs in the north direction towards the Lincoln to Market Rasen Railway track. Running along the southern side of this railway track, it becomes Linc/59/4 as it crosses the railway line and travels into northwest towards the Allenby Road Industrial Estate and continues into Lincoln City.
- Linc/26/1, Cher/102/1 – it runs along the north bank of River Witham from Greetwell Hall towards Lincoln city and terminates close to Spa road.

- Gtwl/102/2 – runs to the north of River Witham between Cher/102/1and the Viking Way.
- Gtwl/136/1 – runs perpendicular to the River Witham in the north direction from the point of contact of Gtwl/102/2 and Gtwl/102/2 and joins into Gtwl/137/1.
- Gtwl/137/1 – from the end point of Gtwl/136/1 it runs in the northeast direction meeting Viking Way south of the Greetwell Road close to a bridge over Lincoln to Market Rasen Railway.
- Gtwl/134/1 – runs north from a point on Viking Way near Greet Well Hall to a point south of Greetwell Road.
- Gtwl/134/2 – forms part of the Viking Way from the south end of Gtwl/134/1 to the north bank of River Witham ending up at the junction of Gtwl/102/1 and Gtwl/102/2.
- Gtwl/102/1 – forms part of the Viking Way on the north bank of River Witham between Greetwell Hall and Fiskerton.
- Gtwl/135/1 – starts at the northern point of Gtwl/134/2 and runs northwest to the point south of the bridge over Lincoln to Market Rasen Railway.
- Gtwl/138/1 – starts from the end point of PF Gtwl/135/1 and runs south of the railway track and meets Linc/59/4.
- Canw/9/1 – runs parallel to the south of the River Witham and ends at a fork from where Footpath Wash/18/2 commences.
- Linc/28/1 – runs immediately south and parallel to Footpath Canw/9/2 and merges together at the fork.
- Linc/23/1 – short footpath running south off Monks Road connecting to Winn Street south of Lincoln County Hospital.
- Linc/24/1 – footpath connecting from Winn Street east to Sewage Works.
- Linc/28/1 – footpath running south of River Witham commencing close to Titanic Bridge connecting to Linc/28/2.
- Linc/28/2 – short footpath connecting Linc/28/1 to Canw/9/1 south of River Witham.
- Wash/18/2 – runs south and parallel to the River Witham before heading south over the delph towards Lincoln Road.
- Wash/18/1 – connects from Footpath Wash/18/2 and leads south to Lincoln Road.
- Wash/13/1 – connects from Footpath Wash/18/2 and veers east parallel to meet Lincoln Road and opposite Church Hill.
- Linc/54/1, Canw/4/1 – this footpath runs from Washingborough Road and links into the Heighington Road to the west of the Sewage Works.
- Canw/3/1 – this public footpath runs from a point on Heighington Road near Canwick to south joining Lincoln Road.

- Wash/8/2 – this footpath starts at a point on Heighington Road south of Sheepwash Grange and runs 50-60m southwards into Glebe Farm fields.
- Wash/8/1 – it runs from a point on Cliff Lane north of Cliff Farm and runs in southwest direction into Glebe Farm fields to join with Wash/8/2.
- Wash/16/1 – this is a short footpath which starts from a meeting point of Wash/8/2 and Wash/8/1 and runs into Glebe Farm fields.
- Wash/10/1 – it starts at a point south of Cliff Lane and traversing through the fields in the south west direction joining into bridleway PB 58/11/1. This footpath links into a number of other pedestrian routes leading into towns of Washingborough, Heighington, and Branston.
- Bran/4/3 – this short run of the footpath is located south of the Lincoln Road and links into a number of equestrian routes.
- Bran/4/1 – from the town of Branston, it runs in the westerly direction passing through a hotel and then southwards joining into a network of bridleways.
- Bran/1/1 – this public footpath starts south of Branston village and runs in the south-westerly direction joining into Bloxholm Lane east of the 'Aircraft Viewing Enclosure'.
- Brac/3/1 – short pathway starts south of Bracebridge Heath from Grantham Road to Sleaford Road.
- Wragby Road – footways are provided on the north and south side of the Wragby Road. The footway on the north side is provided only up to Greetwell Lane.
- Greetwell Road – a narrow footway exists on the northern side of the Greetwell Road.
- Heighington Road – used by Ramblers to gain access between Canw/3/1 and Canw/4/1.

### *Public Bridleways, Restricted Byways and Equestrian Routes*

15.4.3 Bridleways are PRoWs for pedestrians, horse riders and cyclists (who must give way to people on foot or horseback) and Restricted Byways (formerly known as Roads Used as Public Paths, or RUPPs) carry rights for all types of traffic except motorised vehicles. The public bridleways and equestrian routes (routes used by equestrians that are not PRoW) within the study area include:

- Cher/133/1 – connects from Bridleway Cher /133/1 and runs northeast ending west of Cherry Willingham.
- Cher/133/1 – it runs from a point on Greetwell Road to the northeast towards the Lincoln to Grimsby Railway linking near to Green Lane.
- Bran/5/3 – this bridleway runs north east from a point on Bloxholm Lane that is east of Bracebridge Heath. It links into a chain of other bridleways eventually linking up into Hall Lane which leads into Branston.
- Bran/5/2 – connects from Bridleway Bran/5/3 and runs north for a short distance to connect with Bridleway Bran/5/1.

- Bran/5/11 – connects from Footpath Bran/5/2 and runs east to connect to Bridleway PB 58/7/2.
- Bran/7/2 – starts from the junction of Bran/5/1 and Bran/4/3 and runs southeast to join into Bran/7/1.
- Bran/7/1 – starting at Bran/7/2 it carries on running towards southeast to link into Hall Lane.
- Bran/2/1 – this bridleway starts at a point on Bloxholm Lane north of the 'Aircraft Viewing Enclosure' and passes through fields to link into the south-western end of Hall Lane.
- Bran/6/1 – this bridleway starts at Bloxholm Lane east of Sleaford Road past Westfield Bungalows towards Westfield Farm.
- Heighington Road – this road is currently used by equestrians for access to Branston Road.
- Bloxholm Lane – equestrian usage is low on this route.

### *Cycle Routes*

15.4.4 The cycle routes within the study area include:

- National Cycle Network Route No. 1 – runs along the Sustrans Route, south of the River Witham.
- Wragby Road – an off-carriageway cycle path runs along the southern side of Wragby Road, continuing around the outside of the A158 roundabout onto Bunkers Hill.
- Lincoln Road – it currently has an off-road cycle path that runs along its northern side. It is a combined cycle and pedestrian facility.
- Bloxholm Lane – there are no formal cycle facilities along this route. However, it has been identified by CycleLincs (a local cycle campaign group based in Lincoln) as a quiet road used by a number of local cyclists.

### *Greenway Routes*

15.4.5 The following Greenway routes exist within the study area:

- Hawthorn Road – used by local cyclists and equestrians as a radial route into the city centre from Cherry Willingham and Reepham, east of Lincoln.
- Greetwell Fields – a local access road running between Hawthorn Road and Greetwell Road. Greetwell Fields is found useful by cyclists and is identified as a greenway/quiet road in Lincoln Greenways Strategy. Its use extends to equestrians and ramblers.
- Greetwell Lane – Greetwell Lane is identified within the Lincoln Greenways Strategy as a quiet road and links into the bridleways to Nettleham.
- Sustrans Route – runs between River Witham and South Delph and links the city centre to Washingborough and beyond.

### *Non-Motorised Users (NMUs) Survey*

15.4.6 NMU surveys were carried out in December 2004 and October 2007 at a total of 26 locations within the study area. The surveys were carried out for a 12 hour period on a weekday and a weekend day. The weather conditions were observed to be cloudy and foggy during the December 2004 survey, whereas during the October 2007 survey the conditions were noted as fine and dry.

15.4.7 The results of both the surveys showed an active use of the Public Rights of Way and other routes in the study area. The routes were observed to be used for both leisure and commuting purposes. The most popular route within the study area appeared to be the Sustrans route and walking tracks which run along the banks of River Witham, and used by people in the nearby communities for making journeys both leisure and utility to and from Lincoln. It is understood that there is a strong desire among the non-motorised user group and the LCC officers to maintain safe continuity of these routes.

15.4.8 The other useful routes within the study area include:

- Hawthorn Road;
- Greetwell Fields;
- Viking Way;
- Public Rights of Ways along the River Witham;
- Heighington Road;
- Lincoln Road; and
- Bloxholm Lane.

