JACOBS

M11 Junction 7A

Essex County Council

Volume A

Environmental Statement

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RINGWAY JACOBS

integrated expertise

Essex County Council

M11 Junction 7A

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Contents

Executive Summary

This section summarises the findings of the Environmental Impact Assessment (EIA) detailed in this Environmental Statement (ES).

Essex County Council (ECC) is proposing to provide a new motorway Junction (7A) for the M11 motorway between Junction 7 and 8, a new road linking the junction to the existing Gilden Way (B183) and widening of Gilden Way in Harlow. Harlow is currently the primary economic and growth centre in West Essex, with 16,000 new homes expected to be built and thousands of new jobs planned over the next 20 years (as outlined in the surrounding districts adopted Local Plans). Harlow is ideally placed, being close to the M11 and M25, on the West Anglia Main Line railway and close to Stansted Airport. Access to Harlow is, however, restricted with only one link to the strategic road network (via Junction 7 of the M11) and although Harlow has two railway stations they are located on the northern edge of the town. Junction capacity assessment has confirmed that Junction 7 is already at capacity and the primary road access to the town, the A414, is heavily congested during peak hours with the impact felt on the wider Harlow road network.

Jacobs has been commissioned by ECC to design a scheme to alleviate congestion primarily for the A414 corridor, improve accessibility to and from Harlow, and facilitate and support the traffic demands of stated growth in terms of housing developments and employment growth. Without the additional link to the M11 (Proposed Scheme), Harlow and the surrounding area would not be able to realise their full potential.

Construction

The assessment of construction impacts on the environment has been based on the following construction methodology. The methodology incorporates good practice within the constraints of the site and the design. The approach to construction is currently indicative and therefore, could be amended by the Principal Contractor responsible for building the Proposed Scheme. If the contractor were to use a different methodology, a review of potential impacts would need to be carried out with an explanation of why the alternatives were preferable to those proposed in the ES.

Construction of the Proposed Scheme would be spilt into three main phases known as ‘Phase 1’, ‘Phase 2A’ and ‘Phase 2B’. Site set up would involve establishing construction compounds (including welfare cabins), haul routes, soil storage, lorry holding areas and top soil storage areas. It is anticipated that the construction would take approximately 40 months, commencing in 2019, with advance work occurring in 2018, and completion of Phase 2B in 2021. The construction programme has taken into consideration the seasonal nature of the environmental constraints such as ecology, landscape and archaeology.

Development of the scheme

Before the Proposed Scheme was chosen, a number of alternative options were considered, including a Northern Bypass and improvement of M11 Junction 7. A series of non-statutory consultations (Public Information Events (PIE)) on scheme options and alternatives were held from December 2013 to March 2014 and in July 2015 to allow consultees to influence the development of the scheme to meet the needs of the local community and the project objectives. Through option evaluation, the Proposed Scheme ranked the highest (best option) in terms of meeting the scheme objectives and was taken forward to the next stage of design development.

A formal public consultation for the scheme was launched on the 11th May 2016 and lasted until 6th July 2016 prior to a Proposed Scheme announcement and the submission of the planning application (which is scheduled for the 23rd January 2017). The scheme was widely publicised through several platforms including: exhibition events; advertisements in local newspapers and local radio. Letters were sent directly to selected stakeholders. Consultees were encouraged to attend public exhibitions and complete an online questionnaire. Their concerns on environmental effects were taken into consideration and the Proposed Scheme has been designed to reduce potential environmental impacts through mitigation embedded into the design, including:

- removal of the high level loop structure between Sheering Road Roundabout and the M11 to reduce visual impacts;
- shift of scheme alignment southwards and then northwards to protect and avoid rows of mature trees and The Mores Wood, respectively;
- modification of construction layouts to avoid impacts to mature trees;
- upgrade of two existing and introduction of three new pedestrian crossings;
- provision of a combined pedestrian/cycleway from London Road Roundabout to the existing Sheering Road;
- provision of two 2x2m landscaped multi-species underpasses to facilitate movement of bats, badgers and other mammals beneath the proposed road;
- extensive landscape planting with native species for screening and habitat replacement purposes;
- installation of hop-overs (comprising fencing, tree planting and controlled lighting) to encourage bats and birds to fly over live traffic paths on the new carriageways;
- timings of construction activities programmed with consideration given to ecological, landscape and archaeological constraints;
- lining of attenuation ponds and tanks to prevent impacts to aquifers; and
- provision of LED lighting and lower lighting columns to reduce night glow and impacts on residential properties and wildlife.

Essex County Council cabinet approved the preferred scheme on the 13th of December 2016.

Methodology

An Environmental Impact Assessment has been carried out in accordance with Design Manual for Roads and Bridges (DMRB) methodologies and their associated Interim Advice Notes (IANs). Where DMRB guidance provides limited detailed guidance or has become outdated, expert opinion or professional judgement has been used to assess the impact. In addition, references have also been made to more up-to-date methodologies where these are considered to be industry best practice.

Residual effects

Table A provides a summary of residual environmental effects following implementation of the proposed mitigation. Impacts with Neutral residual effects after mitigation have been excluded from the table but are described within relevant topic chapter in the ES. Impacts without mitigation are also described within the individual topic chapters. Following mitigation, some impacts would not be fully mitigated and would remain the same.

Table A: Summary of residual environmental effects after mitigation

Description of impacts	Proposed mitigation	Residual effects (after mitigation)
Air Quality (Chapter 5) (no residual effects)		
Cultural Heritage (Chapter 6)		
Archaeological remains	Implementation of a staged programme of archaeological investigation, followed by assessment, analysis and publication of results.	Slight Adverse
Setting of historic buildings	Photographic survey informed by Historic	Neutral to Slight

Description of impacts	Proposed mitigation	Residual effects (after mitigation)
	England guidance and landscape planting referred in Landscape and Visual section below.	Adverse
Landscape and Visual (Chapter 7)		
Loss of mature woodland protected by Tree Preservation Order (TPO) (0.43 hectares (ha))	Proposed woodland planting totalling over 16ha. Woodland planting could not be fully mitigated for the loss of mature trees.	Moderate Adverse
Loss of other woodland/hedges and scrub (3.12ha)	Proposed woodland hedges and other native planting totalling over 19ha (including the 16ha above), plus planting areas of scattered scrub and 361 individual trees of a larger size. Woodland planting could not fully mitigate for the loss of mature trees.	Slight Adverse
Effect of proposed lighting	Proposed planting would not mitigate for road lighting. The new LED lighting would be directional and focused on the road to limit light spill to adjacent properties.	Neutral in Harlow (urban), Moderate Adverse in the countryside (rural)
Effects of scheme earthworks on landform	Proposed earth mounding would not mitigate effects on landform but landscape planting would soften and disguise embankments and cuttings. However, the impact would still remain the same.	Moderate Adverse
Reduction of tranquillity	Extensive screen planting with woodland, hedges, scrub and planting of many individual trees.	Slight Adverse
Effect on the townscape of the Harlow local character areas due to vegetation losses and the visual severance effect of road widening and noise barriers	Replacement hedge and tree planting and amenity planting; hedges and climbing plants to screen noise barriers.	Slight Adverse
Effect on the landscape character in the Pincey Brook valley due to encroachment of roads roundabouts, lighting and traffic into the Pincey Brook valley	Earth mounding, extensive screen planting with woodland, hedges, scrub and planting of many individual trees.	Moderate Adverse (local)
Visual effects at residential properties	Reinstatement of roadside hedges and other screen planting.	0 Large Adverse; 9 Moderate Adverse; 73 Slight Adverse; and 9 Slight Beneficial (Year 15)

Description of impacts	Proposed mitigation	Residual effects (after mitigation)
Visual effects on road users (Sheering Road north of Pincey Brook)	Reinstatement of roadside hedges and other screen planting.	Slight Adverse (Year 15)
Visual effects on Public Right of Ways (PRoWs) (Each PRoW only recorded once at location with greatest effect)	Reinstatement of roadside hedges and other screen planting; however, for one receptor the impact would still remain the same.	1 Large Adverse; 0 Moderate Adverse; and 9 Slight Adverse (Year 15)
Nature Conservation[1] (Chapter 8)		
Habitat loss – Gilden Way Roundabout Protected Wildlife Verge (PWV)	Compensation and enhancement landscape planting of species-rich grassland especially Betony (local rare plant). However, the impact would still remain the same as the PWV would be lost.	Slight Adverse
Habitat loss – bats	Removal of recorded bat roost trees to be undertaken under Ecological Protected Species (EPS) licence. Compensation planting and woodland reinforcing planting would be carried out for the loss of confirmed and high potential roost habitat. However, the impact would still remain the same.	Slight Adverse
Reduction in local birds population from habitat loss/fragmentation especially for skylark	Timings control on vegetation clearance in construction programme to ensure that the bird nesting habitat is removed outside the nesting season. Introduction of hop-over fences, acoustic fencing and reduction of speed limit to off-set increase risk of traffic collision to birds. Provision of LED lamps, lower lighting columns and landscape planting to reduce disturbance to birds. However, the impact would still remain the same.	Slight Adverse
Impact to foraging and commuting bats from traffic collision, noise/air pollution and night-time light levels	Provision of multi-purpose mammal underpasses, hop-over fences, acoustic fences, associated landscape planting, reduction of speed limit and sensitive lighting to reduce disturbance to bats and the risk of collision with traffic.	Slight Adverse

[1] It should be noted that the term 'adverse' is used in preference to 'negative' as is used in the CIEEM Guidelines and in Chapter 8 – Nature Conservation within the Environmental Statement in this table. This is to provide consistency in terminology across all discipline sections within the table.

Description of impacts	Proposed mitigation	Residual effects (after mitigation)
Impacts to local otter population	Implementation of good practices and Construction Environmental Management Plan (CEMP). Provision of multi-species underpasses in combination with fencing, landscape planting and sensitive lighting to reduce disturbance to otters and the risk of collision with traffic.	Neutral to Slight Adverse
Geology and Soils (Chapter 9)		
Dust or mud from soils containing elevated concentrations of contaminants impacting on general public	A Construction Environmental Management Plan (CEMP) would be prepared and implemented to control contamination risk to the public.	Neutral to Slight Adverse
Loss of high grade agricultural soils within the scheme footprint	Manage and reduce loss of soil with Soil Management Plan (SMP) and Materials Management Plan (MMP); however, would not be fully mitigated, loss could only be reduced.	Slight to Moderate Adverse
Gas accumulation in voids	Additional monitoring and gas sample collection to refine gas risk assessment and design mitigation measures as part of the Proposed Scheme, if required.	Slight Adverse
Risk of encountering Unexploded Ordnance (UXO)	Recommended that a targeted investigation would be carried out prior to any construction works commencing. There is a risk associated with UXO. The slight adverse effect refers to the risk posed.	Slight Adverse
Risk of encountering unstable ground conditions	Potential ground instability would be mitigated as part of the Proposed Scheme design. The slight adverse effect refers to the design risk.	Slight Adverse
Contamination from road operation	Monitoring would be carried out following construction to assess adequacy of protective measures and that any need for corrective action would be identified in a timely manner.	Neutral to Slight Adverse
Materials (Chapter 10)		
Material use and depletion (i.e. virgin aggregates)	Maximising the use of local materials and effectively managing materials use on site. Provision of a Site Waste Management Plan (SWMP) incorporating targets for recycling and waste minimisation and CEMP.	Slight Adverse
Use of imported materials (i.e. blacktop, steel, concrete)	Maximising the use of local and/or recycled materials. Provision of a SWMP incorporating targets for recycling and	Neutral to Slight Adverse

Description of impacts	Proposed mitigation	Residual effects (after mitigation)
	waste minimisation and CEMP. However, the impact would still remain the same.	
Carbon footprint of materials transport and use	Carbon monitoring and management and maximising the amount of material resources and waste to be re-used on-site. Provision of a SWMP incorporating targets for recycling and waste minimisation and CEMP. However, the impact would still remain the same.	Major[2] Adverse
Noise and Vibration (Chapter 11)		
Traffic noise in vicinity of the Proposed Scheme during operation	Provision of noise barriers, landscaping and low noise road surfacing; however, not all receptors would be mitigated from noise due their proximity to the Proposed Scheme and their heights.	Minor to Moderate Adverse (short term) Negligible to Minor Adverse (long term)[3]
Traffic noise to the wider area during operation	Provision of acoustic noise barriers, landscaping and low noise road surfacing; however, not all receptors would be mitigated for noise due their proximity to the Proposed Scheme and their heights.	Overall Beneficial (short term) Overall Neutral to Slight Adverse (long term)[3]
People and Communities (Chapter 12)		
Loss of Best and Most Versatile (BMV) Grades 2 and 3a agricultural land	Loss of good quality land would not be mitigated against, but owners would be compensated.	Large or Very Large Adverse
Entire Scheme (Driver Stress)	Reduced congestion, improved accessibility and lower speed limits.	Beneficial[4]
Road Drainage and Water Environment (Chapter 13)		
Contamination risk to groundwater (during construction)	Implementation of good practices and a CEMP would be in place during construction.	Slight Adverse
Changes to fluvial geomorphology through presence of outfalls, particularly altering flow processes (Pincey Brook and Harlowbury Brook)	Mitigation by following good practice design, using existing outfall structures and inclusion of attenuation ponds.	Slight Adverse
Pollution incidences effecting water quality	Appropriate Sustainable Urban Drainage System (SuDS) and emergency procedures would be put in place.	Neutral to Slight Adverse
Road cuttings intercepting groundwater	Mitigation would not be possible. Slight adverse effect considered acceptable.	Slight Adverse
SuDS providing a route for	Lining of ponds. Implementation of an	Slight Adverse

[2] Carbon assessment in DMRB guidance only assess the magnitude of an impact and not sensitivity, therefore, 'Major' has been used.
[3] DMRB HD 213/11 advice, only to assess the magnitude of an operational impact and not sensitivity, terms used to express residual effects in this table are used in line with the guidance.
[4] Views from the road and driver stress have only been assessed as beneficial, neutral and adverse.

Description of impacts	Proposed mitigation	Residual effects (after mitigation)
potential contamination to groundwater	appropriately designed drainage system.	
Cumulative effects - Type 1 (Chapter 14)		
Cultural heritage: noise, vibration and visual changes	Reinstatement of roadside hedges and other screen planting. Provision of noise barriers, landscaping and low noise road surfacing.	Minor Adverse
Some properties in London Road to Churchgate: increased noise levels, decreased air quality, visual degradation and some severance	Careful positioning of noise barriers and mitigation of visual degradation through screen planting including hedges.	Minor Adverse
Properties from Churchgate Roundabout to Pincey Brook roundabout: alterations in views. However they would benefit from improved air quality traffic flows and traffic reduction along the old Sheering Road	Mitigation of visual impacts through screen planting including hedges.	Minor Beneficial
Recreational users of playing fields: loss of land and visual alterations. Reduced noise, retention of games equipment and reduced visual intrusion	Use of screen planting. Loss of land would not be mitigated against, but would be compensated.	Minor Beneficial
Nature conservation: increased noise, traffic collisions and visual disturbance to local wildlife	Provision of multi-purpose mammal underpasses, hop-over fences, acoustic fences, associated landscape planting, reduction of speed limit and sensitive lighting to reduce disturbance to bats and the risk of collision with traffic.	Minor Adverse
Cumulative effects - Type 2 (Chapter 14)		
Impacts from new developments may increase impact on cultural heritage	None proposed. Assess information on local developments as it becomes available.	Slight Adverse
Increased conflict with the character of the landscape and diminished sense of place	None proposed. Assess information on local developments as it becomes available.	Moderate Adverse
Loss and fragmentation of habitats would increase. Increased predation by cats. Further loss of bat flight lines and lighting impacts	None proposed. Assess information on local developments as it becomes available.	Slight Adverse

Description of impacts	Proposed mitigation	Residual effects (after mitigation)
Low additional loading of groundwater with pollutants from road surfaces and spillages	None proposed. Assess information on local developments as it becomes available.	Neutral to Slight Adverse
Additional loss of agricultural soils	None proposed.	Slight to Moderate Adverse
Increased pressure on resources	Lack of waste arising and materials information.	Not known
New community facilities may be proposed	None proposed. Assess information on local developments as it becomes available.	Minor Beneficial
Loss of best and most versatile agricultural land impacting farming in the locality	None proposed.	Major Adverse
Additional discharges to local watercourses	Assumption that appropriate mitigation will be adopted by the other developments such as: controlled rates of discharge, standard design, good practice and allowance for climate change.	

1. Introduction

1.1 Overview

Essex County Council (ECC) Major Programmes and Infrastructure is developing a proposal for improving access to and from the M11 near to Harlow. The project is for the provision of a new motorway Junction (7A) for the M11 between Junctions 7 and 8, new roads linking the proposed junction to the existing B183 (Gilden Way) and widening of Gilden Way itself. This is known throughout the Environmental Statement (ES) as the Proposed Scheme.

Jacobs have produced this ES on behalf of ECC to report findings of the Environmental Impact Assessment (EIA) undertaken to assess any likely significant effects of the Proposed Scheme and how they would be mitigated. The EIA required under the Town and Country Planning (EIA) Regulations 2011 (amendment 2015) examined the biological, physical and historic environment in accordance with the Design Manual for Roads and Bridges (DMRB) Volume 11 guidance (Highways England, 2009) and Interim Advice Notes (IANs). Interim Advice Notes are new guidance issued by the Highways England (formerly Highways Agency) yet to be incorporated into the DMRB.

1.2 Location of the Proposed Scheme

Harlow is situated in the west of the County of Essex. It is flanked by the M11 to the east which provides its main connectivity (via Junction 7) to the M25, London, Stansted Airport, Cambridge and the north east of England. It is also served by the West Anglia Main Line which provides a direct rail link into London Liverpool Street. Another major link within the county and into Hertfordshire is provided by the A414. The proposed motorway junction is located within Epping Forest District (EFD) and currently within Green Belt land in open, gently undulating countryside. The land is used predominantly for arable cultivation with some housing. The Pincey Brook bounds this area to the north with The Mores Wood to the south. The B183 Gilden Way part of the Proposed Scheme follows a green corridor into Harlow with mature hedgerows and trees along its length. Open countryside is replaced by houses and business premises towards Harlow town centre. The introduction of pavements, signal controlled pedestrian crossings and street lighting signals a change from rural to suburban character within the corridor.

1.3 The Objectives of the Proposed Scheme

The main objectives of the Proposed Scheme are:

- to improve accessibility to and from Harlow;
- to reduce congestion primarily for the A414 corridor;
- to ensure the proposed infrastructure is of an appropriate scale for future traffic demands of the stated growth; and
- to facilitate future housing developments around Harlow and employment growth to the east of Harlow.

It is anticipated that the Proposed Scheme could achieve a number of additional outcomes including maintaining and improving the reliability of journey times along the A414 corridor, improving access between key centres and improving air quality by reducing Nitrogen Oxides (NO_x) emissions. Without an improved link to the motorway, the town and surrounding districts would not be able to realise their full potential.

1.4 Scope and Context of the Environmental Statement

1.4.1 Purpose of the Environmental Statement

This ES has been prepared in compliance with the current Town and Country Planning (EIA) Regulations 2011 (Amendment 2015). The main purpose of the ES is to:

- identify any likely significant environmental effects predicted to occur as a result of the construction and operation of the Proposed Scheme;
- detail the work that has been undertaken to consider alternative route options and design development;
- explain any environmental mitigation measures incorporated into the scheme design;
- explain the environmental mitigation measures included within the Environmental Management Plan (EMP); and
- assist the Planning Authority to make a decision on whether to grant consent to the Proposed Scheme given the predicted environmental impacts and proposed mitigations.