### *Non-Motorised Users (NMUs) Accident Data*

15.4.9 A total of three NMU related accidents were recorded within the proposed scheme corridor for the period from 1 January 2003 to 30 June 2007. All three of the incidents involved cyclists. All these accidents were categorised as ‘slight’ accidents. The locations were:

- Granson Way, Washingborough Village;
- Main Road, Washingborough village, east of Proposed Scheme route; and
- B1188 Lincoln Road, Branston.

15.4.10 The survey did not record any serious accidents.

### *Community Interaction*

15.4.11 The communities within the immediate and surrounding study area include: Lincoln City, North Greetwell, Cherry Willingham, Washingborough, Heighington,

Branston, Bracebridge Heath and the Strategic Development Areas (North East Quadrant (NEQ) and South East Quadrant (SEQ)).

15.4.12 People living within the smaller communities tend to travel north or west into Lincoln City to access facilities or amenities which are not readily available within their local communities.

### *Driver Stress*

15.4.13 Drivers can experience stress as a result of frustration, route uncertainty and fear of accidents. These can occur as a result of congestion and slow moving traffic, poor signage and negotiating busy junctions.

15.4.14 Currently, it is perceived that, drivers' experience of frustration is concentrated between South Park Avenue, along Canwick Road and over the Pelham Bridge to the top of Broadgate, where the majority of slow moving traffic and congestion has been recorded to be most noticeable with few alternative routes available to the driver.

15.4.15 It is also noted that there are particularly confusing road signs along Neville Street and Canwick Road where gantries and the shared lane use alter depending on peak hour flows, which creates a high level of fear of accidents at certain times of the day.

15.4.16 Two junctions have also been identified as confusing to negotiate. These include junction with Cross O' Cliff Road and South Park Avenue to the south; and Lindum Road and Greetwell Gate in the city centre to the north.

### *Views from the Road*

15.4.17 The views below have been described in a north to south orientation along the existing A15.

15.4.18 Views travelling southbound from the Wragby Road roundabout are focussed towards Lincoln along Wragby Road. The views extend to semi-detached housing across gardens and open space areas. Views are also focussed towards Lincoln Cathedral a noticeable landmark of Lincoln. These views become more enclosed when turning south through denser housing and some commercial buildings.

15.4.19 Views open out on Lindum Road and then become restricted again on Broadgate until crossing the River Witham on Melville Street where brief glimpses to industrial buildings are available to the east.

15.4.20 On passing the railway and bus stations, the views become more open over the Pelham Bridge but are still contained to the east by large industrial buildings.

15.4.21 From here the views are contained by housing and industrial buildings on Canwick Road. Gantries also detract and are noticeable in the restricted and narrow view.

15.4.22 Views are then directed west along South Park Avenue towards South Common and housing with commercial warehouses noticeable larger scale buildings and forecourts.

15.4.23 The route continues around the foot of South Common and uphill on Cross O'Cliff Hill, where views are contained by vegetation and semi-detached houses along the roadside. There are some glimpsed views to agricultural land to the northeast and south through gaps in vegetation, but these are only partially visible before entering Bracebridge Heath semi detached housing on London Road.

15.4.24 On passing the junction with Canwick Road onto Sleaford Road, views extend to some industrial units to the north and newer housing to the south before opening out to agricultural land on leaving the village edge.

15.4.25 Views out to the countryside are therefore confined to glimpsed views along certain roads and to the ends of the route where the roads extend out of Lincoln into the rural countryside beyond (Wragby Road and Sleaford Road).

15.4.26 Views travelling northbound on the route would be similar to those described above. However, on travelling from Pelham Bridge to Broadgate, Lincoln Cathedral is particularly focussed due to the direction of travel.

15.4.27 Travelling west on Hawthorn Road, views are dominated by housing to the east of Lincoln with views south west over agricultural fields, with the Cathedral in the distance. Travelling east, views extend across fields towards North Greetwell and Cherry Willingham. The southern slope of the Witham valley is visible in the distance to the south.

15.4.28 Travelling west on Greetwell Road, good quality views look out towards the Witham valley bottom and towards industrial edges of Lincoln with the Cathedral noticeable on the horizon, partially restricted by undulating topography and vegetation to the edge of Lincoln and along the road itself. Travelling east, views are enclosed by vegetation and industrial buildings until they become more open, across agricultural fields towards Greetwell, the valley bottom and the southern slope.

15.4.29 Travelling west on Washingborough Road, views look out towards the River Witham Valley bottom, the Lincoln to Spalding railway embankment and towards Lincoln and the Cathedral. Views towards the northern slope of the valley are restricted by vegetation along road, the South Delph and the River Witham. Travelling east, views are restricted by embankments and vegetation of the

sewage works and the Lincoln to Spalding railway embankment, but then partially open out to the valley bottom fenland, on passing under the railway bridge, mostly restricted by vegetation along the South Delph and the River Witham.

15.4.30 Travelling west on Heighington Road, views look out over agricultural fields towards the woodland at Canwick and Sheepwash Grange, Glebe Farm and Manor Farm on the ridgeline. Lincoln Cathedral, Lincoln and the northern slope of the Witham valley are visible in the distance. Low level views into the valley bottom are partially obstructed by the roadside hedgerow. Travelling east, views look out over agricultural fields towards Washingborough with Sheepwash Grange, Glebe Farm and Manor Farm on the ridgeline. Branston is visible in the distance to the south east and the northern slope of the Witham valley to the north east.

15.4.31 Travelling west from Branston on Lincoln Road, views look out over undulating agricultural fields towards Canwick Heath Farm, Highfield Grange and the woodland at Canwick. Lincoln Cathedral is visible in the distance on the horizon. In the opposite direction, views look out over agricultural fields towards Canwick Heath Farm, Highfield Grange and towards Branston. Views north east are partially obstructed in places by woodland blocks to the north of the road. Low level views are partially obstructed by the roadside hedgerow.

15.4.32 Travelling west on Bloxholm Lane, views look out over agricultural fields towards the woodland at the Manor House and towards Bracebridge Heath. Low level views to the west are partially obstructed by the roadside hedgerow; views to the north are screened by vegetation on the road side and near to Westfield bungalows. Travelling east, views look out over agricultural fields towards Westfield Farm Bungalows and towards the woodland at Branston in the distance.

## 15.5 Predicted Impacts

15.5.1 Potential effects of the Proposed Scheme, without mitigation, are described below.

### *Users of Public Rights of Way (PRoW) and Local Roads and Community Severance*

#### *Construction Impacts*

15.5.2 Table 15-7 shows the PROW and other routes within the route corridor that would be directly impacted during the construction of the Proposed Scheme.

*Table 15-7 Assessment of Temporary Impacts on PRoW and Local Roads during the Construction Period*

| PRoWs, Local Roads | Construction Impacts | Impact Rating |
|---|---|---|
| Cycle path along the south end of the A158 Wragby Road | Construction of the A158 Wragby Road Roundabout and the Proposed Scheme will impact on journeys made by cyclists as the route will be temporarily closed to allow construction activities.<br>An appropriate diversion will be put in place during the construction phase. | Slight Adverse |
| Gtwl/140/1 | Permanent closure during construction. | Slight Adverse |
| Cycle path on Hawthorn Road | Disruption due to construction traffic and activities. | Slight Adverse |
| Gtwl/139/2 | Disruption due to construction traffic and activities.<br>Design proposes appropriate diversion during the construction phase. | Slight Adverse |
| Gtwl/138/1 | Disruption due to construction traffic and activities. | Slight Adverse |
| Greetwell Fields | Proposed Scheme construction to sever route and prevent access between parts. | Severe Adverse |
| Greetwell Road | Construction of the Greetwell Road Roundabout and the Proposed Scheme will impact on journeys made by all users due to temporary closure of paths, route diversions and general construction disruption. | Slight Adverse |
| Viking Way | Disruption due to construction traffic and activities for the Proposed Scheme and temporary location of site compound. | Slight Adverse |
| Sustrans Route/National Cycle Route No.1 | Disruption due to construction traffic and activities for the Proposed Scheme and temporary location of site compound. | Slight Adverse |
| Washingborough Road | Construction of the Washingborough Road Roundabout and the Proposed Scheme will impact on journeys made by all users due to temporary closure of paths, route diversions and general construction disruption. | Slight Adverse |

| PRoWs, Local Roads | Construction Impacts | Impact Rating |
|---|---|---|
| Heighington Road | Disruption due to construction traffic and activities. | Slight Adverse |
| Lincoln Road including Cycle path | Construction of the Lincoln Road Roundabout and the Proposed Scheme will impact on journeys made by all users due to temporary closure of paths, route diversions and general construction disruption. | Slight Adverse |
| Bloxholm Lane | Disruption due to construction traffic and activities as Proposed Scheme to pass under the Bloxholm Lane cycle/footbridge. | Slight Adverse |
| A15 Sleaford Road | Construction of the Sleaford Road Roundabout and the Proposed Scheme will impact on journeys made by all users due to temporary closure of paths, route diversions and general construction disruption. | Slight Adverse |
| A15 into Lincoln city (London Road) | Disruption due to construction traffic and activities. | Slight Adverse |

15.5.3 The effect on the leisure routes (a general term used to describe routes that people use for the purposes of leisure activities e.g. strolling through a scenic area) along the banks of the River Witham would only be slight adverse due to the permanent minor loss of amenity during and after the construction of the Proposed Scheme.