This ES aims to provide an accessible document reflecting the assessment carried out and gives due weight to the significant effects. It is a product of the EIA required under legislation. It has been produced at Project Control Framework (PCF) Stage 3 of the Proposed Scheme development (Highways Agency, 2013).

The main aims of the EIA process are to:

- provide full consideration of potential environmental impacts of the Proposed Scheme in a way that enables both the importance of the predicted effects and the scope for mitigating them to be properly evaluated; and
- allow public, statutory agencies and other bodies an opportunity to comment on the proposal and to take into account their environmental concerns.

1.4.2 Previous Environmental Impact Assessment documents

The ES follows an earlier Environmental Assessment Report (EAR) which was released in March 2016, as part of PCF Stage 2 and the Pre-application Planning Statement and Scoping Report (ECC, 2016a) released to ECC's Planning Department in January 2016.

A Screening Opinion (as to whether the scheme required an EIA) was not requested due to the accepted scale and complexity of the Proposed Scheme. A Scoping Opinion was, however, sought from the local planning authorities via ECC. For this purpose, the Scoping Report was produced outlining what were considered to be the main likely potential impacts. The objective of this pre-application report was to obtain an informal pre-application view from the local planning authorities on the Proposed Scheme and proposed future environmental work undertaken to support the preparation of the formal planning application for the Proposed Scheme.

1.5 Structure of the Environmental Statement

The ES includes a description of the Proposed Scheme, a summary of alternative options considered, assumptions used for the ES and a chapter detailing the assessment of potential impacts for each environmental topic.

The ES covers the topics covered within the latest DMRB guidance IAN 125/15, including Air Quality, Cultural Heritage, Landscape and Visual, Nature Conservation, Geology and Soils, Materials, Noise and Vibration, People and Communities and Road Drainage and the Water Environment. The ES has considered the emerging local plans from EFDC and EHDC in terms of indicative overall planned growth. However, Harlow has yet to publish their emerging local plan and each allocation lacks detail and has therefore not been assessed in the Cumulative Assessment chapter. The structure of the ES is set out in Table 1.1.

Volume A provides the main ES outlining existing conditions within the study area, potential impacts of the Proposed Scheme on the environment, suggested activities to mitigate the effects of those impacts and the residual effect once all suggested mitigations have been put in place. Volume B contains all the figures referenced within the main body of the ES and Volume C contains the Appendices.

In addition to this, a Non-Technical Summary has been produced. This is an integral part of the ES and provides an overview of the ES in a non-technical language.

Table 1.1: Structure of the Environmental Statement

Chapter	Contents
Non-technical Summary	This is a separate stand-alone document which highlights the principal findings of the ES. It is free from technical jargon and abbreviations.
Environmental Statement (Volume A)	
Executive Summary	This summarises the main findings of the ES
1. Introduction	This outlines the EIA process and the status of the current ES.
2. Characteristics of the Development	This provides an explanation of the need for the Proposed Scheme, a description and possible construction strategies.
3. Development of the Proposed Scheme	This includes a description of the development of the Proposed Scheme, the various options considered during the design process, consultation details and planning context involved.
4. Approach to the Assessment	This sets out the proposed general approach followed in undertaking the EIA. The chapter specifies the overarching principles, methodology and significance criteria to be adopted in the EIA, as well as general assumptions and limitations.
5-13. Environmental Impact Topics	Chapters 5-13 set out the scope of the EIA for each environmental topic, including (for each) the legislative context, definition of study area, a description of the baseline environment, identification of potential construction and operational impacts, proposed mitigation measures, and residual effects following implementation of mitigation.
14. Cumulative Assessment	This describes the cumulative impacts when the Proposed Scheme is considered in conjunction with other projects. Also it considers circumstances where more than one effect can influence a receptor or receptors.
15. Summary and Conclusions	This summarises potential impacts of the Proposed Scheme, and provides conclusions and recommendations.
Acronyms, Glossary and References	A description of the acronyms and definitions of technical terms (glossary). This section also lists document sources.
Figures (Volume B)	Contains figures referred to within the main ES.
Appendices (Volume C)	Contains the Appendices referred to within the main ES.

2. Characteristics of the Development

2.1 Background to the Proposed Scheme

Harlow is currently the primary economic and growth centre in West Essex, with 16,000 new homes expected to be built and thousands of new jobs planned in the next 20 years (current growth is identified in the adopted Local Plan/Core Strategy documents for each district further information is contained in the planning statement). Harlow is ideally placed, being close to the M11 and M25, on the West Anglia Main Line railway and close to Stansted Airport. Access to Harlow is, however, restricted with only one link to the strategic road network (via Junction 7 of the M11) and although Harlow has two railway stations they are located on the northern edge of the town.

The primary means of road access to the town, the A414, also serves as an important through route. With high levels of traffic using this one route, congestion is common with impacts of congestion often felt across the town's wider road network. A significant intervention is required to address the challenges of capacity, alongside road improvements. Furthermore, having largely been constructed in the 1950s and 1960s, much of the town's transport infrastructure is now ageing and was originally designed for a period of lower levels of car ownership and mobility. Junction capacity assessment work confirmed that the existing Junction 7 is already at capacity. The town centre is identified as an area for regeneration; a Local Enterprise Zone has been designated for employment growth and further increases in housing is proposed as part of the emerging Local Plans of both Harlow District and Epping Forest District Councils.

To facilitate and support this growth it is essential to improve access to the M11 motorway and improve the highway capacity within and around Harlow. Without an improved link to the M11 (and other planned improvements along the A414 corridor), the town and surrounding area would not be able to accommodate growth and realise their full potential. This proposal to create an additional junction onto the M11 between Junctions 7 and 8 would not only help to relieve congestion at Junction 7, but also help to redistribute traffic flows in and around Harlow by providing an alternative strategic connection to the north-east of the town.

2.2 Traffic Data

The traffic flow and speed figures provided for Air Quality and Noise and Vibration assessments were produced from the Harlow highway assignment Transport Model. The Local Model Validation Report (LMVR) details the base model specifications and performance against WebTAG criteria. This has been reviewed by Highways England (HE) and the model is considered to be fit for the purpose of assessing the impact of this Proposed Scheme.

Without the Proposed Scheme, existing traffic congestion at M11 Junction 7 is expected to worsen. Traffic modelling has been undertaken using best available existing local plan allocations and a best estimate of future deliverable growth informed by the emerging local plans. The results are contained within the Traffic Forecasting Report (TFR) which should be referred to for more information.

The TFR for the Harlow Transport Model specifies the future years assessed and the assumptions made in creating the forecast models. It also discusses key impacts of the Proposed Scheme upon traffic flow. Details of the housing and employment developments and planned infrastructure schemes included in each model are contained within the TFR.

All checking and reporting of these data follows the guidance in the 'IAN 185/15: Updated traffic, air quality and noise advice', serving as a supplementary document to the DMRB Volume 11.

The core medium growth modelling scenario outputs have been used as these represent the most likely growth scenario for the area around the M11 corridor at the time that the modelling was undertaken. This encompasses projected housing and employment developments from the emerging district Local Plans, planned growth at Stansted Airport, planned infrastructure schemes in the modelled area and background growth provided in theTrip End Model Presentation Program (TEMPro) for the areas of the model outside of the detailed model area. Two future years have been assessed, 2021, representing the opening year of the M11 Junction 7A and

2036, representing the horizon year 15 years after the Proposed Scheme would be due to open. The model includes a variable demand component, which takes into account likely changes in travel behaviour due to congestion which can for instance include changes in numbers of car trips in the peak hour and changes in destinations of these trips.

The forecast traffic figures for the link roads at scheme opening are predicted to be as shown in Table 2.1 below.

Table 2.1: Predicted traffic flows Annual Average Daily Traffic 24 to and from proposed M11 Junction 7A 2021

	Flow (No. of vehicles per day)	% Heavy duty vehicles
Westbound Link	16,704	2.1
Eastbound Link	11,961	2.2
Total	28,665	2.1

2.3 Detailed Description of the Proposed Scheme

The Proposed Scheme layout is shown on Figure 2-1 Sheets 1-4 in Volume B. More detail on the scheme is provided in the planning application document. It is recommended that the description of the Proposed Scheme that follows be read in conjunction with these figures. In addition, Figure 2-2 shows the overview of environmental constraints relating to the Proposed Scheme.

The M11 Junction 7A scheme begins, to the west, at the London Road Roundabout on Gilden Way (B183) and the proposal involves widening the existing two-lane road to three lanes. When completed, two of the lanes would take traffic in a westerly direction into Harlow Town and the third lane would take the outbound traffic towards Sheering and the new M11 Junction. Proposed improvements to Gilden Way would include the construction of a combined footpath/cycleway. Two existing pedestrian crossings would be signalised and upgraded and three new pedestrian crossings would be proposed. The Churchgate Roundabout (also known as Gilden Way Roundabout) would be upgraded to a 'hamburger' design roundabout to improve traffic flows along Gilden Way itself. As Gilden Way becomes Sheering Road in the east, it passes Marsh Lane on the left and Mayfield Farm on the right. Within the ES, the Proposed Scheme up to Mayfield Farm is known as "Gilden Way Area".

At Mayfield Farm, a new carriageway would be constructed which would realign the present route of Sheering Road to the east and link the existing Sheering Road with a new roundabout to be known as Sheering Road Roundabout. The existing Sheering Road would be converted into a local access road for use by residents of The Campions only, and would connect to the realigned Sheering Road via a new junction to the south west of the new Sheering Road Roundabout. A new access would be created for Mayfield Farm itself. Exiting the new Sheering Road Roundabout the proposed road would consist of three lanes towards a new Pincey Brook Roundabout; two of which would be north-eastbound and one south-westbound back towards the Sheering Road Roundabout.

Traffic exits the Pincey Brook Roundabout on one lane. The road widens out to two lanes as it approaches the Western Dumbell Roundabout on the western side of the M11. This stretch of road is known as the Eastbound Link. A new two-lane road, known as the Westbound Link, would take traffic in the opposite direction, from the M11 to the new Sheering Road Roundabout. Both the Eastbound and Westbound Links have been future-proofed to allow for the construction of a Northern Bypass in the future.

The new Eastbound and Westbound Links rise on an embankment (up to 10m high) close to the motorway to allow for the difference in elevation between Sheering Road and the M11. The Eastbound and Westbound Link roads would converge at a roundabout adjacent to the M11; this would be one of two new roundabouts to be constructed on either side of the M11 and connected by a new four-lane bridge over the existing M11 motorway (known as the Western Dumbell Roundabout, the Eastern Dumbell Roundabout and the Dumbell Link respectively, due to their combined Dumbell-shaped configuration). North-bound and south-bound slip roads

would be constructed connecting the M11 to the two new roundabouts to enable full access between the new link road and the motorway network without restricting traffic travelling in either direction on the M11 motorway.

The Proposed Scheme from Mayfield Farm towards the east including the M11 off- and on-slips is referred to as the 'Link Area' within the ES.

2.3.1 Lighting

The new motorway junction would be illuminated at night and the lighting on Gilden Way would be upgraded. Efficient LED lighting technology is proposed i.e. no light above the horizontal and minimum light spillage into verges. Most luminaires would be 10m and controlled via a central management system to remotely monitor, control and dim luminaires, to provide the right amount of light at the right time. At sensitive ecological locations, 6m columns with back shields would be used to direct light away. In addition, a dark area would be maintained along the old Sheering Way (in The Campions area).

2.3.2 Non-motorised users

An improved combined pedestrian/cycleway widened to 2.5m would be constructed for the length of the Gilden Way works. It would be connected to the proposed Harlowbury development combined pedestrian/cycleway and link into the National Cycle Network (NCN) Route 1. In addition, two existing crossing points would be upgraded and two new pedestrian crossings would be proposed. A further uncontrolled crossing point would be installed to traverse the Sheering Road at the Sheering Road Roundabout. This would join to a new footpath extending northwards and connecting with the Pincey Brook footpath. Existing bus stops would be maintained and upgraded with real time passenger information.

2.3.3 Drainage

The drainage strategy has been developed as shown in the Drainage System Summary Report (Appendix 2.1). A total of four attenuation ponds would be constructed, designed to reduce flood risk by controlling discharge rates and reducing pollutants entering the local watercourses. In the case of Gilden Way, the two smaller ponds are designed to act in combination with attenuation storage provided by oversized pipework. Attenuation storage requirements would be based on the 1 in 100 year return period storm (plus and allowance for climate change). Drainage at the new M11 Junction and along Gilden Way has been designed to achieve a maximum practical reduction in discharge of up to 50% of the existing 1 in 1 year discharge rates. No construction, other than water compatible uses, would take place within the 1 in 100 year (plus climate change allowance) flood zones determined by modelling.

An existing ordinary watercourse would be re-routed and de-culverted. Where it would pass under the new link roads, two shorter culverts have been designed to accommodate high flows and encourage the passage of mammals such as otters, badgers and bats.

2.3.4 Landscaping and trees

Landscape planting would be provided throughout the Proposed Scheme wherever possible. Tight land constraints along Gilden Way have been addressed with vertical planting and fencing to alleviate visual intrusion. Attenuation ponds would have banks and margins of a natural appearance. Wherever possible, mature trees would be maintained throughout the site. The site footprint has been altered during design in order to avoid the most valuable trees. All planting in the rural areas and along most of Gilden Way would be native species, but amenity planting in the Oxleys/Gilden Close area and at the entrance to Mayfield Farm would include non-native decorative species and varieties.

2.3.5 Noise

Provision of acoustic barriers, landscaping and low noise road surfacing road would be provided to mitigate noise and vibration impacts. Acoustic barriers, landscaping and low noise road surfacing would be provided to mitigate noise and vibration impacts. The construction of barriers would be subject to planning conditions and further discussions with local residents.

2.4 Construction Strategy

Construction of the Proposed Scheme would be undertaken by a Principal Contractor who would make proposals as to the methodology of the construction. The contractor would have to propose a methodology to build the Proposed Scheme whilst taking into account planning conditions laid out in the planning consent documentation. To carry out an assessment of the impacts arising from construction, assumptions have been made as to how the Proposed Scheme could be built. A possible construction methodology has been produced and detailed in a Construction Programme (Appendix 2.) and a Construction Methodology Report (Appendix 2.3 in Volume C)

Whilst the methodology in this section is based on best practice and within the constraints of the site and the design, it is indicative and therefore can be amended. For the purpose of this report we have based our assessment on the following methodology. If the contractor used a different methodology, a review of the impacts would need to be carried out, with an explanation of why the alternatives were preferred to those proposed here.

2.4.1 Scheme phases

Using the current methodology, construction of the Proposed Scheme would be spilt into three main phases based on the release of funding from the 'Department for Transport (DfT)'. These main phases would be known as 'Phase 1', 'Phase 2A' and 'Phase 2B'.

2.4.1.1 Phase 1

Phase 1 works would involve new construction as well as improvement works to the existing road on Gilden Way. The overall strategy is to first widen the road to three lanes and then carry out improvement works to the existing road on Gilden Way. To conduct the works for this phase, a number of traffic management configurations to include traffic light systems would be required throughout the construction period. The speed limit would be reduced during the works as required. Where lane widths drop below 3.25m a 20mph speed limit would be implemented according to guidance given in TAL 15/99 cyclists at Roadworks (1999). Indicative construction activities and plant are contained in Appendix 11.2 within Volume C.

Widening works in Phase 1 for the existing eastbound and westbound lanes would be carried out during normal day time working. Phase 1 surfacing works would be carried out during night time to have minimum impact to the traffic flow on Gilden Way.

The construction of the local access road in Mayfield Farm would be carried out off-line with tie in works to the existing road conducted under the same traffic management as the widening works. Churchgate Roundabout would be modelled in a "hamburger" style to allow traffic to travel through the middle on an east/west trajectory.

For the purposes of this assessment it has been assumed that where footpaths cross the road during construction, a temporary diversion or closure order would be put in place for safety reasons if possible. Where this is not possible the crossing points would be manned at all times. Pedestrian crossing points would be reinstated at the end of Phase 1. The National Cycleway would maintain its crossing point throughout construction in some form with appropriate traffic management and be reinstated at the end of Phase 1. Two new pedestrian crossings would be installed and a further two upgraded. Noise barriers would be erected towards the beginning of construction to gain the added benefit of screening out construction noise.

Two attenuation ponds would be installed during Phase 1: one to the east of the Gilden Way construction compound and the other on the playing field east of Churchgate Roundabout, as shown on Figure 2-1. In addition, two retaining walls (at Long Barn Cottage) would be constructed.

Access to Phase 1 has been assumed to be entirely via existing highways. This would be the responsibility of the contractor. However, as the later stage of Phase 1 would be run in parallel with Phase 2a, it is programmed that a significant portion of construction traffic would access the site directly off the M11 via the new Junction 7A once the slips had been constructed.

2.4.1.2 Phase 2A

Phase 2A Section A would include the construction of a new carriageway between Mayfield Farm and the new Sheering Road Roundabout. Phase 2A Section B would include the construction of the Westbound Link, the M11 Western and Eastern Dumbell Roundabout, the installation of an overbridge (Dumbell Link) over the M11 spanning between the two roundabouts and the construction of the northbound and southbound merge and diverge to provide direct links to the M11.

As the majority of these works are 'off-line', the works would be carried out during normal day time hours. The tie in of the on- and off-slips to the M11 motorway would be carried out during normal day time hours but carried out under the control of an agreed traffic management system on the M11 motorway. Once the northbound and southbound merge and diverge slips had been built, a manned booth barrier control system would be installed at the site entry points (on-slips) to ensure that a clear line of demarcation was set between the construction traffic and the general traffic flowing on the M11 motorway. Launch of the overbridge sections above the M11 motorway would be carried out at night under a full road closure; the deck of the bridge would be constructed during normal traffic operations.

Construction of the M11 Junction 7A slips, northbound merge and diverge and the southbound merge and diverge would be carried out early in the programme to allow use of the slips as haul routes for the construction traffic. This would allow a large proportion of construction traffic to access and egress the construction site directly from the M11 motorway thus reducing site traffic travelling through Harlow and along Gilden Way. Some traffic would need to access along Gilden Way initially to construct the site compound and more westerly works. Widening works would be carried out on the M11 to construct a ghost island for the southbound off-slip. Sheet piling on the eastern side of the M11 would be required for the widening works and installed from the underpass as far as the north end of the Proposed Scheme. At the location of Pincey Brook, a reinforced earth embankment using soil nailing has been proposed. This would avoid the use of sheet piling above the Pincey Brook.

Phase 2A would also include the construction of two drainage attenuation ponds; one to the north of the Sheering Road Roundabout and the second to the north west side of the M11 motorway, east of Sheering Hall Drive. A new uncontrolled crossing point would be located across the northern arm of the Sheering Road Roundabout.

2.4.1.3 Phase 2B

Phase 2B would include the construction of the Pincey Brook Roundabout, link to the Sheering Road Roundabout and the Eastbound Link between Pincey Brook Roundabout and the M11 Western Dumbell Roundabout.

The majority of Phase 2B construction would be off-line; therefore, the majority of construction could be carried out during normal day hours and without any traffic management. See Figure 2-3 Construction Site Layout for clarity.