15.5.4 The lack of the community facilities within North Greetwell means that people either have to travel into Lincoln or Cherry Willingham. The construction of the A158 Wragby Road roundabout will result in the restricted movement on cyclists using the cycle path along the southern side of the A158 Wragby Road due to temporary closures. However, the footpaths from North Greetwell leading into Cherry Willingham would not be affected.

15.5.5 The communities of Cherry Willingham, Washingborough, Heighington, and Branston located on the eastern side of the Proposed Scheme would suffer some severance during construction resulting from the temporary closures of local roads and other routes leading into Lincoln.

15.5.6 The community of Bracebridge Heath located on the south western end of the Proposed Scheme would suffer from the least severance from Lincoln. Only the people trying to access facilities in Branston from the West would suffer from the closure of Bloxholm Lane during the construction of the Proposed Scheme and the Bloxholm Lane cycle/footbridge.

15.5.7 Table 15-8 sets out the following, in respect of each community in the study area:

- For each community/user group, the existing degree of severance;

- The impacts the proposed scheme would have on the users of PROWs and other routes during its construction;
- The predicted degree of severance during the construction of the bypass; and
- The degree of change in severance.

*Table 15-8 Assessment of Users of Local Roads and PROW (community severance) during the Construction Period*

| Community | Existing Severance | Construction Impacts | Construction Severance | Impact Rating |
|---|---|---|---|---|
| North Greetwell | Slight | Construction of the A158 Wragby Road roundabout with Proposed Scheme to obstruct NMU journeys on the A158 Wragby Road Cycleway. | Moderate | Slight Adverse |
| Cherry Willingham | None | Construction of the Greetwell Road roundabout and realignment of Greetwell Road | Moderate | Moderate Adverse |
| Washingborough | None | Construction of the Washingborough Road roundabout. | Moderate | Moderate Adverse |
| Heighington | None | Construction of the Heighington Road overbridge | Moderate | Moderate Adverse |
| Branston | None | Construction of the Lincoln Road roundabout/subway. | Moderate | Moderate Adverse |
| Bracebridge Heath | Moderate | Construction of Bloxholm Lane cycle/footbridge may obstruct some NMU journeys into Branston. | Moderate | Moderate Adverse |

### *Operational Impacts*

15.5.8 The Proposed Scheme would also have a positive impact by providing a link over the River Witham thus reducing the severance between the communities north and south of the river.

15.5.9 The potential effects of the scheme in relation to community severance during operation are set out in By removing the through traffic from the A15 onto the Proposed Scheme, there would be a reduction in severance within Bracebridge Heath resulting in a slightly positive effect on community severance.

15.5.10 Table 15-9Table 15-9 sets out the following, in respect of each community in the study area:

- For each community, the ‘baseline’ degree of severance;
- The effect the proposed scheme would have on community severance;

- The predicted degree of severance after opening of the bypass; and
- The degree of change in severance.

15.5.11 By removing the through traffic from the A15 onto the Proposed Scheme, there would be a reduction in severance within Bracebridge Heath resulting in a slightly positive effect on community severance.

*Table 15-9 Assessment of Users of Local Roads and PRoW (community severance) during the Operational Period*

| Community | Baseline Severance | Operational Impacts | Permanent Severance | Impact Assessment |
|---|---|---|---|---|
| North Greetwell | Slight | Creation of a four arm roundabout at a junction between A158 Wragby Road and Proposed Scheme. Increase in traffic on the roundabout. | Severe | Moderate Negative |
| Lincoln City | Moderate | Creation of Proposed Scheme would remove traffic through city centre thus improving “radial” severance | Slight | Slight Positive |
| Cherry Willingham | Moderate | At-grade crossing between Greetwell Road and Proposed Scheme would increase traffic on Greetwell Road. | Moderate | Moderate Negative |
| Washingborough | None | At-grade crossing between Washingborough Road and Proposed Scheme would increase traffic on Washingborough Road. | Moderate | Moderate Negative |
| Heighington | None | Grade separated crossing between Heighington Road and Proposed Scheme would result in little increase in traffic on Heighington Road. | one | None |
| Branston | None | At-grade crossing between Lincoln Road and Proposed Scheme would result in increase in traffic on Lincoln Road. | Moderate | Moderate Negative |
| Bracebridge Heath | Moderate | Reduction in the traffic flow on the A15 passing through Bracebridge Heath | Slight | Slight Positive |

15.5.12 A number of non-motorised user routes within the route corridor would be affected after the opening of the Proposed Scheme.

15.5.13 Public footpath Gtwl/140/1, between the A158 Wragby Road and the Hawthorn Road, is severed by the Proposed Scheme route. A section of this footpath on the eastern side of the Proposed Scheme and Hawthorn Road would be permanently stopped up. Records from the previous Environmental Statement show that the usage of this footpath was observed to be 'low'.

15.5.14 The public footpath Gtwl/139/2 on the western side of the Greetwell Fields is to be diverted to link into Greetwell Fields.

15.5.15 The predicted impacts on the non-motorised user routes during the operation of the Proposed Scheme are set out in Table 15-10.

*Table 15-10 Assessment of Impacts on NMU Routes during the Operational Period*

| PRoWs, Local Roads and Routes | Sensitivity | Operational Impacts | Impact Severity |
|---|---|---|---|
| Cycle path along the south end of the A158 Wragby Road | Medium | Creation of a four arm roundabout at a junction between the A158 Wragby Road and Proposed Scheme. Increase in the journey time and loss of amenity. | Moderate Adverse |
| Gtwl/140/1 | Low | The section of the footpath on the eastern side of the Proposed Scheme to be permanently closed. | Major Adverse (Permanent closure) |
| Hawthorn Road | Medium | Permanent closure of Hawthorn Road would increase journey times for users and cause severance. | Major Adverse (Permanent closure) |
| Gtwl/139/2 | Low | Footpath to be slightly diverted to link into Greetwell Fields. Slight increase in NMU journey time. | Minor Adverse |
| Greetwell Fields | High | Proposed Scheme to sever route and prevent access between parts. | Major Adverse (Route would be severed) |
| Greetwell Road | High | Grade separation crossing between the Proposed Scheme and Greetwell Road to increase journey time for NMUs. | Negligible (grade separation) |
| Washingborough Road | Medium | At-grade crossing between the Proposed Scheme and Washingborough Road to increase journey time for NMUs. | Moderate Adverse (at-grade crossing) |
| Heighington Road | High | Proposed Scheme to pass under the Heighington Road Overbridge. | Negligible (grade separation) |
| Lincoln Road | High | At-grade crossing between the Proposed Scheme and Lincoln Road to increase journey time for NMUs. | Moderate Adverse (at-grade crossing) |

| PRoWs, Local Roads and Routes | Sensitivity | Operational Impacts | Impact Severity |
|---|---|---|---|
| Bloxholm Lane | High | Proposed Scheme to pass under the Bloxholm Lane cycle/footbridge. | Negligible (grade separation) |
| A15 Sleaford Road | Negligible | At-grade crossing between the Proposed Scheme and A15 Sleaford Road to increase journey time for NMUs. | Moderate Adverse (at-grade crossing) |
| A15 into Lincoln city (London Road) | Negligible | None | Minor Beneficial (improvement to amenity – reduction in traffic) |

15.5.16 New crossing facilities have been included in the design of the Proposed Scheme to maintain the continuity of the NMU routes. A principle of grade-separation has been adopted on popular routes to minimise the impact on the physical fitness of the communities by providing safe facilities.

15.5.17 The scheme includes the provision of a new footway/cycleway along the length of the Proposed Scheme on the western side. This facility provides new links to the existing Public Rights of Way network, particularly the Sustrans route and the Viking Way.

15.5.18 This would increase the accessibility of these routes resulting in a positive effect on the physical fitness. Specifically:

- The Proposed Scheme cycleway/footway will have links to Hawthorn Road to promote connectivity;
- Greetwell Fields will be diverted along the eastern boundary of the Proposed Scheme to reconnect to Greetwell Road and Hawthorn Road. Greetwell Fields will become a bridleway, and will be stopped up to vehicles at Greetwell Road;
- A grade separated NMU overbridge will be provided north of the proposed Greetwell Road roundabout;
- A link to the Viking Way from the Proposed Scheme cycleway/footway. The Viking Way will be retained under the Lincoln to Market Rasen Railway structure;
- The Proposed Scheme cycleway/footway continues over River Witham;
- A link will be provided from the Proposed Scheme cycleway/footway to the Sustrans route via a new footbridge over the South Delph; and
- The Proposed Scheme cycleway/footway will connect to Heighington Road, via the Overbridge.

15.5.19 A subway will be installed under the Proposed Scheme north of the proposed B1188 Lincoln Road roundabout; and a grade separated NMU bridge will be provided to allow safe movement of NMUs across the Proposed Scheme at Bloxholm Lane.

15.5.20 To summarise, the construction of the Proposed Scheme would result in an increase in traffic on some of the local roads but would reduce the traffic flows in other areas. It is anticipated that certain vulnerable users (for example children and the elderly) would be deterred from making non-motorised journeys. However, the scheme design incorporates new crossing facilities across the bypass and over the River Witham and improved access to the existing facilities within the study area. The resulting residual impact on the community severance is therefore assessed as '***Neutral'***.

15.5.21 There would be a minor loss of amenity on the NMU routes along the banks of River Witham after the opening of the Proposed Scheme. The assessment of landscape and visual impact has been undertaken in Chapter 9 of this Environmental Statement. The residual impact on the community facilities is therefore assessed as ***'Slight Negative'***.

15.5.22 With the exception of the permanent closure of Hawthorn Road which would lead to severance. There are no other residual impacts on NMU routes as the design of the Proposed Scheme has adequately considered reduction and/or elimination of community severance and improvement of the experience of users throughout the Proposed Scheme.

15.5.23 The design of the Proposed Scheme incorporates continuity of the existing routes where possible and provides suitable diversions of other routes. This would encourage people to maintain the existing level of walking and cycling in the region.

15.5.24 The design of the Proposed Scheme also includes the provision of a new cycle/footway facility on the western side with new links to the existing network of NMU routes. This would provide new facilities for walking and cycling in the region thus having a positive effect on the physical fitness.

15.5.25 The existing conditions for NMUs within Lincoln would also be improved by the reduction of traffic on A15, thus encouraging more people to take up walking and cycling.

15.5.26 It is therefore assessed that the scheme would have a '***Moderate Positive'*** affect on the physical fitness of the communities within the route corridor.

### *Driver Stress*

#### *Construction Impacts*

15.5.27 During the construction phase of the Proposed Scheme, drivers will generally experience an increase in disruption due to construction traffic and related activities such as road closures and diversions, route uncertainty and temporary signage put up to enable construction work.

15.5.28 These temporary changes will therefore increase the frustration and stress experienced by drivers on the existing routes during the construction of the Proposed Scheme.

### *Operational Impacts*

15.5.29 The current traffic heading towards the southeast of Lincoln has to use the A15 and pass through Lincoln city. Based on figures in the previous Environmental Statement, 2016 was set as the opening year and traffic levels projected in the order of 36,000 vehicles per day using the A15 Broadgate in Lincoln city centre.

15.5.30 The Proposed Scheme is predicted to remove up to one third of the traffic from the A15 Broadgate within Lincoln in the previous opening year of 2016 and proposed improved condition for the non-motorised user routes within Lincoln, making them more attractive than current conditions.

15.5.31 The City Centre - A15 Broadgate is highlighted in Table 15-11 and Table 15-12 as these show the scenarios within the existing A15 which forms a key route for the assessment as detailed in this chapter.

15.5.32 The Proposed Scheme would improve conditions for the MUs within Lincoln by:

- Reducing the amount of through traffic on the A15 resulting in less interaction with the local traffic and causing less congestion; and,
- Reducing the amount of HGVs within Lincoln resulting in improved safety on the NMU routes and roads which should make them more attractive to users.

15.5.33 Baseline data indicates that drivers using the A15 to travel into or through Lincoln experience a moderately stressful journey. Drivers travelling south along Bunkers Hill (A15) would experience moderate levels of stress.

15.5.34 Table 15-11 and Table 15-12 below show the stress ratings for the Do Minimum and Do Something scenarios for both the Opening (2017) and Design (3032) years. The flows have been obtained for indicative points along critical routes and are across a North-South Network defined by the River Witham. .The Average Peak Hourly Flow (APHF) has been obtained using the peak hourly flows for the morning (AM) and afternoon (PM) in both the north bound (NB) and south bound (SB) directions.

*Table 15-11 Stress Ratings for Do Min and Do Something 2017*

| Part of Cordon (Speed km/hr) | APHF ((DM) - NB | APHF (DM) - SB | APHF (DS) - NB | APHF (DS) - SB | Stress Rating |
|---|---|---|---|---|---|
| B1190 Carr Lane (50-70) | 489 | 437 | 435 | 348 | moderate |
| A46 (Over 70) | 1758 | 1648 | 1711 | 1510 | high |
| City Centre - Brayford Way (Under 50) | 1470 | 1138 | 1242 | 1036 | high |

| Part of Cordon (Speed km/hr) | APHF ((DM) - NB | APHF (DM) - SB | APHF (DS) - NB | APHF (DS) - SB | Stress Rating |
|---|---|---|---|---|---|
| City Centre - Wigford Way (Under 50) | 673 | 783 | 705 | 740 | high |
| City Centre - A15 Broadgate (Under 50) | 1827 | 2235 | 1293 | 1719 | high |
| LEB Section 2 (50-70) | - | - | 1109 | 1237 | high |
| Wragby Road (50-70) | 44 | 70 | 7 | 7.5 | moderate |

*Table 15-12 Stress Ratings for Do Min and Do Something 2032*

| Part of Cordon (Speed) | APHF (DM) - NB | APHF (DM) - SB | APHF (DS) - NB | APHF (DS) - SB | Stress Rating |
|---|---|---|---|---|---|
| B1190 Carr Lane (50-70) | 654 | 601 | 541 | 491 | moderate |
| A46 (Over 70) | 1865 | 1737 | 1823 | 1633 | high |
| City Centre - Brayford Way (Under 50) | 1740 | 1267 | 1530 | 1164 | high |
| City Centre - Wigford Way (Under 50) | 799 | 931 | 833 | 885 | high |
| City Centre - A15 Broadgate (Under 50) | 2020 | 2495 | 1544 | 2047 | high |
| LEB Section 2 (50-70) | - | - | 1360 | 1462 | high |
| Wragby Road (50-70) | 156 | 206 | 14 | 15 | moderate |

15.5.35 Table 15-11 indicates that in the opening year (2017) of the scheme, under the DS scenario, drivers travelling north and south along the Proposed Scheme and the existing A15 Broadgate would experience high levels of stress using the DMRB stress rating criteria. However, in comparison, the north bound peak hourly flow on the Proposed Scheme is less than the A15 and the south bound peak hourly flow on the Proposed Scheme is significantly less than the A15. Therefore, for drivers travelling between the north and the south, using the Proposed Scheme will be less stressful than using the current route option (A15) for their travels.

15.5.36 Drivers using many of the road links that adjoin the Proposed Scheme along its route would largely experience high levels of stress.

15.5.37 Table 15.12 indicates that in the design year (2032), under the DS scenario, drivers using the A15 to travel into or through Lincoln would experience high levels of stress throughout their journey. Drivers using the Proposed Scheme will encounter significantly less volume of traffic than using the A15. Although the stress rating for the Proposed Scheme remains high, overall this will inevitably have a beneficial impact on driver frustration and therefore reduce driver stress levels.

15.5.38 However, drivers using many of the roads that adjoin the Proposed Scheme along its route would experience high levels of stress.

15.5.39 The DMRB guidance notes that although fear, and therefore stress, should theoretically increase due to the higher speeds along the Proposed Scheme, the perception of danger is likely to be more than offset by the superior design standards to which the new scheme would be built.

15.5.40 The latest standards of design and signage would mean drivers using the route would have better directions and therefore less route uncertainty when compared to the existing route through Lincoln.

15.5.41 It is predicted that there would be a better provision of route signage on the new route, although there would be greater concentration of signage at roundabout junctions.