2.4.2 Construction programme

The construction programme would be the responsibility of the contractor to finalise. This ES has been based upon an assumed construction programme. Construction of the Proposed Scheme would take approximately 40 months, commencing in 2019, with advance work occurring in 2018, and completion of Phase 2B in 2021. Conclusion of the construction phase and opening of the finished scheme would occur in early 2022. The indicative timescales of the construction of the Proposed Scheme and the timings for each phase of the scheme are listed in Table 2.2.

The programme has been created with consideration of the timing constraints associated with ecological receptors such as bats, Great Crested Newts (GCN) and badgers. For example, clearance of hedges and bushes prior to construction works would be carried out within autumn and winter months avoiding the bird nesting season, whilst tree planting would be during winter months. This has been designed to mitigate some of the potential construction impacts (see Section 3.1- Scheme Development and Alternatives). These are

discussed in more detail within the specialist sections. Any programme proposed by the contractor should be mindful of these archaeological, ecological and landscaping constraints. (Further guidance regarding ecological constraints can be found in C691, CIRIA, 2011). There would be an assumption for the provision of an 8m buffer along the Pincey Brook and the Harlowbury Brook where works are not directly taking place in order to protect the natural banks of these watercourses. This buffer is shown on Figure 2-4 Sheets 1-7.

A Construction Environmental Plan has been produced to inform the contractor of the constraints existing along the Proposed Scheme (see Figure 2-4 Sheets 1-7). This plan would be updated during detailed design and construction phases as further surveys are carried out and new information is forthcoming.

Note that some of the timings overlap. If the programme were to slip in some areas, it might not affect the overall delivery of the Proposed Scheme; however, these timings would be subject to conditions outside the contractors control such as weather conditions and availability of materials.

Table 2.2: Indicative construction programme

Construction phase & sub-section	2018		2019				2020				2021				2022	
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Phase 1 – Section A																
Advanced Vegetation Clearance																
Ecological Works																
Main Construction Works																
Landscape Works and tree planting																
Phase 1 – Section B																
Advanced Vegetation Clearance																
Ecological Works																
Main Construction Works																
Landscape Works and tree planting																
Phase 2A – Section A																
Advanced Vegetation Clearance works & planting landscape mounds to act as Screens for Campions																
Ecological Works																
Main Construction Works																

Construction phase & sub-section	2018		2019				2020				2021				2022	
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Landscape works and tree planting																
Phase 2A – Section B																
Advanced Vegetation Clearance Works																
Ecological Works																
Main Construction Works																
Landscape Works and Tree Planting																
Phase 2B																
Advanced Vegetation Clearance Works																
Landscape Works and Trees Planting																
Ecological Works																
Main Construction Works																

2.4.3 Construction site layout

Site set up would involve establishing construction compounds (including welfare cabins), haul routes, soil storage, lorry holding areas and top soil storage areas. An indicative site layout for each phase of construction is shown in Figure 2-4 Construction Environmental Plan. These locations are indicative only, actual locations of site compounds would be subject to change by the contractor. Any alternative locations would be assessed accordingly.

Location and details of each site compound for each construction phase of the Proposed Scheme is provided in Table 2.3.

Table 2.3: Details of site compounds for the construction of the Proposed Scheme

Phases	Location	Storage	Implications
Phase 1	Old plant nursery site (Gilden Way south side).	General soil, topsoil, plant and equipment and welfare facilities.	The site is an existing depot used for vehicle movements. It is bounded by mature trees, a Local Wildlife Site (LWS), a pond containing Great Crested Newts (GCN), Scheduled Monument and a footpath. Care would need to be taken to reduce the noise and dust impacts on the LWS and GCN in particular. A no dig policy and ground protection surfacing would be required to safeguard tree root protection zones. GCN, bats and reptiles on the site would need to be relocated under license prior to ground clearance.
Phase 2A	South of Sheering Road Roundabout and to the north west of The Mores Wood.	General soil, topsoil, plant and equipment and welfare facilities.	A minimum of 15m clearance would be maintained at all times from the edge of the nearest trees to the edge of the haul route running along the perimeter of the construction compound to ensure that construction traffic do not run too close to the nearest trees of The Mores Wood.
Phase 2A	East of M11.	General soil, topsoil and plant storage.	Required to facilitate construction east of the M11.
Phase 2B	South of the new Pincey Brook Roundabout within the envelope of the Westbound Link and the Eastbound Link embankments.	Materials, welfare facilities and parking facilities for cars/caravans.	An additional storage facility would be needed to store plant and equipment required for the construction of Phase 2B. Additional sites would be built to the north of Pincey Brook Roundabout and to the west of the construction compound site to store the general soil and the top soil. All planned soil storage areas have been located outside the Pincey Brook flood risk zone.

2.4.4 Site works and construction hours

All phases of construction would be carried out with due regard to the environment, following procedures as laid out in the outline Environmental Management Plan (EMP). In summary these procedures would include: all works to take place outside the flood risk zone, dust mitigation measures, restricted night working, bunding of all oil and chemical storage areas, regular maintenance of vehicles to reduce air and noise pollution etc. Normal day time work would be from 08:00 to 18:00, while night time work would typically be from 22:00 to 05:00. In

total, with the suggested methodology, only approximately 5% of construction works would occur at night. Up to three night time closures of the M11 would be required to install the M11 overbridge, see below for further details on construction hours.

The Phase 1 site compound would be expected to accommodate approximately 25-30 staffs and the Phase 2 compound south of Sheering Road Roundabout would have a larger workforce of between 75-125 staffs and the compound to the east of the M11 between 20-40 staffs. Prior to any construction on a live highway, a safe working distance (or exclusion zone) would be created by the contractor to ensure the safety of site workers and road users. All works along the Gilden Way would take place within the boundary of the existing highway.

2.4.5 Proposed machinery

The construction of the Proposed Scheme would involve a range of activities and equipment. Specification of plant would be at the discretion of the contractor. More detail is provided in Chapter 11 – Noise and Vibration and Appendix 11.2 within Volume C.

2.4.6 Construction Traffic

Figure 2-5 below shows the expected levels of construction traffic that would be likely during construction of the Proposed Scheme. Onsite traffic would consist of vehicles not using the main road network. The figures given are round trip journeys i.e. from the soil storage area to an embankment and back. Offsite traffic consists of vehicles using the road network. Again figures show round trip journeys.

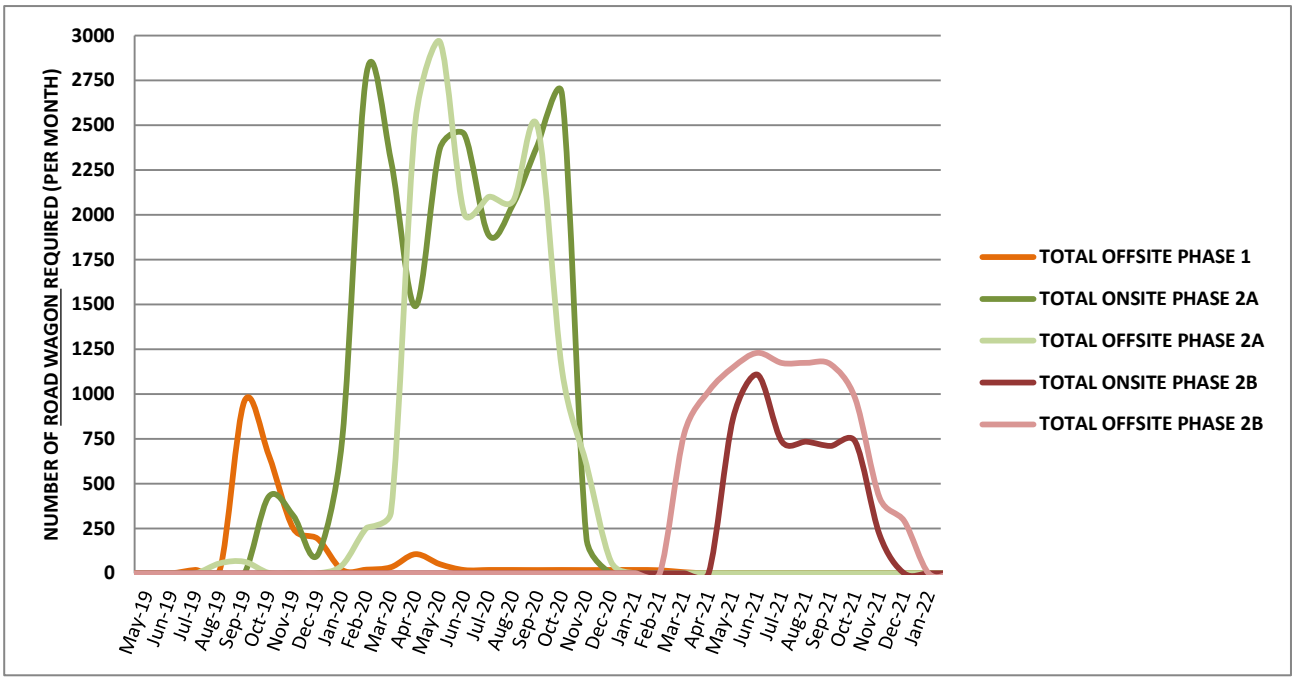

Figure 2-5: Total construction traffic for the Proposed Scheme

3. Development of the Proposed Scheme

3.1 Scheme Development and Alternatives

To meet the objectives of the Proposed Scheme listed in Section 1.3 and to minimise any environmental impacts, the scheme development went through a series of design iterations to reach the current option for the planning application.

An Options Assessment Report (Jacobs, 2016) sets out the history of options developed and the selection of the Proposed Scheme, including details of six strategic options considered to fulfil some or all of the scheme objectives. Through option evaluation, Option 1 (M11 Junction 7A) ranked the highest (best option) and was taken forward to the next stage of design development. Table 3.1 summarises the assessment of these strategic options and Figure 3-1 illustrates their locations.

Table 3.1 Options evaluation summary

	Option description	Assessment results
Option 1	New M11 junction east of Harlow, Junction 7A, with local link to Gilden Way	• Less traffic on route through villages around Harlow; • Improved accessibility for Harlow-related trips; and • Likely to improve network resilience particularly on the A414 north of Junction 7 with additional potential peak period traffic on M11 north and south of Harlow, on Gilden Way and along the A414 around the north of Harlow.
Option 2	Improved M11 Junction 7	• Travel time reductions, but less than Option 1; • Likely to increase flow on M11 south of Junction 7 as well as approaches to the junction; and • Less likely to result in improved accessibility on the local road network within Harlow with any additional traffic on the A414 not improving the network resilience.
Option 3	Both Option 1 and Option 2	• Greater travel time savings than Options 1 and 2 alone. • Improved accessibility for Harlow related trips and could improve network resilience on the A414 and through the town; and • Changes in traffic flows are broadly the same as Option 1 and 2, with increases in traffic on the M11 north and south of the town.
Option 4	'Northern Bypass', which includes a dual carriageway link from Junction 7A through to A414 at Eastwick, and an additional single carriageway access into Harlow via River Way	• Higher levels of traffic on the M11 than for Junction 7A in isolation leading to greater use by strategic traffic rather than Harlow-related traffic; • Traffic reduced on less suitable rural route east of Harlow but there are indications that traffic could increase on rural routes to the north west of the town; and • Key benefit of the Proposed Scheme is achieved through Junction 7A section with the bypass element itself likely to provide network resilience benefits.
Option 5	'Northern Northern Bypass', which comprises a dual carriageway link from A414 at Eastwick, aligned to the south of Gilston, and then to the west of Sawbridgeworth, connecting with the M11 via a new	• Lower time savings than Option 4 in almost all time periods and years; • Attraction of more strategic traffic from the A10 and A120 particularly to the north of its connection to the M11 than other options; • Key beneficial areas would be in Bishop's Stortford and

	Option description	Assessment results
	junction south of Little Hallingbur	Sawbridgeworth; and • Less likely to improve accessibility to Harlow, although could provide strategic network resilience.
Option 6	'Southern Relief Road', comprising a dual carriageway link from the A414 east of Roydon, skirting the western and southern edges of Harlow, and connecting with Junction 7 via the B1393	• Performed less well than both Option 4 and Option 5 in terms of time savings; • Little impact to the level of traffic on M11 but flows along the A414 west of Harlow would be likely to increase; and • Least overall effect on the traffic within Harlow and therefore would not improve accessibility within the town.

Three options of M11 Junction 7A (Options 1, 2 and 3) were developed and taken through to Public Information Exhibitions (PIE) in December 2013. Feedback from the exhibitions and further public stakeholder engagement indicated that there was a need to consider a more strategic scheme future proofed for the development of the Northern Bypass. Consequently, a northern loop was added to the Proposed Scheme from Sheering Road to the M11 motorway. Widening of Gilden Way was proposed in late 2015 following the second PIE in July 2015 to accommodate the increased traffic flow coming through the new M11 Junction 7A. This resulted in the extension of the Proposed Scheme footprint and study area and triggered the need for further environmental surveys to assess potential impacts along the Gilden Way corridor.

In 2016, further elaboration of the design with in house environmental specialists included the removal of the loop between Sheering Road and the M11 and replacing it with a roundabout (Pincey Brook Roundabout) on a terrace at approximately existing ground level to reduce visual impacts. This has resulted in the current version of the scheme taken forward to the Formal Public Consultation (May to July 2016). The alignment of the Proposed Scheme has since been shifted southward to protect rows of mature oaks south of Pincey Brook adjacent to Sheering Road. A slight realignment northwards was also incorporated to avoid damage to The Mores Wood.

In August 2016, the M11 southbound off-slip road was extended north of the Pincey Brook. This was to mitigate the impacts of generated traffic on the junction.

3.1.1 Scheduling alternatives

This report has also considered alternative options within the EIA process. Scheduling alternatives have been incorporated into the construction methodology such that archaeological surveying and trial trenching could be completed prior to construction at each phase. Ecological constraints have been at the heart of the construction programme with works carried out sensitively to the bird nesting season and to bat, reptile and amphibian hibernation times etc. Works would only be carried out once Protected Species had been relocated or protected from potential harm. Noise barriers would be erected as early as possible to allow residents, wildlife etc. to benefit from noise mitigation towards the beginning of the construction period.

3.1.2 Input Alternatives

Input alternatives have also been looked at, with sensitive lighting designs specified to reduce potential impacts of the Proposed Scheme on bat flight routes. In addition, an alternative design for the proposed culverts has been developed to serve as wildlife corridors under the roads. The south bound off-slip extension reinforced earth embankment design would reduce impacts on the Pincey Brook and on existing embankment vegetation. All of these incorporated alternative options have been discussed in greater detail within the relevant topic chapters.

3.2 Consultation and Community Involvement to Date

A series of PIEs on scheme options and alternatives have taken place, with formal public consultation launched on the 11th May 2016 to the 6th July 2016 prior to the submission of the planning application scheduled for the

23rd January 2017. The Statement of Community Involvement provides a detailed report of all consultation and engagement activity and the impact this has had on the development of the Proposed Scheme.

3.2.1 Public Information Events

Two rounds of PIEs have been held for the Proposed Scheme.

The first was held from December 2013 to March 2014 and focused on route options and preliminary technical work. The full report of the 2013/14 exhibitions (Jacobs, 2015), has been published, together with reports on the following:

- more individuals supported the provision of a new junction on the M11 than objected to it;
- the need for further consideration to be given to a northern route option, with the provision of more detail and direct comparisons between options;
- whether the scheme would increase traffic congestion in Harlow rather than improve it;
- whether the scheme would increase the use of alternative minor roads or 'rat running';
- implications of the scheme on road safety, in particular the speed of traffic and impact of Heavy Goods Vehicles;
- implications of the scheme on the environment, and additional measures which would be incorporated into the scheme design to enhance the environment;
- other improvements that would be required as part of the scheme;
- the needs of Non-Motorised Users (NMUs) taken into account in the scheme design;
- making scheme proposals and how people would be impacted clearer; and
- impacts on individual communities, especially issues of severance.

The second PIE was held during July 2015, which updated interested parties on the Proposed Scheme, and demonstrated that issues raised in the first PIE had been taken into account. Three exhibitions were held in East Harlow and Sheering and the specific objectives of the exhibitions were to:

- present the Proposed Scheme and how this was developed using feedback from the previous exhibitions held in 2013 and 2014;
- show the short, medium and long term improvement proposals;
- show what growth is already planned and where some potential growth could take place as part of the Harlow, Epping Forest and East Herts emerging Local Plans;
- discuss the likely impacts on the surrounding area, particularly Gilden Way, The Campions, Old Harlow and the Churchgate Street area and discuss the mitigation measures proposed for these areas;
- provide local residents with an opportunity to meet project team representatives; and
- provide an early opportunity for local residents to discuss their opinions and concerns.

A full report of the PIE and outcomes was prepared and published in September 2015 (Jacobs, 2015).

3.2.2 Formal public consultation

Formal Public Consultation (FPC) was launched on the 11th May 2016 by ECC to the public including key invitees, councillors from Epping Forest District Council, Harlow Council and HE. The consultation was supported by the production of a detailed consultation document; summary leaflet and a dedicated website were accessible to the public. Advertisements placed in local papers, on local radio and posters erected across the area identified the date and time of the exhibitions and how to access the consultation information. Consultees were encouraged to attend public exhibitions and complete an online questionnaire.

Public consultation exhibitions were held on the 3rd, 8th, 16th and 17th of June 2016 in the Harlow area surrounding the Proposed Scheme. The locations of the events were primarily chosen due to their close proximity to the areas most impacted by the proposed M11 Junction 7A, being easily accessible and having good availability of parking spaces. Over 470 people attended the exhibitions, members of the project team were in attendance to explain the Proposed Scheme and to answer questions and respond to issues raised.

Formal Public Consultation was closed on the 6th July 2016, a total of 149 consultation responses were received including six campaign responses. In addition, a petition with more than 150 signatories was received. All responses were analysed and compiled into a consultation report for consideration by the technical teams. The technical teams considered consultation feedback and undertook route and design refinements where practicable. The outcome of the FPC has been reported to ECC.

The Statement of Community Involvement provides further detailed information regarding the consultation and engagement activity undertaken.

3.3 Preferred Route Announcement

Essex County Council cabinet approved the Preferred Route on the 13th of December 2016.

3.4 Planning Policy Material Considerations and Programme Review

The following tables provide a high level summary against each of the relevant Planning Policies. A more detailed review of Planning Policy can be found in the Planning Statement which accompanies the planning application for this Proposed Scheme.

Table 3.1: National planning policy

Policy document	Relevancy to Proposed Scheme
National Planning Policy Framework (NPPF), Department for Communities and Local Government (2012)	Sets out the Government's economic, environmental and social planning policies. In favour of sustainable development. Focus on planning for prosperity, people and places, promoting increased levels of development and supporting infrastructure, whilst also protecting and enhancing the natural and historic environment. Core Principles includes the need to "*proactively drive and support sustainable economic development to deliver the homes, business and industrial units, infrastructure and thriving local places that the country needs. Every effort should be made objectively to identify and then meet the housing, business and other development needs of an area, and respond positively to wider opportunities for growth*". Paragraph 90 defines types of development in the Green Belt which are not inappropriate in policy terms, and includes "*local transport infrastructure which can demonstrate a requirement for Green Belt location*".
National Policy Statement for National Networks, Department for Transport (2014)	The scheme is regarded as a local transport infrastructure scheme and not a Nationally Significant Infrastructure Project; therefore, does not need to be covered by national policy. However, it is worth noting that national policy supports transport infrastructure which addresses traffic congestion.

Table 3.2: County planning policy

Policy Document	Relevancy to Proposed Scheme
South East Growth Deal, South East Local Enterprise Partnership (2015)	Identifies the need for growth in Harlow and recognises that the capacity of the existing access onto the M11 and the lack of an alternative access is a significant barrier to housing and economic growth.
Essex Economic Growth Strategy, Essex County Council (ECC) (2012)	Identifies the need for an additional junction on the M11 to support economic and housing growth in Harlow.
Essex Local Transport Plan, ECC (2011)	Priorities for the West Essex area include improving access to and from the M11 corridor, tackling congestion and improving the management of traffic in Harlow Town Centre, and providing transport improvements needed to support housing and employment growth. Recognises that connectivity between the main towns in Essex is good, but is less satisfactory to the strategic transport network running through Essex, especially at peak times.
Hertfordshire Local Transport Plan, Hertfordshire County Council (2011)	Makes no mention of the opportunity for an additional junction on the M11; the plan therefore has a neutral stance on the proposed development.

Table 3.3: Local planning policy

Policy document	Relevancy to Proposed Scheme
Epping Forest Combined Local Plan 1998 and 2006, Epping Forest District Council (1998/2006)	Contains no proposals relating to the M11 because it also contains no strategic housing allocations as the Structure Plan target for housing has been exceeded. Will oppose any highway proposals unless associated landscaping use the appropriate species, make effective visual screens, create effective sound barriers, and adequately replace trees, hedgerows and woodlands which would be lost to the development. Will seek to ensure that, where feasible, appropriate landscaping would be undertaken prior to the commencement of construction works. Expects highway schemes to have minimal impact on the environment, road safety, traffic congestion, and rights of way network.
Epping Forest Emerging Local Plan Consultation, Epping Forest District Council (2016)	Identifies the opportunities for growth around Harlow provided the necessary infrastructure is provided including a new junction onto the M11 between Junctions 7 and 8.
Adopted Harlow Local Plan, Harlow Council (2006)	Makes no mention of the opportunity for an additional junction on the M11. Highlights the need to balance growth in homes and jobs with protecting the environment and ensuring that local infrastructure can accommodate increased demand.
Emerging Strategy and Options for the Harlow Local Development Plan, Harlow Council (2016)	States "*major investment would also be underway to address a number of specific transport capacity issues across Harlow which is currently restricting growth and investment. This would have included a new junction on the M11 and substantial improvements to the internal road network in Harlow*". Growth scenarios proposed illustrate the constraint caused by the lack of capacity and access to the motorway network and the need for an additional junction to the M11. All scenarios require improved access to the M11 and identifying a preferred option of an additional junction whilst recognising the limited potential to significantly increase capacity at Junction 7.

Policy document	Relevancy to Proposed Scheme
East Hertfordshire Adopted Local Plan, East Hertfordshire District Council (2007)	Makes no mention of the opportunity for an additional junction on the M11.
East Hertfordshire Preferred Options Consultation, East Hertfordshire District Council (2014)	Recognises the need for improved transport infrastructure in order to bring forward housing and employment growth in the Gilston area near Harlow.
Uttlesford Adopted Local Plan, Uttlesford District Council (2005)	Makes no mention of the need for additional access to the M11 and the emerging local plan has been withdrawn. There is no new document published on their website currently.

3.5 Previous Uses and Relevant Planning History

The Link Area lies within EFDC; there is no planning history for this section of the Proposed Scheme. The Gilden Way section of the Proposed Scheme lies mainly within HC; there are major housing and enterprise developments with planning permission or already under construction in the vicinity of the Proposed Scheme as outlined below:

- Planning permission has been granted for Harlowbury housing development and it is under construction. Planning permission reference HM/PL/00055 granted outline planning permission in November 2012 for 1,000 dwellings, a new primary school, community buildings and commercial/retail/live work accommodation. Reserved Matters approval has been granted for Phase 1 of 716 homes and a community building under planning permission reference 15/00006 and for Phase 2 was granted for a further 195 homes in December 2015, planning reference HW/REM/15/00389 and HW/PL/15/00389. The total number of homes with full planning permission at Harlowbury currently stands at 911.
- The development of the New Hall Farm site is also underway. The initial scheme, Newhall Phase I, with 440 residential dwellings was granted outline planning permission in 1998 (ref: 96/00088) and followed by several subsequent Reserved Matters applications. Outline planning permission reference HW/PL/04/00302 granted in June 2012 for 2,300 dwellings including parkland and recreation, employment and a neighbourhood centre. Reserved Matters Approval for Parcel 1 of Phase II (328 homes via two linked applications) was granted in June 2013 (refs: HW/PL/13/00098 and HW/PL/13/00100). Reserved Matters Approval for Phase II Parcel 2 (239 homes) was granted in March 2014 (ref: HW/PL/13/00482).
- Harlow has Enterprise Zone status with associated Local Development Orders to facilitate economic development on three sites:
    - London Road South - 20,000m^2 of 'Grade A' office space as well as a Data Centre development;
    - London Road North - 14 hectare (ha) Greenfield site available for design and build opportunities with a focus on the Med Tech, Life Science and ICT sectors;
    - Templefields - an existing industrial estate offering SME manufacturing space and longer term re-development opportunities; and
    - A condition placed on the Local Development Orders (LDOs) by Highways England is that additional employment growth within the Enterprise Zone cannot be brought forward without the provision of additional highway capacity at Junction 7A on the M11.

All of these developments add to the existing traffic congestion issues in and around Harlow, which will be exacerbated by further growth as proposed in the emerging planning framework documents for Harlow and the surrounding area.

4. Approach to Assessment

The EIA has been carried out by environmental specialists working in close iterative collaboration with design engineers responsible for the design of the Proposed Scheme. It is crucial that the EIA and design process operate iteratively and in parallel. Environmental Impact Assessment is a statutory process required for the Proposed Scheme, bringing together the assessment of likely significant environmental effects arising from the construction and operation of the scheme. It provides an opportunity to avoid or reduce environmental effects at source, and to enable the most effective mitigation of effects that cannot be avoided.

4.1 The Design Manual for Roads and Bridges

The main aspects of the development and design of major highway projects are governed by guidance set out in the DMRB. Guidance on EIA for highway projects is given in Volume 11 of DMRB, with guidance on environmental design and mitigation in Volume 10. In addition, the HE (formerly the Highways Agency) issues IANs, when new guidance emerges which is yet to be incorporated in the DMRB. For some subjects, the guidance within the DMRB has become outdated. In those cases, reference will be made to more up-to-date methodologies that are considered industry best practice.

4.2 Scope of the Assessment

In accordance with the HE PCF Handbook, an Environmental Appraisal Report (EAR) was produced in March 2016 to summarise the environmental findings and assessment undertaken during Stage 2 of the Proposed Scheme. The report follows the Pre-application Planning Statement and Scoping Report (2016a), which were both released to ECC as the Relevant Planning Authority in January 2016.

As a result of the scoping exercise a number of issues were scoped out. However, during the course of the scheme design, alternative scheme options have been considered leading to the reinstatement of many of the topic areas. As a result only dormice have been scoped out as a topic. The rationale for this is because all potentially affected, suitable habitats within the Link Area were surveyed, with the results indicating the likely absence of this species. Due to the urbanised nature of the environment around Gilden Way (and assumed increase in cat predation), lack of biological records, and lack of records from the Link Area (following intensive survey), the need for dormouse surveys was scoped out for the Gilden Way study area.

The scoping opinion was provided from the local planning authorities on 27th June 2016. Matters that were raised by consultees during the scoping process are addressed in each of the topic chapters (Chapters 5-14) Issues raised in the scoping opinion are set out in Appendix 4.2 with information as to how this has been responded to. The main issues raised concerned ecological surveys and mitigation and protection of the water environment.

4.3 Study Areas

Study areas are defined individually for each environmental topic according to guidance and the geographic scope of potential impacts of the Proposed Scheme on the environment. The following lists the general study areas used. For more detailed information please refer to the relevant chapters:

- **Air quality**: The study area for the assessment of local air quality has been defined in line with the guidance contained in DMRB Volume 11, Section 3, Part 1 (HA207/07). It comprises all land within 200m of the centre line of the existing road; land within 200m of the centre line of the Proposed Scheme; and land within 200m of any other ‘affected roads’.
- **Cultural Heritage**: 200m in all directions from the Proposed Scheme.
- **Landscape and Visual**: The area was delineated to include areas from which any part of the Proposed Scheme would be visible as a significant feature in the view. Refer to Figure 7-1 for the boundary.

- **Nature Conservation:** A number of study areas are used for nature conservation dependent on what is being surveyed: 10km for Special Areas for Conservation (SAC) when designated for bats; 2km for Natura 2000 sites: National Nature Reserves (NNRs), Local Nature Reserves (LNRs), Sites of Special Scientific Interest (SSSI) and Ancient and Semi-Natural Woodland; 1km for Local Wildlife Sites (LWS), Protected Wildlife Verges (PWV) and protected species records; 500m for waterbodies with potential for GCN; 250m for watercourses with potential for otters and water Voles; 50m buffer for badger; and Natura 2000 sites if they are within 200m of any roads affected by a decrease in air quality.
- **Geology and Soils**: 250m on either side of the route, increased/decreased depending on the potential magnitude of impact of identified contamination sources.
- **Materials**: All land contained within the Proposed Scheme boundary, within which materials would be contained and wastes generated and managed.
- **Noise and Vibration:** 1km boundary around the start and end points of the physical works associated with the Proposed Scheme route, and any routes improved or bypassed as part of the scheme.
- **People and Communities:** 500m either side of the proposed route corridor for the local study area. Where relevant, impacts along the connecting road network were also considered 1km of the Proposed Scheme was used for the developments study area.
- **Water Quality and Drainage**: 1km buffer from the Proposed Scheme. For the flood risk aspect of the assessment the study area is instead defined by the Proposed Scheme redline boundary and the model extents provided from the modelling of the flood zones.
- **Cumulative Impacts**: 3km from Proposed Scheme boundary.

4.4 Existing Baseline and Future Conditions

A desk based assessment and site visits were undertaken to identify the baseline conditions. The baseline conditions were used to scope the impacts of the Proposed Scheme on the environment.

The baseline conditions are the conditions that would exist in the absence of the Proposed Scheme either (a) at the time that construction is expected to start, for impacts arising from construction or (b) at the time that the Proposed Scheme is expected to open to traffic, for impacts arising from its operation. Some disciplines also consider the Proposed Scheme design year, 15 years post opening. Therefore, the identification of the baseline conditions involves predicting changes that would likely to happen in the intervening period, for reasons unrelated to the Proposed Scheme. The baseline conditions set out in this report are based on the best information currently available.

For the purpose of the EIA, the Proposed Scheme has a baseline year of 2016, an opening year of 2021 and a design year of 2036 (15 years after opening). The impacts of the Proposed Scheme have been compared against the Do-minimum (DM) conditions; “Do-minimum” conditions are the conditions predicted to exist in that year in the absence of the Proposed Scheme

Information was gathered for each topic from a number of sources during previous phases of the Proposed Scheme development and the scoping exercise. Additional or updated information from these sources, as well as new sources, were gathered during the EIA phase following the scoping exercise to inform the preparation of this ES, and the design development. For some topics (Air Quality, Noise and Vibration, People and Communities and Road Drainage and the Water Environment), a key source of information has been the predicted flows of traffic.

The EIA considers both direct and indirect impacts arising from the construction and operation of the Proposed Scheme. For the purpose of this assessment, direct impacts both beneficial and adverse would be as a result of construction processes, land take or impacts caused by the operation of the scheme itself. Indirect impacts would be caused by changes that would happen in part due to pressure arising from the Proposed Scheme, but not as a direct consequence of it.

Cumulative effects and impact interactions are also identified. The approach to the assessment of cumulative effects is set out in Chapter 14.

4.5 Significance of Effects

Environmental impacts have been expressed in terms of the significance of their effect, both beneficial and adverse. Impacts are defined as the changes resulting from an action and effects are defined as the consequences of impacts. The significance of the effect of an impact is derived through consideration of the sensitivity of a receptor (sometimes referred to as its value or importance) and the magnitude of the impact. The significance of the effect is influenced by both of these variables.

The significance of any particular effect can typically be identified through the use of a matrix, with the values of sensitivity of the receptor placed along one axis and the magnitude of impact on the other. A typical matrix is provided in Table 2.4 of DMRB Volume 11, Section 2 Part 5, and is reproduced in Table 4.1.

Table 4.1: Typical matrix for the assessment of significant effects

Sensitivity or value	Magnitude of impact				
	No change	Negligible	Minor	Moderate	Major
Very high	Neutral	Slight	Moderate or Large	Large or Very Large	Large or Very Large
High	Neutral	Slight	Slight or Moderate	Moderate or Large	Large or Very Large
Medium	Neutral	Neutral or Slight	Slight	Slight or Moderate	Moderate or Large
Low	Neutral	Neutral or Slight	Neutral or Slight	Slight	Slight or Moderate
Negligible	Neutral	Neutral	Neutral or Slight	Neutral or Slight	Slight

The assessments contained within this ES are largely carried out using this matrix. However, matrices for individual topics vary slightly in some instances. Consequently, the approach and relevant guidance is explained within each topic chapter. Certain disciplines do not use a matrix-based approach, as calculations are used to assess impacts in numerical terms. For some topics, where guidance is not available for identifying sensitivity or magnitude, the effects have been identified using professional judgement, and described simply as being either significant or insignificant.

4.6 Mitigation and Residual Effects

In cases where the Proposed Scheme would cause adverse effects exceeding best practice management, mitigation measures have been proposed. Mitigation measures aim to avoid effects at their source, perhaps through amendments to the Proposed Scheme design or by regulating the timing or location of activities. If effects cannot be avoided or reduced, it could be appropriate for compensatory measures to be taken, for example to provide replacement habitat.

Where appropriate, the measures used in mitigation would be developed in consultation with statutory organisations and/or other third parties.

Mitigation could take several forms outlined below.

4.6.1 Primary (inherent) mitigation

This type of mitigation is an intrinsic part of the project design included as part of the original design. Part of the Proposed Scheme, has been relocated southwards to avoid the destruction of mature trees in the landscape and to ensure all works would be carried out outside the Pincey Brook floodplain. In addition, a significant loop was removed from the original scheme design which resulted in a beneficial impact on the landscape and visual

impacts and the amount of materials used in the Proposed Scheme. The scheme would incorporate three new and two improved pedestrian crossings in addition to a joint pedestrian/cycleway from London Road Roundabout to Sheering Road.

4.6.2 Secondary mitigation

Secondary mitigation is further mitigation required to reduce the impact of the scheme on the environment. These mitigations are discussed within the individual chapters of the ES. Of these, the most significant on the Proposed Scheme are:

- trial trenching and recording of archaeological remains within the study area;
- extensive landscape planting with native species for screening and habitat replacement purposes;
- provision of landscaped multi-species underpasses to enable movement of bats, badgers and other mammals to pass safely under the new road;
- construction of a hop-over (comprising fencing, tree planting and controlled lighting) to prevent bats and birds from flying into the path of traffic on the new road;
- installation of LED lighting and creation of dark areas to reduce night glow and impacts on residential properties and wildlife;
- timings of construction activities to avoid sensitive ecological periods;
- excavated materials to be reused on site in construction of embankments;
- provision of noise barriers along the Gilden Way and near The Campions;
- retention of access to pedestrian/cycleway crossing points and bus stops throughout construction;
- up to 50% reductions in the discharge from areas of existing roads, and attenuation for all storm events up to and including the 1% Annual Exceedance Probability (AEP) event, plus a 30% allowance for climate change;
- all attenuation ponds and tanks to be lined to protect underlying aquifers;
- sheet piling to minimise landtake and soil nailing over the Pincey Brook; and
- no significant construction to take place within the Pincey Brook flood plain.

The secondary mitigations for the Proposed Scheme are summarised in the Register of Environmental Actions and Commitments (REAC) table in Chapter 5 of the outline Environmental Management Plan (EMP) document.

4.6.3 Tertiary mitigation

Tertiary mitigation is that which would be required regardless of any EIA assessment as it is required as a result of legislative requirements and/or standard practice. For example, the need to obtain a Protected Species licence prior to relocating protected species from the site. Tertiary mitigation measures identified in the topic assessments in this ES are summarised in the Register of Environmental Actions and Commitments (REAC) table (Chapter 5.1) in the EMP document.

4.6.4 Residual effects

Effects that would still occur once mitigation measures have been taken are referred to as residual effects. Mitigation measures which are desirable but cannot be committed to as part of the Proposed Scheme, at this stage, have not been taken into account in the assessment of residual effects. Where there is any doubt about the effectiveness of the mitigation, a worst case scenario has been assumed and taken into account in the assessment of residual effects.

4.7 Assumptions and Limitations

Assumptions and limitations are highlighted within the topic chapters. The main limitation of any ES is that it is written at a given point in time and can only be based on information available up to this point. The main limitations of the current ES are described below:

- The construction information used for the purpose of this assessment has been based on an assumed construction methodology including an informed approach to likely construction sequencing, construction duration (or 'programme') and construction activities. If the contractor uses a different methodology, ECC would require it to undertake the works in a way that was not more environmentally damaging than the methods and assumptions made at this stage. Any proposed divergence in construction approach would be agreed with ECC and reassessed for environmental impacts.
- The proposed noise barrier locations, alignments and heights given in the current ES are indicative only to mitigate the impact of noise from the Proposed Scheme on the local area. Final design would only be carried out after the planning submission following consultation with the planning authority and local residents, businesses and landowners. All assessments based on these indicative locations, such as Air Quality, Cultural Heritage, Landscape and Visual, Nature Conservation and People and Communities would need to be re-visited as a result of any alterations. As the details of the noise barriers emerge following discussions with affected residents, the impacts would be assessed more thoroughly by relevant topic specialists.
- Due to the iterative nature of the ES process, some investigations were carried out prior to alterations in the scheme design. Such investigations include the Ground Investigation (GI). Further GI would be necessary at the detailed design stage to obtain a fuller picture of the ground conditions across the site.
- An extensive number of ecological surveys were carried out across the site. However, due to the nature of ecology, the baseline condition is always changing. Further surveys would be required prior to construction to gain a fuller understanding of the location of protected species across the site.
- Air quality and noise calculations and assessments have been based on traffic modelling. This is a forecasting model and might not be representative of the actual situation in the future. No consideration of topography or "canyon" effects from noise barriers has been undertaken.
- The assessment of impacts on agricultural land was carried out via a desk-based study. Soil classification, to determine the grades of soil types in line with the updated 'Agricultural Land Classification of England and Wales' (MAFF, 1998) i.e. 3a or 3b, was outside of the scope of the assessment. It was therefore assumed that all fields identified as Grade 3 are in fact Grade 3a (Best and Most Versatile (BMV)).
- Low water flow information was not available for the Harlowbury Brook so professional judgement was used in this location. Further advice and agreement from the EA was being sought at the time of writing.
- The new developments at Harlowbury and New Hall have been considered in Chapter 14 - Cumulative Effects. However, the impacts of the Proposed Scheme on properties yet to be built for example in the visual assessments chapter have not been assessed due to insufficient information. In addition, the alignment of the joint pedestrian/cycleway is not known as it is expected to tie in with one specified in the planning conditions for Harlowbury. Indicative noise barriers have been proposed alongside Harlowbury, but at detail design it is expected that noise mitigation along this stretch would be designed in conjunction with Harlowbury. Topic specific limitations and assumptions are described in each chapter.