15.5.42 In summary, drivers travelling north and south along the Proposed Scheme would experience ***low*** levels of stress. However, drivers joining or traversing the Proposed Scheme would experience ***moderate or highly stressful*** movements.

15.5.43 In addition, although the Proposed Scheme would have no quantifiable impact on stress levels through Lincoln in 2017 and 2032, traffic figures used in the 2009 Environmental Statement report indicate that the Proposed Scheme would significantly reduce the numbers of cars passing through Lincoln by drawing them out of the city centre onto the Proposed Scheme therefore being ***beneficial*** to drivers in the centre.

### *Views from the Road*

#### *Construction Impacts*

15.5.44 The views experienced by drivers travelling both north and southbound will be interrupted by new elements such as construction traffic, equipment, site compounds and general construction activities. This change in experience will be more evident at both ends of the route, where the junction works would be noticeable. There may be some diversions through works to the roundabouts, especially on Sleaford Road before the driver continues on the existing route through the city centre.

15.5.45 Similarly, views from the other roads that cross the Proposed Scheme alignment would be different from the existing views as the respective roundabout junctions are constructed. These views will be redirected around the works before continuing on the existing alignments east and west.

#### *Operational Impacts*

15.5.46 It is anticipated that there will be considerable changes to drivers' views during the opening and design years and these would include:

- Open views across rural landscapes to the south of the Proposed Scheme whilst the road is at grade or on embankments;
- The junction at Lincoln Road would be noticeable on approach from both north and southbound directions on the Proposed Scheme and also noticeable on Lincoln Road when approaching from east/west directions;
- Views would be restricted by deep cuttings on the southern slope;
- Views to and around the Washingborough Road junction would be enclosed by cuttings and railway embankments, from drivers both on the Proposed Scheme and travelling east-west on Washingborough Road;
- New elevated views would be experienced in both north and southbound directions across the valley bottom between the two railway crossings as drivers pass over the River Witham on embankment and bridge with views extending to the edge of Lincoln to the west and the Witham valley extending to the east;
- Greetwell Road junction area would be a noticeable junction on the northern ridge on approach northbound on the Proposed Scheme and from drivers on the road itself travelling in both east and westerly directions;
- To the north the views north and south would be directed due to the Proposed Scheme being in cutting adjacent to the Greetwell Quarry;
- To the north-eastern edge of Lincoln, views would be open to the new housing edge to the west and to fields to the east where the Proposed Scheme is at grade or on embankment;
- On passing underneath Hawthorn Road, views on the Proposed Scheme north and southbound would be restricted by cuttings and focussed to the direction of travel; and
- Views on Hawthorn Road would be elevated over the Proposed Scheme here with glimpsed views to the south and the edge of Lincoln to the west.

15.5.47 The construction of the Lincoln Eastern Proposed Scheme would have a neutral effect on travellers' views on the main movements from north to south on the A15 route between Wragby Road and Sleaford Road. It would, however, make the views worse for travellers on all of the roads which it crosses including the A158, Wragby Road, Hawthorn Road, Greetwell Road, Washingborough Road, Heighington Road, Lincoln Road, Bloxholm Lane and Sleaford Road.

15.5.48 In general, views experienced by motorists would benefit from more open views to agricultural land whilst travelling along the Proposed Scheme north and southbound, as well as suffer from a perceived lack of integration of the scheme from views towards it travelling east / westbound on the minor roads. This would result in both "better" and "worse" views depending on the quality of landscape character made visible and the existing quality of views.

15.5.49 In the Opening Year (2017) views northwards and southwards would be better when travellers use the Proposed Scheme to cross Lincoln between Wragby

Road and Sleaford Road. Views on roads the Proposed Scheme crosses would remain worse apart from the A158, Wragby Road and Hawthorn Road east where views would be neutral.

15.5.50 In the Design Year (2032), views northwards and southwards would be better when using the Proposed Scheme to cross Lincoln between Wragby Road and Sleaford Road. Views on roads the Proposed Scheme crosses would remain worse apart from the A158, Wragby Road, Hawthorn Road west and Sleaford Road south which would be neutral and Hawthorn Road east which would be better.

## 15.6 Proposed Mitigation

15.6.1 A number of mitigation measures are proposed as discussed below.

### *Construction Mitigation*

15.6.2 Mitigation measures for the Proposed Scheme during the construction phase are as follows:

- Suitable temporary diversion routes to be provided for the affected routes by the contractor to minimise disruption and ensure safe continuity;
- Construction to be programmed such that planned closures are implemented only when alternative routes or suitable diversions are provided; and
- Clear signage to ensure safe pedestrian routes across working area.

15.6.3 A clearly organised Traffic Management Plan would be implemented for traffic using the road network during the construction of the scheme in order to minimise travellers' stress and reduce congestion that might otherwise result from the works.

### *Operational Mitigation*

15.6.4 Potential severance has been addressed throughout the assessment and development of the proposed scheme such that there would be no significant impacts related to use or amenity value for NMUs or users of local roads.

15.6.5 The assessment has concluded that there is no requirement for any further mitigation.

15.6.6 All mitigation proposals as described in Chapter 9 are considered. These would include native planting and habitat creation to integrate the proposals into the surrounding landscape and allow certain views into good quality landscape / historic landscape character areas).

## 15.7 Conclusions and Effects

15.7.1 The assessment has demonstrated that there would be temporary and permanent impacts on NMUs and road users during construction. However with the Proposed Scheme design, these impacts are either reduced or eliminated.

15.7.2 Provision has been made in the design of the Proposed Scheme and measures incorporated to ensure the reduction in severance as a result of the proposed scheme.

15.7.3 The construction of the Proposed Scheme would reduce the traffic within Lincoln thus improving conditions for the NMUs and encouraging people to either continue or take up walking and cycling. This would also have a positive impact upon the physical fitness of the people in and around Lincoln.

15.7.4 The assessment has demonstrated that without the proposed scheme in place, drivers' stress levels on the existing A15 would remain high. However with the Proposed Scheme, drivers travelling north or south will encounter less volume of traffic which is predicted to have a beneficial impact on driver frustration hence stress levels.

15.7.5 Due to the varied nature of the landscape along the lengths of the Proposed Scheme, road users would experience either a "Better" or "Worse" view due to the mix of both open views and perceived lack of integration of the Proposed Scheme with views travelling east or west on intersecting minor roads.

# 16 Interactions and Cumulative Impacts

## 16.1 Scope of the Assessment

16.1.1 Interactions and cumulative impacts are issues associated with the net environmental effects, either between the Proposed Scheme and others or between different environmental disciplines, of the Proposed Scheme. Both of these types of effect are considered in this chapter.

16.1.2 The individual assessments for each principal environmental aspect (Chapters 7 to 15 in this report) identify the key potential impacts as a result of the Proposed Scheme.

16.1.3 This assessment focuses on the likely significant cumulative effects and interactions.

## 16.2 Statutory and Planning Context

16.2.1 The methodology here has been informed by the following legislation/guidance:

### *The Town and Country (Environmental Impact Assessment) Regulations 2011*

16.2.2 Schedule 4 of the Regulations requires a description of the likely significant effects of the development on the environment, which should cover the direct effects and any indirect, secondary, cumulative, short, medium and long-term, permanent and temporary, positive and negative effects of the development.

### *Circular 02/99: Environmental Impact Assessment*

16.2.3 This document provides guidance on the implementation of the above legislation. It states that in judging whether the effects of a development are likely to be significant, local planning authorities should always have regard to the possible cumulative effects with any existing or approved development.

## 16.3 Method of Assessment

16.3.1 There are a number of different categories of cumulative impact; for the purpose of this assessment the following definitions will be adopted.

### *Indirect Impacts*

16.3.2 Impacts on the environment, which are not a direct result of the Proposed Scheme, often produced away from it or as a result of a complex pathway. Sometimes referred to as second or third level impacts, or secondary impacts.

For example, disturbance/nuisance to local residents from the use of road sweepers as a dust mitigation measure.

#### *Impact Interactions*

16.3.3 The reactions between the residual impacts of just one project. For example, the combined effect of individual impacts, e.g. noise, dust and visual, from one development on a particular receptor.

#### *Cumulative Impacts*

16.3.4 Impacts that result from interactions between the Proposed Scheme and impacts of other projects, particularly major ones, in the area for which planning permission has been granted. For example, emissions to air from one project combined with emissions from an existing development or two major developments being constructed adjacent to one another and during overlapping time periods will have many interactive impacts, from land use issues to construction and operational noise.