5. Air Quality

5.1 Introduction

An air quality assessment is the consideration of any scheme proposal causing significant changes to the nature and location of emissions to air. The Proposed Scheme involves the introduction of the new junctions with the link road and widening of Gilden Way thereby attracting more traffic than the existing road. This would change traffic flows on other roads in the wider area. These proposals have the potential to increase emissions from vehicle traffic and change ambient air quality at nearby receptors.

A detailed assessment has been undertaken to establish the potential effects of the Proposed Scheme on local air quality and regional emissions. This chapter describes the assessment and the operational effects arising from the Proposed Scheme.

Additional information to support this chapter is presented in the following appendices:

- Appendix 5.1: Designated Sites Assessment Detailed Results;
- Appendix 5.2: Verification and Model Adjustment;
- Appendix 5.3: Local Air Quality Monitoring;
- Appendix 5.4: Air Quality Modelling Results; and
- Appendix 5.5: Recommended Construction Mitigation Measures.

5.1.1 Legislative and planning context

Key European Union (EU) and United Kingdom (UK) air quality legislation, policy and guidance are identified below:

- EU Directive 2008/50/CE - published to consolidate previous European Directives on ambient air quality. The UK government is responsible to the European Commission (EC) for ensuring that it complies with the provisions of EU Directives; and
- Air Quality Standards Regulations 2010 - transposed and formalised in UK law the limit values set out in the EU ambient air quality directive 2008/50/EC.

The air quality criteria for human exposure and ecosystems for the key pollutants relevant to the assessment are presented in Table 5.1.

Table 5.1: UK Air Quality Objective (AQO) and EU limit values

Pollutant	Statistic	Objective/EU limit value (µg/m^3)
Nitrogen dioxide (NO_2) (for human exposure)	Annual Mean	40
	1-hour mean, not to be exceeded more than 18 times per year (equivalent to the 99.79th percentile of 1-hour means)	200[5]
Particulate Matter (PM_{10}) (for human exposure)	Annual Mean	40
	24-hour mean, not to be exceeded more than 35 times per year (equivalent to the 90.08th percentile of 24-hour means)	50
Nitrogen oxides (NO_x) (for ecosystem)	Annual Mean	30

[5] For 1-hour mean Air Quality Standard (AQS) objective for NO2, Defra advises that if the annual mean NO2 concentration is less than 60µg/m3, the hourly mean objective is unlikely to be exceeded.

5.1.2 Study area

The air quality assessment comprises two sub-topics:

- local air quality - this relates to pollutants with potential to affect human health and ecosystems at a local level; and
- regional emissions - this relates to pollutants dispersing over a larger area, with potential to affect human health, ecosystems or climate change.

The study area for the assessment of local air quality has been defined in line with the guidance contained in the DMRB Volume 11, Section 3, Part 1 (HA207/07) (Highways Agency, 2007a). It comprises all land within 200m of the centre line of the existing road; land within 200m of the centre line of the Proposed Scheme; and land within 200m of any other 'affected roads'.

For local air quality, 'affected roads' have been identified by qualifying criteria published in HA207/07 based on changes between Do-Minimum (DM) and Do-Something (DS) scenarios, as follows:

- road alignment would change by 5m or more;
- daily traffic flows would change by 1,000 Annual Average Daily Traffic (AADT) or more;
- Heavy Duty Vehicle (HDV) flows would change by 200 AADT or more;
- daily average speed would change by 10kph or more; or
- peak hour speed would change by 20kph or more.

For regional emissions, 'affected roads' are those meeting any of the following criteria:

- a change of more than 10% in AADT;
- a change of more than 10% to the number of HDV; or
- a change in daily average speed of more than 20kph.

Data from the traffic model have been used to define the study area. Figure 5-1 defines the air quality study area and constraints. The study area covers the Proposed Scheme and also lengths of the local road network serving these areas.

5.2 Assumptions and Limitations

The following factors that could potentially affect concentrations have not been taken into account in the assessment as the information was not available when the assessment was carried out:

- the effect of cuttings/embankments/barriers/vegetation; and
- changes in local terrain/topography.

5.3 Methodology and Assessment Criteria

5.3.1 Methodology

A detailed level assessment has been carried out following guidance set out in HA207/07, associated HE IANs, and Defra's Local Air Quality Management Technical Guidance 2016 (LAQM.TG16) (Defra, 2016), where appropriate.

The key elements of the assessment are as follows:

- Consideration of relevant local authorities' Local Air Quality Review and Assessment documents; assessment of existing local air quality conditions through a review of air quality monitoring data for the study area.
- Local air quality assessment for NO_2 and PM_{10} at human exposure receptors within 200m of affected roads using dispersion modelling.
- Ecological assessment of N-deposition at Designated Sites within 200m of affected roads using dispersion modelling.
- Regional assessment calculation emissions of Nitrogen Oxides (NO_x), PM_{10} and carbon dioxide (CO_2).

5.3.1.1 Construction dust impacts

The construction phase assessment comprises a dust risk assessment and an assessment of emissions from construction vehicles and associated with traffic management measures. The construction impact has been assessed using the qualitative approach described in Institute of Air Quality Management (IAQM) guidance (IAQM, 2014). Figure 5.2 details the air quality construction assessment.

The dust impacts from the construction phase are due to the activities on construction sites, mainly demolition, earthworks, construction and trackout. The assessment methodology considers three separate dust impacts:

- annoyance due to dust soiling;
- the risk of exposure effects due to an increase in exposure to PM_{10}; and
- harm to ecological receptors.

The assessment has taken into account the potential dust emission magnitude and the sensitivity of the area to define the risk of significant effects.

5.3.1.2 Operational phase

The assessment identifies potential air quality effects by predicting changes in air quality pollutant concentrations resulting from the combination of background concentrations with the contributions from the roads in the study area, including the Proposed Scheme.

This assessment conforms to the standard practice of EIA, whereby the baseline is established, and then the situation with the development in place (DS) is compared to the situation without it (DM).

The effect of the Proposed Scheme has been assessed using HA207/07 and LAQM TG (16). Design Manual for Roads and Bridges allows for the progression to a 'detailed' assessment from a 'simple' assessment, depending on the potential for significant effects to be identified. For the Proposed Scheme, a detailed assessment has been carried out for local air quality, taking account of diurnal changes in traffic flows using the dispersion modelling software, Advanced Dispersion Modelling Software ADMS-Roads (v4.0.1); and a simple assessment has been carried out for regional emissions.

5.3.1.3 Assessment scenarios

The assessment method is to quantify ambient pollution concentrations for a number of road traffic scenarios.

- Baseline 2014.
- Opening year 2021 – without the Proposed Scheme (DM).
- Opening year 2021 – with the Proposed Scheme (DS).

In addition to these, future scenarios 15 years after opening are considered for regional emissions for:

- Design Year 2036 – DM.
- Design Year 2036 – DS.

The assessment covers different geographic scales, as follows:

- local air quality, focusing only on the headline pollutants NO_2 and PM_{10}; and
- regional emissions, focusing on NO_x, PM_{10} and CO_2 emissions due to their effect on climate.

The designated habitats assessment focuses on N-deposition at sites within 200m of affected roads.

5.3.1.4 Traffic data

Traffic data for the modelling scenarios have been provided from the Saturn traffic models produced by Jacobs. The base year air quality modelling uses traffic data, pollution measurements and meteorological measurements from 2014.

Traffic data that represent the average conditions occurring in specific time periods were provided for the periods specified in Table 5.2.

Table 5.2: Annual average weekday time periods used in the assessment

Traffic period	Time period
Annual Average Daily Traffic (AADT)	00:00 – 23:00
Annual Average Weekday Traffic (AAWT) AM peak (AM)	07:00 – 10:00
AAWT inter-peak (IP)	10:00 – 16:00
AAWT PM peak (PM)	16:00 – 19:00
AAWT off peak (OP)	19:00 – 07:00

For each time period, the following traffic data parameters were provided:

- total traffic flow, defined as vehicles/hour;
- percentage HDV;
- vehicle speed, in kph;
- vehicle speed band, in kph; and
- vehicle speed category.

5.3.1.5 Local air quality concentration prediction

The assessment of the potential air quality effects of the Proposed Scheme has been undertaken using the ADMS-Roads, developed by Cambridge Environmental Research Consultants Ltd. (CERC). This software is an atmospheric modelling system focussing on road traffic as a source of pollutant emissions. It is a recognised

tool for carrying out air quality impact assessments and has been comprehensively validated both by the manufacturer and independently.

This software is used by regulatory authorities and commercially to assist in decisions related to air quality and traffic management, urban planning and public exposure in many countries around the world. Version 4.0.1 (November 2015) has been used for this assessment.

It should be noted that dispersion models provide an estimate of concentrations arising from input emissions and historical meteorological data. The estimates produced, whilst appropriately representing the complex factors involved in atmospheric dispersion, are subject to uncertainty. Whilst the predictions provided by the models should not be regarded as definitive statements of concentrations arising in the future, they are the most reasonable, robust and representative estimates available. The estimates are composed of calculations made at a single point on each residential property.

5.3.1.6 Meteorological data

The effect of meteorological conditions on dispersion is given a complex treatment within the model. The most significant factors in the dispersion of emitted pollutants are wind speed and direction. The meteorological data site considered to be most representative of conditions across the study area was Stansted, the most reliable meteorological site close to the study area.

5.3.1.7 Vehicle emissions

The modelling system takes into account the emissions produced by Light Duty Vehicles (LDV), less than 3.5 tonnes; and HDV, greater than 3.5 tonnes, travelling at speed along a section of road over an average hour. A Speed Pivot adjustment factor is calculated by dividing the observed speed in the base year by the modelled speed in the base year. From this a speed category is assigned to each modelled road link with the emission rate for each speed category predefined in IAN 185/15. Emissions for the road links HDV and LDV component are then inputted into the dispersion model.

5.3.1.8 Human exposure receptors

Within the study area, residential properties and other sensitive receptors (such as schools and nursing homes) have been considered. Building usage has been determined using the Ordnance Survey Address Base Plus dataset, and calculations made at the nearest façade to the busiest road.

A total of 16,528 receptors were within the study area and 758 were selected using professional judgement for being:

- close to the affected roads;
- representative of the maximum effects of the Proposed Scheme in that region;
- and at risk of exceeding the annual mean NO_2 Air Quality Objective (AQO) (the list includes dwellings, hospitals, educational establishments and others; shown as points on Figures 5-3 Sheets 1-7.

5.3.1.9 Designated sites

Within the study area, nature conservation sites designated at an International, European or National level have been considered. A detailed assessment of the potential air quality effects on designated habitat sites within 200m of the study areas has been undertaken. The sites included are shown in Table 5.3 and details of designated sites are provided in Appendix 5.1.

Table 5.3: Designated sites assessed in the assessment

Site name	Designation
Sawbridgeworth Marsh	Site of Special Scientific Interest (SSSI)
Epping Forest	SSSI
Thorley Flood Pound	SSSI

5.3.1.10 Background concentrations

'Background' air quality is a concept used to enable assessments of the effects of particular emissions sources, without the need for all sources in the area to be considered explicitly. For the purposes of this assessment, the background air quality is the boundary condition of the road emissions pollution model. The road derived pollution is added to the background pollution concentration.

Defra provides empirically-derived national background maps, providing estimates of background pollutant concentrations on a 1km x 1km grid square resolution; the data have been obtained from Defra (http://www.laqm.defra.gov.uk). The data for NO_x, NO_2 and PM_{10} have recently been updated, with a base year of 2013 from which future years are projected.

The 'in-grid square' contribution from motorway, trunk 'A' road and primary 'A' road sectors have been removed from the background annual mean NO_x and PM_{10} concentration estimates, and background annual mean NO_2 estimates have been corrected using the Defra's Background NO_2 Calculator. This process has been undertaken to avoid double counting of road traffic emissions included in the dispersion model. Where predicted concentrations for specific receptors are presented, the sector-removed background concentrations used are also presented. The predicted background pollutant concentrations in the study area are significantly below the AQOs.

5.3.1.11 Prediction of environmental concentrations including adjustment for long term trends in NO_x and NO_2

The model is used to predict the road traffic contributions to NO_x and PM_{10} concentrations at specified receptors. Adjustments are applied to the model predictions based on a comparison against measured air quality concentrations, in a process known as model verification and adjustment. The modelled road contributions of NO_x, NO_2 and PM_{10} have been adjusted to correct them against measured road components derived from monitoring data, following an adjustment method set out in LAQM TG (16). NO_x and NO_2 concentrations have been calculated using the NO_x from NO_2 calculator (version 5.1) available on the Defra website. The calculator has been issued in conjunction with the LAQM TG (16) guidance. A total environmental concentration has then been produced by addition of the adjusted road contribution to the background concentration. Further detail on the verification process is provided in Appendix 5.2.

For the opening year predictions, a further adjustment step is undertaken to account for the observed trends in ambient roadside NO_x and NO_2.

In July 2011, Defra published a report (Defra, 2011a) examining the long term air quality trends in NO_x and NO_2 concentrations. This identified that there has been a clear decrease in NO_2 concentrations between 1996 and 2002. Thereafter NO_2 concentrations have stabilised with little to no reduction between 2004 and 2012. The consequence of the conclusions of Defra's advice on long term trends is that there is now a gap between current projected vehicle emission reductions and projections on the annual rate of improvements in ambient air quality, built into the vehicle emission factors, the projected background maps and the NO_x and NO_2 calculator.

Highways England has developed the Gap Analysis methodology to adjust model predictions based on the method in LAQM TG (09) to account for the long term NO_x and NO_2 profiles. This uses the relationship between the base year vehicle emission rates and the opening year vehicle emission rates, and the measured trends in roadside air quality concentrations to uplift opening year predicted concentrations to align them better with the long term trends of NO_x and NO_2.

The current trends in air quality are based on measurements of emissions from the existing vehicle fleet. New vehicles would need to comply with the more stringent Euro 6/VI emissions standards from September 2014 onwards. Vehicles complying with the Euro 6/VI emissions standard are not yet on the road network, and therefore their performance is not present in the long term air quality monitoring trends. If the Euro 6/VI fleet emissions perform as predicted, then this should lead to substantial reductions in predicted future roadside air quality concentrations. However, because the likely effects of Euro 6/VI vehicles on air quality are yet to be fully understood, HE's advice is that a long term trend based on the existing fleet is assumed to be linear and to continue at this projected rate of decrease into the future.

The gap analysis methodology (IAN 170/12v3) (Highways Agency, 2013) incorporates the Euro 6/VI improvements. These projection factors are referred to as 'Long Term Trend Euro 6/VI (LTTE6)'. The LTTE6 factors assume that the measured trends from 2004 to 2012 continue to occur for all pre-Euro 6/VI fleet. They also take a precautionary approach to account for uncertainty associated with Euro 6/VI performance and fleet mix in the future, rather than assuming full reductions in emissions occur as predicted by Euro 6/VI, which has not been observed by air quality monitoring trends associated with recent Euro standards. This is implemented into LTTE6 by taking the mid-point between the measured trend predictions (which assume no improvement in emissions associated with Euro 6/VI) and predicted Euro 6/VI uptake and emission improvements.

On this basis, the LTTE6 projections are considered to be the most reasonable prediction of likely actual future NO_x and NO_2 concentrations, and have been used in the calculations for this updated local air quality assessment. The gap analysis method is not applied to PM_{10} predictions, and results based on the LAQM TG (16) method are the final predicted concentrations throughout this assessment.

5.3.1.12 Regional emissions

The regional assessment for this chapter calculated the total emissions of NO_x, PM_{10}, and CO_2 for DM and DS scenarios and compared the changes between the scenarios. Emission rates for individual links have been based upon their corresponding traffic flow, percentage of HDV and average link speed and then multiplied by the total length of the respective link. The emissions of all the links are combined to determine the regional emissions of NO_x, PM_{10}, and CO_2.

5.3.2 Assessment of magnitude and significance

5.3.2.1 Construction impacts

The impact of construction activities and vehicles has been assessed in accordance with IAQM guidance and professional judgement on the basis of impact magnitude and sensitivity of receptors.

5.3.2.2 Local air quality impacts on human exposure and ecology

To convey the level of impact of the Proposed Scheme, it is necessary to determine the significance of the predicted impacts. The 'significance' of an environmental impact is a function of the 'sensitivity' of the receptor and the 'scale' of the impact.

The model results have been used to assess whether there are any significant effects as a result of the Proposed Scheme.

Highways England's approach to evaluating significant air quality effects is set out in two IANs (IAN 174/13 and IAN 175/13) published in June 2013. These IANs are intended to reflect the change in national planning policy associated with the National Planning Policy Framework (NPPF).

Highways England's approach to air quality assessment identifies and assesses sensitive receptors near roads where air quality might be affected. Consequently, areas where national AQOs might be expected to be exceeded are considered, which includes Air Quality Management Areas (AQMAs). The model results are used to identify those receptors which are in exceedance of AQOs in either the DM or DS scenario. These are the only receptors that are considered in the judgement of significance. The change in predicted concentration is then calculated as the difference between DS and DM model results at these receptors.

Where the difference in concentrations are less than 1% of the AQO (i.e. less than 0.4µg/m³ for annual average NO_2) then the change at these receptors was considered to be imperceptible and have been scoped out of the judgement on significance.

Highway England has developed a framework to provide guidance on the number of receptors for each of the magnitude of change categories that might result in a significant effect. These are guideline values only, and are to be used to inform professional judgement on significant effects of the Proposed Scheme. The guideline bands are based on the Highway England's considered opinion and are intended to help provide consistency across all Highway England schemes. However, they are guideline values only, and are to be used to inform professional judgement on significant effects of the Proposed Scheme. The significance categories and guideline property numbers are summarised in Table 5.4.

Table 5.4: Guideline to number of properties constituting a significant effect

Magnitude of change in NO_2 or PM_{10} concentration (µg/m³)	Number of receptors where Air Quality Objectives (AQO) already above objective with:	
	Worsening or creation of a new exceedance	Improvement or the removal of an existing exceedance
Large (>4)	1 to 10	1 to 10
Medium (>2)	10 to 30	10 to 30
Small (>0.4)	30 to 60	30 to 60

If the significance of the change is greater, the higher above the air quality thresholds the changes are predicted to occur. Where it is predicted that the short term NO_2 and/or PM_{10} thresholds are exceeded, then more significance should be attributed to these effects.

The upper and lower bands presented are guidelines and not absolutes. On occasions when the number of properties affected is above the upper guideline band, consideration should be given to all the evidence that may support or detract from a conclusion of a significant effect when coming to an overall view. The further above the upper guideline band the more likely local air quality effects would be significant.

Where the results reside between the lower and upper guideline bands for any of the magnitude criteria, then the scheme effects could be significant and a judgement is required taking into account the results for all six categories. This judgement is based on the technical knowledge and experience of the air quality professional. To assist this judgement, consideration should be given (but not limited) to the following:

Proposed Scheme effects are more likely to be significant where:

- there are no/few receptors with any improvements;
- PM_{10} annual averages are also affected by small, medium or large deteriorations; or
- short-term exceedances may be caused or worsened by the Proposed Scheme for either NO_2 or PM_{10}.

Proposed Scheme effects are more likely to be not significant where:

- there are receptors with small, medium or large improvements;
- PM_{10} annual averages are not affected by small, medium or large deteriorations; or
- short-term exceedances are not caused or worsened by the Proposed Scheme for either NO_2 or PM_{10}.

The establishment of overall air quality significance for a scheme should also consider: whether it detracts or supports measures set out in relevant Local Authority air quality action plans; if a scheme represents a low or high compliance risk with the EU directive on air quality; if any designated site(s) are affected; and if there is any available potential effective mitigation.

The EU Directive on *Ambient Air Quality and Clean Air for Europe (CAFE) (2008/50/EC)* sets limit values for a range of pollutants. The purpose of the Directive is to protect human exposure, and the environment as a whole. Defra (on behalf of the UK government) reports annually to the EC on the status of air quality. Highways England's compliance risk assessment test (IAN 175/13) has been developed to enable decision makers to judge a scheme's likelihood of non-compliance with the EU Directive. The compliance risk assessment test also informs the air quality significance test.

For designated sites, the magnitude of concentrations of NO_x is assessed against a Critical Level (annual mean concentration of 30µg/m^3). Where NO_x concentrations are assessed to be below their objective then significant effects on N-deposition are not anticipated. Where changes in NO_x concentrations are greater than 0.4µg/m^3, then this information along with changes in N-deposition has been assessed in Chapter 8 – Nature Conservation, to determine the significance of effects based on professional judgement.

5.3.2.3 Regional impacts

There is no guidance for determining significant effects of regional impacts. The impact of regional emissions has therefore, been assessed based on professional judgement based on the magnitude of change to national emissions.

5.4 Baseline Environment

5.4.1 Baseline sources and conditions

To provide an assessment of the significance of any new development proposal (in terms of air quality), it is necessary to identify and understand the baseline air quality conditions in and around the study area. This provides a reference level against which any potential changes in air quality can be assessed. Since the baseline air quality is predicted to change in the future (mainly because vehicle emissions are changing), the baseline situation is extrapolated forward to the opening year. The DM scenario is the predicted baseline for the opening year, and includes any other Proposed Schemes with a high level of certainty of being built. The DS scenario is the same as the DM, but also includes the Proposed Scheme. The baseline year used for the Proposed Scheme is 2014.

To identify the existing air quality conditions, a review of information has been undertaken, including the latest Local Authority air quality reports, monitoring data and background concentration maps. Appendix 5.3 contains information about local air quality monitoring for NO_2. This section presents the results of the review. The affected roads and air quality constraints including AQMAs are shown in Figure 5-1.

The baseline condition was established using various information sources:

- Defra background mapping for projected background concentrations in the assessment years (Defra, 2016);
- Local Authorities' air quality review reports;
- Local Authorities' air quality monitoring data;
- UK Air Pollutant Information System for site relevant Critical Loads (APIS, 2016);
- Natural England (NE) http://www.gis.naturalengland.org.uk/pubs/gis/GIS_register.asp for designated sites locations and https://designatedsites.naturalengland.org.uk/ for designated sites information;
- human exposure receptors were identified from the Ordnance Survey Address base Plus dataset; and
- UK National Atmospheric Emissions Inventory (NAEI) (NAEI, 2013a) and for local authorities' source sector emission data (NAEI, 2013b).

5.4.1.1 Local air quality management summary

Under Part IV of the Environment Act 1995, the UK Government introduced Local Air Quality Management (LAQM), placing duties on local authorities to undertake periodic reviews of air quality in their areas to assess

present and likely future air quality against the Air Quality Strategy (AQS) objectives. Where these objectives are not likely to be met, the Local Authority must designate an AQMA, and produce an action plan for improvement in air quality.

The Proposed Scheme study area is located within the jurisdiction of four local authorities: Epping Forest District Council, Uttlesford District Council, Harlow Council and East Hertfordshire District Council. The baseline assessment includes a brief review and summary of the LAQM reports. Monitoring data have been obtained directly from the Local Authority where necessary. A summary of the most recent LAQM report obtained is provided in Table 5.5.

Table 5.5: Summary of LAQM reports for Local Authorities within the air quality study area

Report title	Conclusion summary
2015 Updating and Screening Assessment for Epping Forest District Council (EFDC)	No locations, except for Bell Vue which is located within the existing AQMA, with specific sensitive receptors exceeded the Air Quality Objectives (AQO). 17 locations showed an improvement in air quality, 2 reporting a slight increase and 2 sites reporting no change compared to the previous year. EFDC does not operate continuous monitors.
Uttlesford District Council (UDC) 2015 LAQM Updating and Screening Assessment	No locations within the Local Authority exceeded the AQO in 2014. UDC operates 3 continuous monitors, none of which exceeded the relevant AQO.
Harlow Council 2015 LAQM Updating and Screening Assessment	No locations within the Local Authority exceeded the AQO in 2014. HC does not currently operate continuous monitors.
2015 Updating and Screening Assessment for East Hertfordshire District Council	The diffusion tube data indicate that in 2014, the AQO for NO_2 annual mean is unlikely to be met at 11 locations within the EHDC boundary. All of these locations are within the existing AQMA. The data obtained from the continuous monitors locations within the Local Authority indicate that the relevant objectives are likely to be met.

5.4.1.2 Air Quality Management Area

Where a Local Authority measures and/or predicts an exceedance of AQS objectives they would declare an AQMA. There are two AQMAs within 200m of the affected roads. The Sawbridgeworth AQMA was declared in May 2015 for annual mean nitrogen dioxide (NO_2). The Bishops Stortford AQMA was declared in February 2007 for annual mean NO_2. The Sawbridgeworth AQMA contains 458 sensitive human receptors and the Bishops Stortford AQMA contains 106 sensitive human receptors.

5.4.1.3 Monitoring data

Air quality monitoring data within the study area have been collated and reviewed for use in the assessment. All four local authorities manage a network of NO_2 diffusion tubes, including at locations in the vicinity of the study area.

Sites with suitable data capture and where the exact monitoring location could be confirmed have been used to inform the air quality assessment and verify dispersion modelling results. The 2014 annual mean measurement data used for verification in this assessment are provided in Appendix 5.2, and presented in Figure 5-1 Sheet 2 of 3.

Monitoring locations with the highest measured concentrations of annual mean NO_2 for 2014, for each Local Authority in the study area, are provided in Table 5.6. The 2014 NO_2 monitoring data for other locations in each authority are presented in Appendix 5.3. The measurements have shown no exceedances of the NO_2 annual mean objective (40µg/m^3) in the vicinity of Gilden Way and M11; however, there are some exceedances at East Hertfordshire District Council. It should be noted that the monitoring locations tend to be in worst-case locations, and might not be representative of locations actually representing public exposure.

Table 5.6: Local Authorities highest NO_2 monitoring data (2014 annual mean) (µg/m^3)

Local authority	Reference	Location	2014 Annual mean (µg/m^3)
Harlow Council	HAR11	Town Centre	33.6
East Hertfordshire District Council	EH19/EH39/EH40	London Road, Bishops Stortford	76.0
Uttlesford District Council	UT009	Burton End	33.6
Epping Forest District Council	n/a	Outside of study area	n/a
Note: exceedances are shown as bold underlined text			

The PM_{10} annual mean concentrations for 2014 for monitoring locations in the study area are provided in Table 5.7. The measurements show no exceedances of the PM_{10} annual mean objective (40µg/m^3) in the vicinity of the Proposed Scheme and the wider study area.

Table 5.7: Local Authorities PM_{10} monitoring data (2014 annual mean) (µg/m^3)

Local authority	Reference	Location	2014 Annual mean (µg/m^3)
Uttlesford District Council	Takeley	Prior's Wood Road	26.8
Uttlesford District Council	Birchanger	Duck End	31.2
East Hertfordshire District Council	EH2	Cambridge Road	17.0
Note: Epping Forest District Council and Harlow Council do not monitor PM10 concentrations within their administrative areas			

5.4.1.4 Modelled estimates of baseline concentrations at monitoring locations

The air quality study area has been defined by the traffic changes predicted to result from the Proposed Scheme. At the monitoring locations (outlined above), estimates have been made by dispersion modelling of the base year; this has been taken to represent the current air quality situation at these locations. Dispersion models use meteorological data to represent the way that emissions from vehicles are transported through the atmosphere.

The base year dispersion modelling has indicated a reasonable overall agreement between predicted concentrations and measured concentrations at the monitoring locations. Details of the model verification exercise are provided in Appendix 5.2.

5.4.1.5 Summary

In the base year exceedances of the NO_2 annual mean AQO within the local authorities of Epping Forest and East Hertfordshire have been found. The locations of the exceedances within Epping Forest are near the M25 and along the main high street through the town of Epping. Within the Local Authority of East Hertfordshire, the locations of the exceedances would be in and around the Bishops Stortford AQMA and the Sawbridgeworth AQMA.

5.4.2 Value of receptors

The dust emission magnitude is based on the scale of the anticipated work and classified as Table 5.8 below:

Table 5.8: Determination of the potential dust emissions magnitude

Activities	Relevant definitions	Potential dust emission magnitude
Demolition	n/a	-
Earthworks	Site area >10,000m^2; greater than 10 heavy earth moving vehicles active at any one time.	Large
Construction	Total building volumes between 25,000m^3 to 100,000m^3 with potentially dusty construction material (concrete).	Medium
Track out	>50 HDV outward movements in any one day.	Large

The sensitivity of the receptors and area has been defined for dust soiling, human exposure and ecological impact as shown in Table 5.9.

Table 5.9: Sensitivity of the receptors

Impact	Relevant receptors	Sensitivity of the receptors	Relevant definition	Sensitivity of the area to the impact
Dust soiling	Residential properties and car parks.	High sensitivity receptors.	71 receptors within 20m of the Proposed Scheme construction boundary.	High
Human exposure effects of PM_{10}	Residential properties, schools etc.	High sensitivity receptors.	71 receptors within 20m of the Proposed Scheme with 16.6µg/m^3 average annual mean PM_{10} background concentration for 2014.	Low
Ecological impact	No nationally designated ecological receptor within the construction boundary.			

5.5 Significant Effects

5.5.1 Construction effects

5.5.1.1 Construction activities

Part of the Proposed Scheme would be located in the open field to the north east of Harlow and east of Gilden Way. There are a total of 1,394 receptors within 350m of the boundary of this site. No ecological receptors within 50m of the boundary of the site; 50m of the route used by construction vehicles on the public highway; or 500m from the site entrances have been identified. The locations of these sensitive receptors are presented in Figure 5-2.

The risk of dust impact to both dust soiling and human exposure effects for each construction activity is summarised in Table 5.10.

Table 5.10: Risk of construction impact

Impact (sensitivity of the area)	Construction activities (dust emission magnitude category)				
	Demolition (n/a)	Earthworks (Large)	Construction (Medium)	Track out (Large)	Overall risk of dust impact
Dust soiling (High sensitivity)	n/a	High Risk	Medium Risk	High Risk	High Risk
Human exposure (Low sensitivity)	n/a	Low Risk	Low Risk	Low Risk	Low Risk
Overall risk for activity	n/a	High Risk	Medium Risk	High Risk	High Risk

The dust impact assessment has demonstrated that the risk of dust soiling without any mitigation would be High Risk for earthworks, Medium Risk for Construction and High Risk for trackout. The risk of adverse exposure effects of PM_{10} for all construction activities has been assessed as Low.

5.5.1.2 Construction traffic

Traffic data for all the construction phases have been included in the assessment. The latest available construction traffic data (version DRAFT8) shows the maximum AADT from HDVs associated with the entire construction phase to be 97 vehicle movements and below the DMRB HA207/07 criteria for affected links as listed in Section 5.1.2. Therefore it has been assessed that the impact of the construction traffic on local air quality would not be significant and therefore no further assessment has been undertaken for construction traffic.

5.5.2 Operational effects

5.5.2.1 Human exposure receptors predictions

This section presents the potential effects of the operation of the Proposed Scheme on local air quality along affected roads in the study area. The results presented have been based on the values predicted using the gap analysis methodology, taking into account LTTE6 for NO_x and NO_2. This approach is considered more conservative and representative of opening year impacts than the LAQM TG (16) methodology.

In accordance with IAN 174/13, 646 receptors modelled have been predicted to receive concentrations below AQOs in both the DM and DS scenarios. Consequently, it has been assessed that there would be no significant effects and therefore they are not discussed further in this chapter.

133 exceedances of the annual mean NO_2 AQO in the DM scenario have been identified. There would be 126 exceedances of the annual mean NO_2 AQO in the DS scenario. The exceedances of the annual mean NO_2 AQO would be at locations along the A414, A1169, M11, A1184 within the Sawbridgeworth AQMA and locations within the surrounding roads of the Bishops Stortford AQMA in the study area. No exceedances of the PM_{10} annual mean AQO in the 2021 DM and DS scenarios have been identified. Annual mean NO_2 predictions for each receptor exceeding the NO_2 AQO are included in Appendix 5.4.

Figures 5-3 Sheet 1 and 2 show the 83 receptors that would be exceeded in both the DM and DS scenarios. The majority of these receptors are located in and around the Bishops Stortford AQMA.

Figures 5-3 Sheet 3 and 4 show the 37 receptors that would exceed the AQO in the DM scenario and 33 receptors would exceed the DS scenario in the Sawbridgeworth AQMA.

Figure 5-3 Sheet 5 also shows that there would be six exceedances of the AQO within both the DM and DS scenarios. These receptors are located along the east of the M11.

Figure 5-3 Sheet 6 shows that there would be five exceedances in the DM scenario and three exceedances in the DS scenario. Receptor 146738 to the east of the A1169 roundabout would be likely to experience an increase in exposure to pollutant concentrations with the Proposed Scheme. Receptor 142369 to the west of the A1169 roundabout would be likely to experience a reduction in exposure to pollutant concentrations with the Proposed Scheme.

In Figure 5-3 Sheet 6 Receptor 151280 would be likely to experience an increase in exposure to pollutant concentrations with the Proposed Scheme and is located next to the M11 whereas the three receptors would experience a reduction in exposure to pollutant concentrations with the Proposed Scheme.

Twenty two receptors have been predicted to exceed the annual mean NO_2 equivalent for the 1 hour mean AQO of 60µg/m^3 in DM and two receptors predicted to exceed the annual mean NO_2 equivalent for the 1 hour mean AQO of 60µg/m^3 in DS. The 24 hour PM_{10} mean objective has not been predicted to be exceeded in both scenarios.

The maximum modelled annual mean NO_2 concentration would be at Receptor 205250 (22 Hockerill Court, Bishops Stortford) at 83.4µg/m^3 in the DM scenario; this receptor is shown in Figure 5-3 Sheet 1.

The maximum modelled annual mean PM_{10} concentration would be at Receptor 205250 (22 Hockerill Court, Bishops Stortford) at 25.7µg/m^3 in the DM scenario.

5.5.2.2 Summary of compliance risk assessment

The Proposed Scheme study area contains seven roads (A414, A1019, A1025, A1169 and A1184 in Harlow and A1060, A1184 and A1250 in East Hertfordshire) forming part of Defra's assessment for the EC on the status of air quality in the UK. The Compliance Risk Road Network (CRRN) comprises the affected road network and is presented in Figure 5-1.

The modelling used for the local air quality assessment has been combined with Defra's Pollution Climate Mapping (PCM) model dataset to determine the risk as to whether the Proposed Scheme would affect the UK's ability to comply with the European Air Quality Directive.

The values reported by Defra based on the PCM model are all below, the EU limit values for the CRRN in 2016 (the latest year publicly available) and the impact of the Proposed Scheme would not lead to increases in concentrations sufficient to alter these conclusions.

5.5.2.3 Designated sites

The results of the ecosystems modelling are presented Appendix 5.3.

Table 5.11: Designated sites N-deposition results

Receptor ID	X	Y	Change (DS- DM)	Critical load	Greater than 1% of the lower threshold of critical load
Sawbridgeworth Marsh 0	549318.1	215766.2	-0.2	10 – 15	Yes

The results indicate that the Proposed Scheme could decrease N-deposition (an improvement) by more than 1% of the lower threshold of the critical load (10-15kg N ha^{-1} yr^{-1} for neutral grassland) at the edge of Sawbridgeworth Marsh. For details of the implications of this change in N-deposition, please refer to Chapter 8 - Nature Conservation. No changes in N-deposition have been identified for the closest three Natura 2000 sites.

5.5.2.4 Regional impact

NO_x, PM_{10} and CO_2 results for the regional assessment for opening year 2021 and design year 2036 are shown in Table 5.11 and Table 5.12.

Table 5.11: Regional emissions in opening year (2021)

Pollutants	Annual regional emission (tonnes)		
	2021 DM	2021 DS	Absolute change
NO_x	333	339	+6.4
PM_{10}	28	28	+0.3
CO_2 (as CO_2)	178,755	181,717	+2,962
CO_2 (as C[6])	48,707	49,514	+807
National emissions*:	**2014 (Kilotonne)**		**% Change**
National Road traffic NO_x emissions	300		+0.002100%
National Road traffic PM_{10} emissions	21		+0.001600%
National Road traffic CO_2 emissions (as C[6])	29,600		+0.000003%

The results for the opening year 2021 indicate an increase in NO_x emissions of 6.4tonnes/year with the Proposed Scheme in place (compared to the DM scenario). PM_{10} emissions have been determined to increase by 0.3 tonnes/year; and CO_2 emissions are predicted to increase by 2,962tonnes/year.

Table 5.12: Regional emissions in design year (2036)

Pollutants (tonnes)	Annual regional emission in tonnes		
	2036 DM	2036 DS	Absolute change
NO_x	265	274	8.8
PM_{10}	32	3	0.6
CO_2	198,608	204,373	5,765
CO_2 (as C[6])	54,117	55,687	1,571

[6] Carbon (C) equivalent emissions can be converted to CO2 equivalent emissions by multiplying by the conversion factor of 44/12 based on the relative molecular mass of CO2 relative to C.

Regional/National emissions*:	2014 (Kilotonne)	% Change
National Road traffic NO_x emissions	300	+0.002900%
National Road traffic PM_{10} emissions	21	+0.002900%
National Road traffic CO_2 emissions (as C^6)	29,600	+0.000005%

The results for the design year 2036 indicate an increase in NO_x emissions of 8.8tonnes/year with the Proposed Scheme in place (compared to the DM scenario). It has been predicted that PM_{10} emissions would increase by 0.6 tonnes/year and CO_2 emissions would increase by 5,765tonnes/year.

5.5.3 Impact significance

5.5.3.1 Human exposure

Where the difference in concentrations were less than 1% of the air quality threshold (i.e. less than 0.4µg/m^3 for annual mean NO_2) the changes at these receptors would be imperceptible and therefore they have been scoped out of the judgement on significance.

The receptors informing the Proposed Scheme significance on local air quality are show in Table 5.13.

Table 5.13: Changes and number of properties constituting a significance effect

Magnitude of change in annual average NO_2 (µg/m^3)	Number of receptors where Air Quality Objectives (AQO) already above objective with:			
	Improvement or removal of an existing exceedance			
	Rest of study area	Sawbridgeworth AQMA	Bishop's Stortford AQMA/Junction	Total
Large (>4)	0	0	25	25
Medium (>2)	8	28	63 (+38)	99 (+74)
Small (>0.4)	10 (+2)	31 (+3)	83 (+20)	124 (+25)
Magnitude of change in annual average NO_2 (µg/m^3)	**Number of receptors where AQO already above objective with:**			
	Worsening or creation of a new exceedance			
	Rest of study area	**Sawbridgeworth AQMA**	**Bishop's Stortford AQMA/Junction**	**Total**
Large (>4)	0	0	0	0
Medium (>2)	6	0	0	6
Small (>0.4)	8 (+2)	0	0	8 (+2)
Bracket indicates number of receptors added to the band.				