16.3.5 In addition to the above, proposed developments where planning permission has not yet been granted have been considered where they are prominent in the planning process.

## 16.4 Predicted Impacts

#### *Indirect Impacts*

16.4.1 No indirect impacts are anticipated as a result of construction or operation of the Proposed Scheme.

#### *Impact Interactions*

16.4.2 The potential key interactions identified and outlined in Chapters 7 to 15 are as follows;

#### *Air Quality, Noise, Vibration & Landscape*

16.4.3 During the construction phase of the Proposed Scheme there will likely be an increased impact on nearby sensitive receptors (residential properties), from the combined effects on air quality, noise and landscape. There will be negative impacts on air quality from construction traffic and dust, an increase in noise levels from construction activities and a degradation of visual amenity from the construction activities and site clearances. The impact will likely be greater than predicted in the separate chapter assessments. However, the construction works will deploy mitigation measures that are routinely and widely deployed in the construction industry and are found to be highly successful in controlling the

construction impacts on noise, air quality and landscape. These measures are outlined in Chapter 17 Schedule of Environmental Commitments and will minimise the impacts.

16.4.4 Non Motorised Users (NMUs) utilising the Public Rights of Way (PRoW) in the area of the works during the construction phase will also be susceptible to cumulative impacts associated with construction activity. Increases in noise, dust emissions and reduced visual amenity may act to dissuade NMUs from utilising the PRoW during the construction phase. The mitigation measures that will be deployed on site will help to minimise these impacts.

### *Flood Risk, Drainage & Ecology*

16.4.5 The Proposed Scheme will impact on adjacent watercourses through the required channel alterations, additional highway run off and potential pollution incidents and spillages. These changes to watercourses may negatively impact upon aquatic and riparian wildlife and when combined with the expected habitat loss from construction of the Proposed Scheme may have a cumulatively greater impact on ecology. The cumulative impact can be minimised by designing out at the detailed design stage of the scheme and using the mitigation outlined in Chapter 07 Flood risk at Drainage.

16.4.6 The inclusion of SuDs, such as balancing ponds, in the detailed design can provide additional habitat areas and have a positive impact on local ecology.

### *Cumulative Impacts*

16.4.7 A number of developments have been identified as part of the transport future year modelling in liaison with the Central Lincolnshire Joint Planning Unit (CLJPU) and utilising the Strategic Housing Land Allocation Assessment (SHLAA) database. See Table 16-1.

*Table 16-1 Committed Development Summary*

| Committed Development: Location & Description | Size (ha) | Size (units) | Site Open Date |
|---|---|---|---|
| **Development:** North East Quadrant, Centre bounded by LEB. 48.5% B1, 33.5% B2, 18% B8 + housing. | 5 | 2,000 | 2031 |
| **Development:** Teal Park - Whisby Road/ Station Rd SW Lincoln. Phase 1: B1, B2, B8 (Siemens) 21,140sqm, 6,500 hotel, public house, restaurant, 14,300 sqm trade counters, showrooms, leisure. | 10 | | 2016 |
| **Development:** Western Growth Corridor (WGC) - W & SW of Lincoln city centre. C3 Residential Units, 5,750sqm (A1, A2,A3,A4), 36ha B1/B8, 6.35ha D1, 3.1ha Park & Ride | 36 | 2,700 | 2031 |

| Committed Development: Location & Description | Size (ha) | Size (units) | Site Open Date |
|---|---|---|---|
| **Network Change:** Part of the WGC. From A46 to Tritton Road with a connection to the Skellingthorpe Road/Birchwood Avenue junction | | | 2016 |
| **Development:** South East Quadrant; SE of Lincoln between Bracebridge Heath and Canwick between the A15 and the B1188. 19 ha of employment land and 2,800 homes by 2031 | 19 | 2,800 | 2031 |
| **Development:** Employment Land Review Sites - By 2016**.** 33 individual sites ranging from 0.05ha – 2 ha | 1.19 | | 2016 |
| **Development:** Employment Land Review Sites - By 2026. 7 individual sites ranging from 0.14 – 2.79 | 0.64 | | 2026 |
| **Network Change:** High Street environment improvements (from Portland Street to St Catherines). Now formalising parking by reducing footway and creating two lanes including informal bus priority lane. | | | 2011 |
| **Development:** Lindongate development, Lincoln City Centre. Approx 34,000sqm of A1 retail, 4,000sqm of A3 restaurant & bar use, 21 apartments of C3 residential, New Bus station, up to 900 space carpark (680 short stay, 20 residential, 150 long stay network rail) | 3.8 | 21 | 2015 |
| **Network Change:** East West Link Phase 1 - Lincoln City Centre | | | 2014 |
| **Network Changes:** Railway Crossings, Brayford Wharf East. Barrier downtime increased to 27min/hr | | | 2014 |
| **Development:** Ruston Works, Pelham Street, Lincoln (CL533) | | 819 | 2021 |
| **Development:** Land at Firth Road (CL534) | | 200 | 2021 |
| **Development:** Mill Lane/Newark Road, North Hykeham (CL1113) | | 314 | 2016 |
| **Development:** BW(M)1 (part of remaining capacity) (CL1535) | | 302 | 2016 |
| **Development:** G11 Foxby Lane, Park Springs Road (CL1633) | | 275 | 2016 |
| **Development:** LF2/3 Land off Wolsey Way (CL1687) | | 374 | 2016 |
| **Development:** Former Lincoln Castings Site A, Plot 1, Station Road, North Hykeham (CL2098) | 10.3 | 310 | 2021 |
| **Development:** Former Lincoln Castings Site A, Plot 1, Station Road, North Hykeham (CL248) | | 229 | 2021 |
| **Development:** Local Plan Allocation H9, Land North-West of Nettleham Road (CL515) | | 213 | 2016 |
| **Development:** Land between, Newark Road/Mill Lane, North Hykeham, Lincoln (CL58) | | 206 | 2016 |
| **Development:** Land at Ruston Way, Brayford Enterprise Park, Lincoln LN6 7FS (CL607) | | 226 | 2016 |

| Committed Development: Location & Description | Size (ha) | Size (units) | Site Open Date |
|---|---|---|---|
| **Development:** E2V Engineering works, Carholme Road, Lincoln (CL770) | | 255 | 2016 |
| **Development:** Cardinal Grange, 544 Newark road , North Hykeham, Lincoln (CL81) | | 322 | 2016 |
| **Development:** Former Lincoln Castings Site B, Station Road, North Hykeham (CL927) | 1.02 | | 2016 |
| **Development:** Land east of Lincoln Road, Skellingthorpe (CL994) | | 207 | 2016 |

16.4.8 There is potential for cumulative impacts developing during the construction phase of the scheme. If the construction phases of the Proposed Scheme and any of the identified committed developments coincide there is potential for increased impacts of the site activities to interact and increase. Areas that have the potential to have a cumulative impact interaction during construction on nearby receptors include Noise & Vibration, Landscape, Air Quality, Landscape, Ecology, Water Environment and Effects on all Travellers. For example noise, vibration and dust levels from two nearby construction sites will cause more disturbance/impacts on the local residents, than if the schemes where delivered in isolation.

16.4.9 The construction activities for Proposed Scheme will be undertaken under strict controls and best practice methodologies to minimise the construction impacts of the scheme on sensitive receptors. These mitigation and best practice measures are outlined in the Schedule of Environmental Commitments, Chapter 17. It is assumed as a condition of planning permission being granted that these other developments would be required to implement methodologies to reduce their impacts also. As such, it is considered the potential cumulative impact would be minor.

## 16.5 Conclusions and Effects

16.5.1 No significant cumulative impacts are anticipated for the scheme, provided that all the environmental commitments detailed in Chapter 17 are followed.

# 17 Schedule of Environmental Commitments

17.1.1 The table below presents a summary of the mitigation and enhancement measures proposed and environmental commitments made in the previous chapters.

17.1.2 These measures will avoid, minimise, offset or compensate for potential adverse environmental impacts and effects of the Lincoln Eastern Bypass Scheme and will be implemented at Detailed Design, Pre-Construction and/or Construction Stage. Enhancement measures will result in beneficial/positive impacts.