The results show that for the NO_2 annual mean AQO, the Proposed Scheme would lead to a large magnitude improvement at 25 receptors, all of which are located along A1060 London Road and B1383 Stansted Road, Bishop's Stortford. There would be a medium magnitude improvement at a further 74 receptors located along A1060 London Road and B1383 Stansted Road, Bishop's Stortford; at Sawbridgworth AQMA; a roundabout at A414/Second Avenue, Harlow; and Priory Court/A414 Harlow. Finally, there would be a small magnitude improvement at a further 25 receptors located approximately at A414/Second Avenue, Harlow and A1169 Elizabeth Way, Harlow.

Six receptors would experience a medium magnitude (worsening) and located along B183 The Street, Harlow and Crown Close, Sheering Harlow (along M11). There would be a small magnitude worsening at a further two receptors located at A414 Edinburgh Way, Harlow and Weald Hall Lane, Epping Forest (along M11). There would not be any new exceedances created with the Proposed Scheme.

Table 5.14: Changes and number of properties constituting a significant effect (conservative approach)

Magnitude of change in annual average NO_2 ($\mu g/m^3$)	Number of receptors where Air Quality Objectives (AQO) already above objective with:	
	Worsening or creation of a new exceedance	Improvement or removal of an existing exceedance
Large (>4)	0	0
Medium (>2)	6	8
Small (>0.4)	8 (+2)	10 (+2)

Based on the conservative approach of excluding those receptors in Sawbridgeworth AQMA and Bishop's Stortford AQMA junction (which are potentially overestimated beneficial effects), ten receptors would experience small to medium improvements in local air quality and eight receptors would be predicted to experience small to medium worsening of local air quality.

As the number of properties affected would be fewer than the lower guideline bands (10-30 for medium and 30-60 for small) it has been assessed that the Proposed Scheme effects would not be significant.

5.5.3.2 Designated sites

N-deposition could decrease (i.e. an improvement) by more than 1% of the lower threshold of the critical load (10-15kg N ha^{-1} yr^{-1} for neutral grassland) at the edge of Sawbridgeworth Marsh. The significance of the effects on Epping Forest SSSI is covered in Chapter 8 - Nature Conservation.

5.5.3.3 EU compliance risk assessment

The values reported by Defra based on the PCM model are all below the EU limit values for the CRRN in 2016 (the latest year publicly available), and the impact of the Proposed Scheme would not lead to increases in concentrations sufficient to alter these conclusions. Therefore, the compliance risk assessment has identified that the Proposed Scheme has a low risk of being non-compliant with the EU Directive on ambient air quality.

5.5.3.4 Regional emissions

There is no published government guidance for assessing the significance of the effects of individual highway schemes on regional or greenhouse gas emissions. The regional assessment results have shown relatively small percentage increases (up to 5 millionths) in NO_x, PM_{10} and CO_2 emissions that would result from the Proposed Scheme compared to regional and national road traffic emissions. Therefore, the effect of the Proposed Scheme on regional emissions has been assessed as Negligible.

5.5.3.5 Overall significance of air quality effects

The number of properties that would be likely to receive changes greater than imperceptible has been compared to the guideline bands presented in Table 5.4.

As the number of properties would be fewer than the lower guideline band for all six bands, the effect of the Proposed Scheme would most likely be insignificant.

In addition, the following points have been used to inform and support the professional judgement on significance:

- PM_{10} annual averages are affected by small, medium or large deteriorations;
- there are receptors with small, medium or large improvements; and
- short term exceedances are not caused or worsened by the Proposed Scheme for either NO_2 or $PM_{10.}$

The overall evaluation of local air quality significance is presented in Table 5.15 below.

Table 5.15: Overall evaluation of local air quality significance

Key criteria question	Yes/No	Explanation/justification
Is there a risk that environmental standards would be breached?	Yes	The AQOs are currently exceeding without the Proposed Scheme. No new exceedance would be created with the Proposed Scheme.
Would there be a large change in environmental conditions?	Yes	There would be large beneficial changes with the Proposed Scheme but no large worsening changes.
Would the effect continue for a long time?	Yes	As there would be worsening greater than 2µg/m^3 it is anticipated that the effect would continue for six years or longer before it returned to pre-scheme conditions.
Would many people be affected?	No	Fewer than 10 medium magnitude receptors and 30 small magnitude receptors would be affected.
Is there a risk that designated sites, areas, or features would be affected?	Yes	Scheme ecologist has confirmed that the changes at the edge of the designated sites would be unlikely to have a significant effect.
Would it be difficult to avoid, or reduce or repair or compensate for the effect?	n/a	n/a
On balance is the overall effect significant?	No	

Evidence in support of the professional judgement

It is the judgement of the air quality professional that in the Opening Year the Proposed Scheme would be unlikely to represent an overall significant effect.

Changes in concentrations would be outside the bands for likely significance in the Small and Medium magnitudes of change categories. Consequently, it has been concluded that there would be a low likelihood that local air quality effects would be significant.

It has been assessed that annual mean NO_2 concentrations would reduce year on year, and this would be likely to occur whether the Proposed Scheme was implemented or not. Consequently, the relative significance of effects and the number of properties adversely affected would most likely reduce year-on-year.

Supporting criteria:

- PM_{10} annual averages would be affected by small (at two locations) but not medium or large deteriorations.
- Short term exceedances would be unlikely to be caused or worsened by the Proposed Scheme for either NO_2 or $PM_{10.}$
- There would be receptors with large improvements at multiple locations.
- Annual average NO_2 would be the key pollutant alone and no other short term averaging periods or pollutants have therefore been taken into account.
- Large beneficial changes would occur at 25 properties (locations at Sawbridgeworth AQMA and Bishop's Stortford AQMA).
- The Proposed Scheme would not interfere with the measures set out in the air quality action plan where there are predicted improvements in air quality.
- The Proposed Scheme represents a Low risk of EU limit value non-compliance.
- The Proposed Scheme could have a worsening effect at the edge of the designated site (Epping Forest SSSI) but unlikely to be significant.
- New features would not be out-of-scale with the existing environment.

The effect would not be unusual in the area or particularly complex.

5.6 Proposed Mitigation

5.6.1 Construction mitigation

Appendix 5.5 within Volume C outlines the recommended construction mitigation measures required for the dust related impact (dust soiling) associated with the construction activities to include a Dust Management Plan (DMP) and a Construction Environmental Management Plan (CEMP). Measures are also included in the outline EMP.

5.6.2 Operational mitigation

As it has been concluded that the local air quality effects would be not be significant, no mitigation measures have been incorporated into the Proposed Scheme.

5.7 Residual Effects

If appropriate mitigation measures were to be implemented as recommended it is anticipated that the construction impact of the Proposed Scheme would not be significant.

As mitigation measures have been determined to not be necessary, it is anticipated that the residual impact associated with the operational phase of the Proposed Scheme would remain as likely not to be significant.

5.8 Summary and Conclusions

The proposed mitigation and significance of impact prior to and after mitigation for air quality are summarised in Table 5.16.

Table 5.16: Summary of air quality impacts

Description of effect	Significance of effect (prior to mitigation)	Proposed mitigation	Residual effect (after mitigation)
Dust soiling	High risk	As recommended in Appendix 5.5	Not significant
Air quality	Not significant	Not required	Not significant

During construction of the Proposed Scheme, 71 receptors within 20m of the construction boundary could be susceptible to dust impacts. With appropriate mitigation measures implemented it has been assessed that the construction impact of the Proposed Scheme would not be significant.

Once the Proposed Scheme became operational, 126 of the receptors would experience an improvement of an AQO already above objective or the removal of an existing exceedance. Eight receptors located along the M11 and A414 Edinburgh Way would experience a worsening of AQOs already above AQO with small to medium changes.

Predicted concentrations of PM_{10} have been shown to be well below AQO limits (<30 µg/m^3) with and without the Proposed Scheme.

The compliance risk assessment has been predicted as low and the impact on designated sites predicted by ecologists as not likely to be significant.

The majority of modelled receptors would receive improvements in annual mean NO_2 concentrations and the overall direction of change would be likely to be negative (i.e. an improvement). Based on IAN 174/13 guidance, the overall impact of the Proposed Scheme would not be significant.

6. Cultural Heritage

6.1 Introduction

This chapter presents the results of the cultural heritage assessment undertaken as part of the environmental inputs into the DMRB Stage 3 for the Proposed Scheme. The assessment comprised:

- a Heritage Statement of the proposed route;
- a walkover survey of the proposed route, and
- a programme of geophysical survey.

Additional information to support this chapter is presented in the following appendices:

- Appendix 6.1: Gazetteer of Cultural Heritage Assets;
- Appendix 6.2: Heritage Statement (Jacobs, 2015);
- Appendix 6.3: Cartographic Analysis (ECC, 2015a);
- Appendix 6.4: Built Heritage Assessment (ECC, 2015b);
- Appendix 6.5: Results of Geophysical Survey (Headland Archaeology, 2016a);
- Appendix 6.6: Predicted less than significant impacts; and
- Appendix 6.7: Results of Additional Geophysical Survey (Headland Archaeology, 2016b).

A detailed assessment was undertaken based on the guidance provided in DMRB Volume 11, Section 3, Part 2 (HA208/07) (Highways Agency *et al*. 2007b). This chapter considers the impacts of the scheme on cultural heritage under the three sub-topics of 'Archaeological Remains', 'Historic Buildings' and the 'Historic Landscape'.

6.1.1 Legislative and planning context

The following legislation and national policy is relevant to the Proposed Scheme:

- Ancient Monuments and Archaeological Areas Act 1979;
- Planning (Listed Buildings and Conservation Areas) Act 1990;
- Town and Country Planning (EIA) (England and Wales) Regulations 1999;
- Infrastructure Planning (EIA) Regulations 2009;
- National Planning Policy Framework (2012);
- Enterprise and Regulatory Reform Act (2013);
- Historic Environment Good Practice Advice in Planning Note 3: The Setting of Heritage Assets (Historic England, 2015);
- Epping Forest District Local Plan (adopted 1998) and Local Plan Alterations (adopted 2006), and
- Adopted Replacement Harlow Local Plan (2006).

Further detail is provided in Appendix 6.2.

6.1.2 Study area

HA208/07 notes that once route options have been identified, the study area should be assessed for an area extending for at least 200m in all directions from scheme options (Annex 5, paragraph 5.4.1). The study area is shown on Figures 6-1 and 6-2.

6.2 Assumptions and Limitations

Assessments of value and magnitude of impact on archaeological remains are based on data from desk-based sources and non-intrusive evaluation. Intrusive evaluation to inform the detailed design of mitigation measures is included in the proposed mitigation (Appendix 6.6).

The sources consulted and surveys undertaken are considered appropriate to inform this assessment (see Section 6.4.1).

At the time of writing, the location, extent and design of noise mitigation was still under development. Consequently, assessments of the effect of noise impacts and mitigation on this topic are incomplete.

6.3 Methodology and Assessment Criteria

6.3.1 Asset value

The NPPF defines significance as '*the value of a heritage asset to this and future generations because of its heritage interest*' (DCLG, 2012, p.52). This significance may be related to archaeological, architectural and artistic or historic elements, and may also derive from the setting of the site (DCLG 2012). HA208/07 provides a methodology for the assessment of the value of cultural heritage assets and use of this methodology in this assessment aligns with the guidance provided by the NPPF. The term 'value' is used throughout this report to avoid confusion with significance of effect as commonly used in EIA.

Setting is recognised as contributing to the significance of heritage assets and the NPPF defines setting as the '*surroundings in which a heritage asset is experienced*', the extent of which '*is not fixed and may change over time*' (DCLG 2012, p.56). The assessment of the setting of heritage assets was undertaken in accordance with the guidance provided in Historic Environment Good Practice Advice in Planning Note 3: The Setting of Heritage Assets (Historic England, 2015).

Based on the guidance provided in HA208/07, cultural heritage was considered under the subtopics of 'Archaeological Remains', 'Historic Buildings' and 'Historic Landscape'. For all three sub-topics, an assessment of the value of each cultural heritage asset was undertaken on a six-point scale of Very High, High, Medium, Low, Negligible and Unknown, based on professional judgement and guided by the criteria provided in HA208/07 as presented in Table 6.1.

Table 6.1: Criteria to assess the value of archaeological remains, historic buildings and historic landscape types

Value	Criteria
Very High	World Heritage Sites (including nominated sites). Assets of acknowledged international importance. Assets that can contribute significantly to acknowledged international research objectives. Structures inscribed as of universal importance as World Heritage Sites. Other buildings of recognised international importance. World Heritage Sites inscribed for their historic landscape qualities. Historic landscapes of international value, whether designated or not. Extremely well preserved historic landscapes with exceptional coherence, time-depth, or other critical factor(s).
High	Scheduled Monuments (including proposed sites). Undesignated assets of schedulable quality and importance. Assets that can contribute significantly to acknowledged national research objectives. Scheduled Monuments with standing remains. Grade I and Grade II* Listed Buildings. Other Listed Buildings that can be shown to have exceptional qualities in their fabric or

Value	Criteria
	historical associations not adequately reflected in the listing grade. Conservation Areas containing very important buildings. Undesignated structures of clear national importance. Designated historic landscapes of outstanding interest. Undesignated landscapes of outstanding interest. Undesignated landscapes of high quality and importance, and of demonstrable national value. Well preserved historic landscapes, exhibiting considerable coherence, time-depth or other critical factor(s).
Medium	Designated or undesignated assets that contribute to regional research objectives. Grade II Listed Buildings. Historic (unlisted) buildings that can be shown to have exceptional qualities in their fabric or historical associations. Conservation Areas containing buildings which contribute significantly to its historic character. Historic Townscape or built-up areas with important historic integrity in their buildings, or built settings (i.e. including street furniture and other structures). Designated special historic landscapes. Undesignated historic landscapes that would justify special historic landscape designation, landscapes of regional value. Averagely well-preserved historic landscapes with reasonable coherence, time-depth or other critical factor(s).
Low	Designated and undesignated assets of local importance. Assets compromised by poor preservation and/or poor survival of contextual associations. Assets of limited value, but with potential to contribute to local research objectives. 'Locally Listed' buildings. Historic (unlisted) buildings of modest quality in their fabric or historical association. Historic Townscape or built-up areas of limited historic integrity in their buildings, or built settings (i.e. including street furniture and other structures). Robust undesignated historic landscapes. Historic landscapes with importance to local interest groups. Historic landscapes whose value is limited by poor preservation and/or poor survival of contextual associations.
Negligible	Assets with very little or no surviving archaeological interest. Buildings of no architectural or historical note; buildings of an intrusive character. Landscapes with little or no significant historical interest.
Unknown	The importance of the resource has not been ascertained. Buildings with some hidden (i.e. inaccessible) potential for historic significance.

Source: Tables 5.1, 6.1 and 7.1 of DMRB Volume 11, Section 3, Part 2 (HA208/07), Annex 5-7

6.3.2 Impact magnitude

Magnitude of impact is the degree of change that would be experienced by a cultural heritage asset and its setting if the Proposed Scheme was completed, as compared with a 'Do-nothing' situation. Magnitude of impact is assessed without reference to the value of the cultural heritage asset, and may include physical impacts upon the asset, or impacts on its setting or amenity value.

Assessment of magnitude of impact was based on professional judgement informed by the methodology and criteria provided by HA208/07 for archaeological remains, historic buildings and the historic landscape presented in Table 6.2. Unless otherwise stated, all impacts are adverse.

Table 6.2: Magnitude of impact on cultural heritage assets

Magnitude	Criteria
Major	Change to most or all key archaeological materials, such that the resource is totally altered. Change to key historic building elements, such that the resource is totally altered. Change to most or all key historic landscape elements, parcels or components; extreme visual effects; gross change of noise levels or change to sound quality; or fundamental changes to use or access, resulting in total change to historic landscape character unit. Comprehensive changes to setting.
Moderate	Changes to many key archaeological materials, such that the resource is clearly modified. Change to many key historic building elements, such that the resource is significantly modified. Changes to some key historic landscape elements, parcels or components; visual change to many key aspects of the historic landscape; noticeable differences in noise levels or sound quality; or considerable changes to use or access, resulting in moderate changes to historic landscape character. Considerable changes to setting that affect the character of the asset.
Minor	Changes to key archaeological materials, such that the asset is slightly altered. Change to key historic building elements, such that the asset is slightly different. Changes to few key historic landscape elements, parcels or components; slight visual changes to few key aspects of historic landscape; limited changes to noise levels or sound quality; or slight changes to use or access, resulting in limited changes to historic landscape character. Slight changes to setting.
Negligible	Very minor changes to archaeological materials or setting. Slight changes to historic buildings elements or setting that hardly affect it. Very minor changes to key historic landscape elements, parcels or components; virtually unchanged visual effects; very slight changes in noise levels or sound quality; or very slight changes to use or access, resulting in a very small change to historic landscape character.
No Change	No change to elements, parcels or components; no visual or audible changes; or no changes arising from amenity or community factors.

Source: Table 5.3, 6.3 and 7.3 of DMRB Volume 11, Section 3, Part 2 (HA208/07), Annex 5-7

6.3.3 Impact significance

For all three sub-topics, the significance of impact with and without mitigation was determined as a combination of the value of the asset and the magnitude of impact. This is achieved using professional judgement informed by the matrix illustrated in Section 4.5, Table 4.1. Five levels of significance of impact are defined which apply equally to adverse and beneficial impacts.

For the purpose of this assessment, residual effects on assets of large and very large adverse significance were taken to be commensurate with substantial harm as defined under the NPPF. A permanent residual effect of moderate adverse or less is taken to be commensurate with “less than substantial harm” as defined under the NPPF (DCLG, 2012). For the purposes of this assessment, impacts with a residual significance of effect of moderate or greater have been assessed to be significant.

6.3.4 Consultation

The proposed scope of field surveys and methodology for the assessment of magnitude and significance of impact was agreed with the Historic Environment Consultant of ECC, by telephone on 1st April 2015. Further consultation on the outcome of the assessment was conducted with ECC's Historic Environment and Historic Buildings Consultants at a meeting held on 28th November 2016.

Consultation has been undertaken with Historic England on potential impacts on the settings of a Scheduled Monument and a number of Grade II* Listed Buildings. Historic England responded that their key concern was the potential for impacts to occur on the setting of Grade II* Listed Sheering Hall (Asset 8) and its associated Grade II Listed barns (Assets 6 and 7) (Letter dated 27/09/2016).

Historic England also expressed concern about the potential for impacts on the setting of Grade II* Listed Aylmers (Asset 105) and its associated Grade II Listed Barn (Asset 106), and Grade II* Listed Durrington Hall (Asset 107) and its associated Grade II Listed gates and ancillary buildings (Assets 108, 109 and 110).

6.4 Baseline Environment

6.4.1 Baseline sources

Baseline data were collected from a number of sources including:

- The National Heritage List (NHL) for information on statutorily and other nationally designated assets (World Heritage Sites, Scheduled Monuments, Listed Buildings, Registered Historic Parks and Gardens and Registered Battlefields);
- Essex Historic Environment Record (EHER) for information on designated and undesignated assets, and historic landscape characterisation data;
- Essex County Council website for information on Conservation Areas;
- Essex Record Office for documents, historic mapping and local history publications (for Harlow, Matching and Sheering) (visited on 7th August 2014);
- An Envirocheck report for historic Ordnance Survey mapping (August 2014);
- Walkover surveys conducted in August 2014 and May 2016; and
- A geophysical survey of all suitable areas of the footprint of the proposed route (Headland Archaeology, 2016a and 2016b) (Appendix 6.5; Appendix 6.7).