*Table 17-1 Schedule of Environmental Commitments*

| Environmental Commitment | Point of Implementing Mitigation Measure | Monitoring Requirements | Additional Consultation Requirement and Comments |
|---|---|---|---|
| **Flood Risk and Drainage** | | | |
| Measures are to be included in the design stage of the proposed scheme to mitigate potential impacts on drainage and flood risk. These measures will include but are not limited to;<br>• The use of SUDs solutions on outfalls identified under HAWRAT & EQS.<br>• Drainage system to be sealed to prevent groundwater infiltration.<br>• Shut off valves will be installed on all drainage networks to isolate the network in the event of accidental spillages.<br>• Discharges to be attenuated to Greenfield runoff rates.<br>• Road and footbridge to be located to minimise the loss of floodplain and to protect the integrity of the watercourse banks.<br>• Where the scheme impinges on the River Witham floodplain, compensation will be provided (for 1 in 100yrs flood + 30% Climate Change capacity).<br>• Riverbank erosion protection installed where necessary to protect the bridge piers and abutment<br>• Watercourse diversions will be aligned and profiled to maintain hydraulic capacity. Where erosion protection is required for diverted channel, soft engineering techniques will be used where feasible.<br>• Road cuttings which intercept the groundwater table will be designed with appropriate drainage to deal with groundwater flows. | Detailed Design | N/A | Liaise with Environment Agency and Anglian Water |
| Specific Construction Method Statements (CMS) will be developed and implemented for construction works in or near the watercourses. These will include<br>• Details of methods proposed to control run-off from site and minimisation of sediment pollution of the watercourses.<br>• Adherance to Environment Agency Pollution Prevention Guidelines.<br>• The development of an emergency pollution response plan and deployment of spill kits to address the risk of accidental spillages.<br>• Measures for the appropriate usage, storage and transport of fuels, materials and | Construction | | Liaise with Environment Agency and Anglian Water |

| Environmental Commitment | Point of Implementing Mitigation Measure | Monitoring Requirements | Additional Consultation Requirement and Comments |
|---|---|---|---|
| waste to minimise the risk of a pollution incident.<br>• A programme of water quality monitoring on the relevant watercourses, upstream and downstream of the working corridor.<br>• A programme of post-construction geomorphological monitoring to ensure the proposed channel modifications, in particular the channel diversions/realignments, have bedded in and are stable. | | Watercourse water quality monitoring<br>Post-construction geomorphological monitoring | |
| **Geology and Soils** | | | |
| It is understood that the proposed highway embankment will obscure a small part of the rock exposure at Greetwell Hollow Quarry but other exposed areas of the sequence will remain visible. As part of the Proposed Scheme, it may be possible to engineer improved/safer pedestrian access to the exposed outcrop via the proposed embankment. Whilst this will not mitigate against obscuring part of the rock outcrop, it is considered that the construction of improved access to the outcrop will provide a positive benefit to those wishing to study the geological formations. | Pre-construction / construction | N/A | Liaise with Natural England on works at Greetwell Hollow Quarry SSSI. |
| Further assessment of the encountered areas of made ground/waste materials is considered necessary to identify suitable disposal routes for materials requiring excavation, including re-use within the Proposed Scheme. Further assessment will also be necessary to identify engineering solutions to prevent made ground/waste materials remaining in situ from further impacting the surrounding environment.<br>Detailed mitigation measures of impacts from made ground/contaminated materials encountered during construction cannot be easily provided at this stage, but will need to be managed by the contractor through their method statements and good construction practices, and controlled with a Construction Environmental Management Plan. | Construction | N/A | Measures will be set out in the Construction Environmental Management Plan (see General/Other Commitments). |
| The Proposed Scheme is within a nitrate sensitive area, due to the limited drift cover. Consideration will be given to this designation when considering fill materials for import, to ensure they will not impact the nitrate sensitive area. | Detailed design | N/A | N/A |
| In order to minimise the impact of off-site disposal of surplus excavated materials or the impact of importing fill materials, a cut and fill balance exercise will be undertaken. | Detailed Design | N/A | N/A |

| Environmental Commitment | Point of Implementing Mitigation Measure | Monitoring Requirements | Additional Consultation Requirement and Comments |
|---|---|---|---|
| Detailed design of new embankments and cuttings Will fully consider hydrology and hyrdrogeology to ensure minimal impact on the surface water and groundwater flow. | | | |
| The mitigation of landslip potential is to be undertaken at the detailed design stage and could include:<br>- shallow slope angles to achieve a suitable factor of safety<br>- soil nailing where shallow slopes are not possible | Detailed Design | N/A | N |
| **Landscape and Visual** | | | |
| The proposed scheme design will minimise the height of embankments and structures where appropriate to minimise the extent the scheme will be visible within the wider environment.<br><br>Extensive areas of screening planting will be included to screen views of traffic and low level street furniture.<br><br>Mitigation planting consisting of native tree and shrub planting, hedgerows and wildflower planting will be used to reinstate the scheme area on completion of the construction works. | Detailed design & Construction | Monitoring of planting during prolonged dry periods – re-watering may be required. | N/A |
| **Noise and Vibration** | | | |
| The construction delivery partners will incorporate specific noise abatement measures as part on the Noise and Vibration Management Plan which Will be implemented during the construction phase.<br><br>It is recommended that a Noise and Vibration Management Plan in line with BS5528 is agreed with the local Environmental Health Officers and implemented by the contractor. This Will also include any Temporary Traffic Management (TTM) plan, for example traffic re-routing and diversions. | Construction | N/A | Liaise with the local authority Environmental Health Officer (EHO)<br>Measures will be set out in the CEMP (see General/Other Commitments). |

| Environmental Commitment | Point of Implementing Mitigation Measure | Monitoring Requirements | Additional Consultation Requirement and Comments |
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| The Highways Agency advise that a maximum reduction of -3.5dB(A) can be achieved by the use of thin low noise surfacing (LNS) compared to the standard hot rolled asphalt (HRA) road surfacing. It is important to note that the traffic noise reduction of -3.5dB(A) applies to roads where the mean traffic speed is above or equal to 75km/hr. LNS will be therefore applied, where practicable, along sections of the scheme where significant adverse noise impacts have been identified. | Detailed design | N/A | |
| **Air Quality** | | | |
| The contractor will plan, follow and apply detailed dust control and management procedures as outlined in Chapter 11 Air Quality. These will be included in the Construction Environmental Management Plan (CEMP) | Pre-Construction and Construction | Complaint receipt and management procedures to ensure issues are addressed, should they be raised by the public. | Measures will be set out in the CEMP (see General/Other Commitments). |
| **Archaeology and Cultural Heritage** | | | |
| The proposed scheme has the potential to damage or destroy known and unknown archaeological remains during construction. The preferred mitigation measure will be to avoid all assets and to preserve the archaeology in situ. Where this is not possible, the assets are to be investigated and recorded allowing for preservation by record. Specific mitigation measures have been identified for each of the known assets to be affected and these are detailed in Chapter 12. All works will be detailed in a Written Scheme of Investigation (WSI) and will be agreed with the Lincolnshire Historic Environment Manager prior to the commencement of works.<br>Where significant remains are encountered these will need to be discussed with the Lincolnshire Historic Environment Manager to determine further mitigation if required. | Detailed design/construction | N/A | Consultation with the County Historic Environment Manager and City Archaeologist. |

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| Archaeological monitoring will be maintained on the area between Wragby Road and Heighington Road and the areas adjacent to Sleaford Road and Bloxholm Lane. | Construction | N/A | Consultation with County Historic Environment Manager and City Archaeologist. |
| In order to remove part of the Important Hedgerows (Reference 204 and 205) a Hedgerow removal notice will need to be submitted along with the planning application. | Pre-construction | N/A | Consultation with Lincolnshire County Council |
| Sympathetic Landscaping will be used to soften impact of the proposed scheme on the wider setting. Directional lighting at night will help to limit the visual impact on the setting of the built heritage assets at night. | Pre-construction/ construction | Monitoring of planting during prolonged dry periods – re-watering may be required. | |
| It is proposed that an English Heritage level 2 Historic Building Record is created of the railway underpass and its immediate setting prior to the commencement of construction works. This will include a written record, photographic record and measured plan. The survey will be detailed in a Written Scheme of Investigation (WSI) which will be approved by the Lincolnshire Historic Environment Manager prior to the survey being undertaken.<br>In addition It is proposed that an English Heritage level 1 photographic survey of the landscape is prepared prior to the commencement of construction works. | Pre-construction | N/A | Refer to English Heritage<br>Level 1 & 2 Standard. |
| **Nature Conservation and Ecology** | | | |
| To minimise the impacts of the construction phase on ecology, measures will be implemented to reduce risk and severity of pollution.<br>Works in or near to ecologically sensitive areas will be undertaken at times of the year when they are least likely to cause and adverse effect.<br>An Ecological Clerk of Works will be available to the construction team to advise on unexpected ecological issues that may arise during the course of works. The Ecological Clerk | Pre-construction and construction | N/A | N/A |

| Environmental Commitment | Point of Implementing Mitigation Measure | Monitoring Requirements | Additional Consultation Requirement and Comments |
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| of Works will advise construction personnel of likely ecological risks and will advise as to best practice that can be employed to manage these issues | | | |
| A general landscape and ecological mitigation proposal will be implemented to re-instate onsite designated sites and ensure that the sites' overall integrity and conservation objectives are maintained. This includes planting with appropriate species compositions within the extents of the designated sites and the establishment of new habitat to replace areas of woodland, grassland and scrub lost to development. | Pre-construction and construction | Monitoring of planting during prolonged dry periods – re-watering may be required. | |
| Bats<br>During preconstruction further confirmatory bat surveys at Greetwell Hollow Quarry and Greetwell Wood SNCI will be undertaken to confirm absence of roosting bats. This will inform the potential requirements for European Protected Species Licensing from Natural England.<br>Where possible, existing hedgerows will be safeguarded and retained and new native hedgerows designed to integrate with commuting routes and adjust flight lines towards safe crossing routes (underpasses and hop-overs) | Pre-construction | N/A | Natural England for EPS license application may be required. |
| During construction the Schedule of Works will be developed to consider undertaking works at the least sensitive times and locations. Night working will be avoided wherever possible, in the vicinity of known commuting routes and foraging habitats. Consideration will be made to the lighting design (temporary and permanent) and locating the site compound to avoid sensitive locations.<br>Bat Boxes will be erected in existing woodland areas as an enhancement measure. | Construction | N/A | |
| Badgers<br>At least one active badger sett is present within the study area. If works occur within 30m of any of the entrances to this sett, specific mitigation will be required. Furthermore, badgers are known to move between territories and establish new setts from year to year. For this reason, it is recommended that badger surveys are repeated throughout the entire study area during the year and at least three months prior to the commencement of works. Confirmatory checks Will also be made within the footprint of the works and up to 30m distance immediately prior to works. This will confirm the locations and status of any badger setts potentially affected by the scheme. If works occur within 30m of a sett, specific mitigation is likely to be necessary and this may require a licence from Natural England to be obtained. Works affecting badger setts | Preconstruction | N/A | Natural England for EPS license application. |

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| undertaken under licence will to be restricted to the period 1st Nov – 30th June. | | | |
| Construction – Contractors will be vigilant for badgers which may enter the works area. If badgers are found, an ecologist will be notified for advice to offset potential impacts. As best practice, in areas known to support badgers, trenches Will be covered overnight to prevent badgers form falling in or trenches will include earth ramps to allow badgers to climb out.<br>Works covered by a badger licence, and works close to known setts should be completed under ecological supervision.<br>Vegetation clearance close to badger setts will be undertaken in a sensitive manner with regard for potential effects on badgers. Badger/ mammal paths should be cleared of any felled trees or scrub.<br>Badger fencing and mammal tunnels will be installed to enable badgers to have access to foraging area without the need to cross the highway.<br>Works close to setts will be restricted at night to reduce disturbance to any badgers which may be leaving or returning. If night works are essential then they will be completed under ecological supervision.<br>Toolbox talks to be given to contractors to make them aware of the presence of badgers nearby, and the legal implications of their presence. Site workers will be instructed to stop works and consult a suitably qualified ecologist if they see or disturb a badger while working on site. | Construction | N/A | N/A |
| Water Voles<br>Water voles will be persuaded from using stretches of watercourses that are likely to be impacted by the development. Vegetation will be removed from these stretches in advance of the works. Vegetation removal will continue at regular intervals throughout the duration of the construction period to discourage water voles from returning.<br>Post construction, mammal tunnels may be required to ensure that there is connectivity between habitats suitable for water vole. | Preconstruction/ Construction/ Post Construction | N/A | N/A |
| Otters<br>Mitigation to avoid increased road fatalities during the operational phase consists of design considerations to allow otters to avoid crossing the road such as mammal tunnels, ledges beneath bridges and strategically located fencing. | Preconstruction/ Construction/ Post Construction | N/A | N/A |

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| Kingfisher<br>The operational phase of the proposed scheme will only be likely to have a minor impact on kingfisher but adverse effects could arise during construction if kingfishers choose to nest in burrows within the works area at this time. Pre-construction checks for this species in suitable areas within the works area will therefore be undertaken prior to works by an ecologist | Construction | N/A | N/A |
| Nesting Birds<br>Any necessary vegetation clearance works will be undertaken outside the main bird breeding season (March to July) if at all possible. Should works be required to take place during these dates, an ecologist or watching brief will attend the site to check for the presence of species within patches of vegetation prior to the commencement of works | Construction | N/A | N/A |
| A pre-construction walkover survey will be carried out to access whether any over-wintering birds are present. In order to deter overwintering birds from works areas, equipment will be present on site, and ideally works will have commenced, by mid-August. | Preconstruction | N/A | N/A |
| Reptiles<br>Areas providing habitats of likely value to reptiles within the works area will be prepared in advance to minimise risk of adverse effects on reptiles. It is recommended that in these areas, vegetation is strimmed to a height of 10-15cm and hand searches of refugia and potential shelters are undertaken to remove any reptiles present. Reptiles that are found will be moved into adjacent areas of suitable habitat outside the works area. Following completion of construction, areas of vegetation could be enhanced for reptiles by creating artificial hibernacula such as piles of wood and stone. | Construction | N/A | N/A |
| Habitats<br>Construction phase impacts can be minimised by strict compliance with all environmental regulations, particularly those relating to working beside watercourses to minimise the risk of sediment or chemical pollutants entering any of the watercourses comprising the River Witham corridor.<br>Operational phase impacts can be mitigated by compensating for lost areas of valuable habitat such as woodland, hedgerows and waterbodies, through habitat creation measures. | Construction/ Post Construction | N/A | N/A |

| Environmental Commitment | Point of Implementing Mitigation Measure | Monitoring Requirements | Additional Consultation Requirement and Comments |
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| **Community Effects** | | | |
| Mitigation measures for construction phase impacts on land and property will include;<br>Controlled operational hours to minimise disruptions due to construction traffic at peak times; and<br>Temporary fenced-off pedestrian routes and clear signage to ensure safe pedestrian routes across working areas. | | | |
| To minimise the impacts on land use, consultation with all landowners will be considered as part of the execution of the proposed scheme.<br>Appropriate scheduling of construction tasks and activities with respect to each landowner and their various land uses will then be considered. | | | |
| Where the proposed scheme would involve land-take on the boundary of private properties, boundaries will be reinstated as part of the accommodation works for the proposed scheme. | Construction | N/A | N/A |
| Accommodation works will be provided to maintain access (where economically viable), services and a secure boundary. These works will be agreed with the individual landowners prior to the construction phase. Similarly, the contractors will ensure that access to severed land is maintained during the construction phase. | Detailed design/ Construction | N/A | Liaise with the affected landowners |
| **Effects on All Travellers** | | | |
| During the construction phase the proposed mitigation requirements are based around reducing disruption to travel routes. A carefully considered schedule of works will ensure temporary diversion routes are in place as required and that closures are timed for off peak times and months. Clear notification and signage of diversions and safe routes will be deployed. | Construction | N/A | Liaison with Lincoln County Council |
| A clearly organised traffic management plan will be implemented for traffic using the road network during the construction of the scheme in order to prevent travellers' stress and reduce congestion that might otherwise result from the works. | Preconstruction | N/A | Liaison with Lincoln County Council |
| **General / Other Commitments** | | | |
| A Construction Environment Management Plan (CEMP) will be implemented to manage and monitor potential impacts. The CEMP will be prepared prior to the construction phase and will be broadly based on the 'Environmental Good Practice on Site' (C692) produced by CIRIA (Construction Industry Research and Information Association). | Pre-construction | N/A | N/A |

| Environmental Commitment | Point of Implementing Mitigation Measure | Monitoring Requirements | Additional Consultation Requirement and Comments |
|---|---|---|---|
| A Site Waste Management Plan (SWMP) will be prepared for management of waste produced from the construction of all phases of the proposed development to conform to SWMP Regulations (2008/134). | Pre-construction | N/A | N/A |
| A comprehensive construction traffic management plan will be implemented during the development to conform to all relevant standards and, wherever possible, seek to prevent disruption to residents and other users. | Pre-construction and construction | N/A | N/A |
| A detailed schedule of imported construction materials will be produced for the development. This will include an earthworks balance which will reflect the amount of suitable materials that could be recovered from the development site. | Detailed design / construction | N/A | N/A |