Information on the historic landscape of the study area was derived from GIS data supplied by the EHER and the published Historic Landscape Characterisation Report for Essex (Bennett, 2011), supplemented by observations made during the walkover surveys.

6.4.2 Baseline conditions

This section describes the baseline conditions under the three sub-topics of Archaeological Remains, Historic Buildings and the Historic Landscape. A total of 82 cultural heritage assets have been identified within the study area; a further nine designated cultural heritage assets located outside the study area but have the potential to be impacted on by the Proposed Scheme. A total of 91 cultural heritage assets were considered as part of the baseline comprising: 27 archaeological remains; 55 historic buildings and 9 historic landscape types (see Table 6.3 for a breakdown of assets by value). These assets can be seen on Figures 6-1 and 6-2.

Table 6.3: Summary of cultural heritage asset values

Sub-Topic	Unknown	Negligible	Low	Medium	High	Very High	All value total
Archaeological Remains	0	10	6	9	2	0	27
Historic Buildings	0	2	14	28	11	0	55
Historic Landscape	0	6	0	3	0	0	9
Total	**0**	**18**	**20**	**40**	**13**	**0**	**91**

6.4.2.1 Archaeological and historical background of the study area

A summary of the archaeological and historical background is provided below to provide a context for the baseline and significance of effects. A more detailed baseline can be found in Appendix 6.2.

Prehistoric period (up to AD 43)

The earliest human activity in the study area dates to the Mesolithic period (7,000 to 4,000 BC) and Neolithic periods (4,000 to 2,200 BC) and comprises an assemblage of worked flint recovered during construction of the M11 (Asset 25), and a findspot of a polished stone axe head (Asset 10).

Evidence for Bronze Age (2,500 to 700 BC) activity comprises ceremonial and funerary use of the landscape represented by Harlow Mound (Asset 59) a bowl barrow, designated as a Scheduled Monument, south of Gilden Way.

The Iron Age (800 BC to AD 43) is represented by finds of pottery made during construction of the M11 (Asset 20) and cropmarks north of Gilden Way (Asset 12), which were dated during trial trenching conducted ahead of residential development. Features dating from this period were also identified north of Gilden Way (Asset 21) and near Mark Hall School (Asset 42). Undated crop marks located east of Sheering Hall were identified on aerial photographs (Asset 3), and geophysical anomalies recorded north-east of Mayfield Farm (Asset 98) and east of the M11 (Asset 115) have been interpreted as of prehistoric date through the form of the features; their precise date has not yet been determined.

Romano-British period (AD 43 to 410) and early medieval period (AD 410 to 1066)

As with the prehistoric period, there is limited evidence for activity within the study area. A single asset of Romano-British date, an enclosure, was identified during investigations ahead of residential development north of Gilden Way (Asset 21).

Evidence for early medieval activity includes Harlowbury deserted village which lies outside the study area (NHL Ref.1002151), a ringwork moat at Sheering Hall (Asset 5), and parts of the Harlow and Churchgate Street medieval settlements (Assets 48 and 90).

Medieval period (AD 1066 to 1540) and post-medieval period (AD 1540 to 1900)

Medieval Harlow was a polyfocal settlement, under the principal ownership of the Abbey of Bury St Edmunds in Suffolk (ECC, 1999), with its core at Harlowbury, outside the study area. Churchgate Street is believed to have its origins in the 11th century AD, and to have been created by the Abbey of St Edmunds to replace the earlier settlement at Harlowbury to the north-east (ECC, 1999); Old Harlow was a market town founded by charter in 1218, although it is believed to be of earlier medieval origin.

Later medieval assets include the Grade II* Listed Sheering Hall (Asset 8), and the moated sites at Moor Hall (Asset 17) and Newhall (Asset 75). The archaeological remains of the post-medieval period are represented by

evidence of industrial activity including the site of Harlowbury Brickworks (Asset 11), former gravel pits (Assets 27 and 39), the site of a boathouse (Asset 30), and archaeological features discovered during investigations in Mulberry Green and Churchgate Street (Assets 65 and 80).

Modern period (AD 1900 to present)

Harlow is perhaps most famous for its modern architecture, having been hugely expanded as a New Town to ease the housing shortage in London after the Second World War. The New Town was constructed between the late 1940s and early 1960s and some of its estates such as Mark Hall are now designated as Conservation Areas, and some of its prominent buildings have been listed.

6.4.3 Value of receptors

6.4.3.1 Archaeological remains

High value archaeological remains

Harlow Mound (Asset 59) is a bowl barrow located within modern plantation woodland approximately 85m south of Gilden Way. Despite evidence of un-documented excavations in the past, it is considered to be in good condition, and has the potential to contribute to the understanding of its date of construction and function (Historic England Schedule description). Although located on high ground overlooking a broad valley to the south-east, the setting of the barrow is dominated by modern industrial and residential development to the immediate north and west, and is visually isolated from the surrounding landscape by post-medieval plantation woodland. The setting of this asset therefore does not contribute significantly to its value. Taking its designation as a Scheduled Monument into account, the value of Harlow Mound (Asset 59) has been assessed to be High.

Sheering Hall Ringwork (Asset 5) is undated, but this type of feature was typically constructed between the late Anglo-Saxon period and the later 12th century as defensive earthworks around high status dwellings. In the scheduling notes for other ringworks, Historic England notes that ringworks are rare nationally with only 200 surviving examples in England. Due to its rarity and its potential to contribute to regional research objectives on rural landscapes and settlement (Medlycott, 2011), the value of this asset has been assessed to be High.

Medium value archaeological remains

An assemblage of Mesolithic worked flint blades and a core (Asset 25) was found in plough soil near Pincey Brook in the 1970s. Physical remains from the Mesolithic period are relatively scarce and activity is generally represented by collections of worked flint, as is the case with Asset 25. Although the archaeological remains have been removed, they are an indicator of Mesolithic activity in the study area, and as a result the value of Asset 25 has been assessed to be Medium.

The New Hall archaeological evaluations (Asset 50) conducted south of Gilden Way identified archaeological remains from a wide range of periods, the earliest of which were a ring ditch and urnfield cremation cemetery dating to the Bronze Age (Archaeological Solutions Ltd., 2016). Other features included a rectilinear enclosure and kiln of Romano British date; and evidence of Anglo Saxon settlement. These remains have the potential to contribute to regional research topics on patterns of burial practice in the Bronze Age (Medlycott, 2011), rural landscape and settlement in the Romano British period, and the Roman-Saxon transition. Taking this into account, the value of Asset 50 has been assessed to be Medium.

Geophysical surveys conducted to inform this assessment (Appendix 6.5 and 6.7) identified a group of anomalies to the west of the M11 (Asset 98). The anomalies included two circular features which have provisionally been interpreted as barrows (similar to Asset 59), and a series of ditches likely forming a field system. Linear and discrete anomalies identified to the east of the M11 have been provisionally interpreted as part of an enclosure or field system (Asset 115). In addition, analysis of aerial photography has identified areas of cropmarks in an area between Sheering Hall and the M11 (Asset 3), and north of Gilden Way (Asset 12). Both assets remain undated, but include pennanular and circular features which are often indicative of prehistoric settlement. Due to the potential of these assets to contribute to themes of prehistoric settlement activity and funerary practices (Medlycott, 2011), their value has been assessed to be Medium.

Old Harlow (Asset 48) and Churchgate Street (Asset 90) are within areas of archaeological potential defined by the EHER. The assets have the potential to contribute to the regional research themes of the development of towns in the medieval period, specifically planned layout and the development of individual plots (Medlycott, 2011). Based on this the value of both assets has been assessed to be Medium.

The manor of Moor Hall (Asset 17) was established in the mid-12th century AD and was subject to a series of modifications between 1805 and 1810; the house was largely demolished in the 1950s following a fire. The asset has the potential to contribute to regional research objectives on the impact of social change on the landscape (Medlycott, 2011) and its value has been assessed to be Medium.

Low value archaeological remains

Archaeological features investigated north of Gilden Way (Asset 21), and south of Mark Hall School (Asset 42) have been dated to the Bronze Age, and surface finds of a polished stone Neolithic axe head and Iron Age pottery (Assets 10 and 20) were found west of the M11 close to the site of the proposed junction. A scatter of medieval pottery was found during a watching brief on new house construction east of Sheering Road (Asset 14). The largely infilled remains of Newhall moat (Asset 75) south of Gilden Way, survives in the grounds of Newhall (Asset 74) as a pond and part of a sunken garden. These assets have the potential to provide information on human activity within the local area from the prehistoric through to the medieval periods, and have therefore been assessed to be of Low value.

Negligible value archaeological remains

Assets of negligible value include the field name 'Potters croft' (Asset 9), which indicates evidence of extractive industries and associated production areas, such as brickworks, which have subsequently fallen from use and have been demolished or backfilled; these include assets 9, 11, 27 and 39. A boathouse (Asset 30) is marked on a 1:2,500 Ordnance Survey map published in 1921 (Essex, Sheet 42.14), at the eastern end of a lake near Ealing Bridge (Asset 33). No trace of this asset is visible on the surface today. Little evidence of these assets survives so their value has been assessed to be Negligible.

Archaeological investigations of land north and south of Gilden Way identified truncated archaeological features and finds dating to the post-medieval (Assets 65, 66 and 80) and modern periods (Assets 61 and 69). As the assets have been excavated and the area redeveloped the value of all six assets has been assessed to be Negligible.

Potential for unknown archaeological remains

The nearby presence of prehistoric and Roman archaeological remains in the form of excavated archaeological remains, cropmarks and surface finds (Assets 2, 3 and 25), or features identified by geophysical survey and archaeological fieldwork (Assets 12, 21, 50, 98 and 115), indicates that there is the potential for unknown archaeological remains to be present within the scheme footprint. The EHER data indicate the presence of archaeological activity throughout the study area; the identification of archaeological remains during the construction of the M11 motorway indicates the potential for archaeological remains in the area. Taking this into account, the potential for the presence of unknown archaeological remains within the study area has been assessed to be Medium.

6.4.3.2 Historic buildings

High value historic buildings

Sheering Hall (Asset 8) is a Grade II* Listed Building of medieval date that incorporates a pair of hall houses dating to the late 15th and early 16th centuries; two Grade II Listed 17th century barns (Asset 6, Asset 7) form part of the group of buildings. The three buildings form a coherent group and have been assessed together; based on the Grade II* designation of Sheering Hall, the value of all three assets has been assessed to be High.

Mulberry Green House and Stables (Asset 60) and Hill House (Asset 64) are both Grade II* Listed Buildings located in Old Harlow. Asset 60 is of late 18th century date and is a two storey building of red brick with a three bay façade and full-height semi-circular bays in the outer bays. Asset 64 dates to the 16th century, and was substantially remodelled in the 18th century. The buildings are situated adjacent on the south side of Mulberry Green; part of the Old Harlow Conservation Area (Asset 49). Taking their designation as Grade II* Listed Buildings into account, their group value and association with the Mulberry Green Conservation Area (Asset 49), the value of Assets 60 and 64 has been assessed to be High.

Aylmers (Asset 105) is a 17th century farmhouse located west of Sheering Low Road, and 175m north of the study area. It is a Grade II* Listed Building that has been extensively but sensitively restored during the mid-20th century and that retains many period features. The contemporary Grade II Listed Aylmers Barn (Asset 106) is located a short distance to the north, and the two buildings functioned together as a farm. Because both buildings are demonstrably a group they have been assessed as such, and taking this and their designations into account, the value of both has been assessed to be High.

Durrington Hall (Asset 107) is a mid-18th century country house located east of Sheering Low Road, and 300m north of the study area. It is a Grade II* Listed Building and has recently been restored. It was built for Samuel Feake in the late 1760s and was historically known as Durrington House. The Gate-Piers (Asset 108), Domestic Range (Asset 109), and Coach House and Stable Block (Asset 110) are of broadly contemporary date, and are all Grade II Listed Buildings. As all four buildings form a coherent group they have been assessed as such, and taking this and their designations into account, the value of Assets 107, 108, 109 and 110 has been assessed to be High.

Medium value historic buildings

Excluding the six assets associated with Sheering Hall, Aylmers and Durrington Hall described above (Assets 6, 7, 106, 108, 109 and 110), 26 Grade II Listed Buildings have been identified within or close to the study area (Assets 13, 15, 23, 24, 45, 46, 47, 52, 55, 56, 57, 58, 63, 67, 68, 71, 74, 76, 77, 78, 79, 81, 83, 112, 113 and 114). Those of particular note include:

- a timber framed Tudor Cottage (Asset 13) in Churchgate Street;
- an elaborately decorated cast iron water pump (Asset 15) adjacent to Mayfield Farm;
- three gates or gate lodges (Assets 45, 63 and 79);
- an 18th century Almshouse (Asset 76) in Churchgate Street; and
- 16th century Housham Hall and its associated Barns (Assets 112, 113 and 114) 350m south-east of the study area.

Taking their designation as Grade II Listed Buildings into account, the value of all of these assets has been assessed to be Medium.

Two Conservation Areas are located partly within the study area: Old Harlow (Asset 49), and Churchgate Street (Asset 85). Both Conservation Areas contain a number of Grade II* and Grade II Listed Buildings and were designated as Conservation Areas because they were considered to exhibit special architectural or historic interest. Taking this and their designation into account, the value of Assets 49 and 85 has been assessed to be Medium.

Low value historic buildings

Low value assets include 18th to 19th century housing stock, a number of which have been 'locally listed' as buildings of local architectural or historical merit (Assets 26, 100, 101, 102 and 103). Residential buildings are represented by assets 26, 29, 32, 35, 36, 99, 100, 101, 102, and 111. Other buildings and structures include a former police station (Asset 103) and modern road bridges Ealing Bridge (Asset 33) and Sheering Road Bridge (Asset 104). Mayfield Farm (Asset 31) is a late 19th or early 20th century farmstead arranged on a courtyard plan, with a single story range of byres and storage sheds arranged around a square farmyard, with a separate dairy and farmhouse to the south, and a weatherboard-clad barn to the south-east. The value of all these assets has been assessed to be Low.

Negligible value historic buildings

A modern facsimile guide post (Asset 37) and neighbouring mid-20th century 'lamp box' post box (Asset 38) were identified at the junction of Matching Road and Chalk Lane. Due to their lack of historic value, the value of both has been assessed to be Negligible.

6.4.3.3 Historic landscape

Medium value historic landscape

Based on the evidence from *The Enclosure Maps of England and Wales, 1595-1918* (Kain *et al*., 2004), Acts of Enclosure in Essex took place predominantly in the 19th century. Historic Landscape Type 5: Pre-18th Century Enclosure has been assessed to be of Medium value as it represents an early form of informal enclosure, which is not common in the landscape of the study area.

Within the study area, Informal Parkland (HLT6) is represented by the landscape park associated with Durrington Hall (Asset 107). The parkland surrounding Durrington Hall is believed to have been established by Samuel Feake in the late 1760s to complement his newly constructed country house. The legibility and apparent time-depth of the parkland contributes to the aesthetic value of Durrington Hall (Asset 107) and its associated estate buildings (Assets 108, 109 and 110). Taking this into account, the value of HLT6 has been assessed to be Medium.

The Historic Earthworks Type (HLT9) is represented by a single element within the study area, which conforms to the location of Harlow Mound (Asset 59), a Scheduled Monument. The type is defined as representing large scale monuments large enough to be defined at a landscape scale. Historic Landscape Type 9 is considered rare at a county level, and taking this and its association with the Scheduled Harlow Mound into account, its value has been assessed to be Medium.

Negligible value historic landscape

The six historic landscape types assessed to be of Negligible value comprise: 20th Century Agriculture (HLT1) represented in the study area by large fields created by amalgamating earlier small fields to accommodate modern mechanised farming; 19th and 20th Century Woodland Plantation (HLT2); Built-up Areas (HLT3); Enclosed Meadow Pasture (HLT4), in this case represented by the low lying pasture land on the banks of Pincey Brook west of Ealing Bridge (Asset 33), and 20th Century Communications represented by the M11 motorway (HLT7). Historic Landscape Type 8 represents evidence for modern horticulture, in this case a plant nursery south of Gilden Way which at the time of writing was disused and with its glasshouses and other buildings removed. These are all common historic landscape types and as such their value has been assessed to be Negligible.

6.5 Significant effects

Where impacts have been identified, this information is presented in Appendix 6.6. Impacts on key assets are described in the following paragraphs.

6.5.1 Construction effects

6.5.1.1 Archaeological remains

The Scheduled bowl barrow Harlow Mound (Asset 59) is screened from the Proposed Scheme by a block of mature woodland. Proposed use of the neighbouring former plant nursery as a temporary site compound (CS1) will have no physical impact on the site and is unlikely to have any impact on its setting. The magnitude of this temporary impact has been assessed to be Negligible.

Construction of the proposed Sheering Road and Pincey Brook Roundabouts and Westbound and Eastbound Links would remove a probable prehistoric barrow and remains associated with an early (possibly prehistoric) field system, identified by geophysical survey (Asset 98). Likewise, to the east of the M11, the construction of

temporary haul roads, the Eastern Dumbell Roundabout, Compound Sites CS2 and CS4, Soil Storage Areas SS2, SS3, SS5, SS6 and SS7, and Topsoil Storage Areas TS3, TS5 and TS7 are likely to remove (see Figure 2-4) archaeological remains associated with possible prehistoric settlement and funerary activity (Asset 115). Because of the potential for total removal of these assets the magnitude of this impact has been assessed to be Major Adverse.

6.5.1.2 Historic buildings

The Grade II* Listed Sheering Hall (Asset 8) and its associated Grade II Listed Barns (Assets 6 and 7) are located approximately 360m north-east of the proposed Sheering Road and Pincey Brook Roundabouts, and the Westbound Link. Construction activities, such as the movement of plant and the presence of site compounds and materials storage areas would have a temporary impact on their setting. However, the assets are screened by extensive mature vegetation which would block views from them to the south, and the temporary impact would cease on completion of the construction programme. The magnitude of this impact has therefore been assessed to be Minor Adverse.

Construction of the proposed Sheering Road and Sheering Road Roundabout would be directly adjacent to Mayfield Farm (Asset 31). There would be a likely increase in noise levels during construction due to the presence and operation of construction plant and earth-moving activities which would also result in a temporary visual impact on its semi-rural setting. Similar impacts would also be anticipated during the construction of temporary haul roads: Compound Site CS2; Soil Storage Areas SS2 and SS3; and Topsoil Storage Area TS3 (see Figure 2.4). These impacts would be temporary and would cease on completion of the construction programme. The magnitude of this impact has been assessed to be Minor Adverse.

Construction activities on Gilden Way could have an adverse impact on the setting of Old Harlow Conservation Area (Asset 49); Churchgate Street Conservation Area (Asset 85), and the Grade II Listed Long Barn (Asset 71). These impacts would be temporary and would cease on completion of the construction programme. The magnitude of impact has been assessed to be Minor Adverse for all three assets.

Grade II* Listed Aylmers (Asset 105) would be approximately 450m north of the proposed Sheering Road and Pincey Brook Roundabouts and Westbound and Eastbound Links. This asset is well screened by existing mature vegetation within its grounds, alongside Sheering Lower Road and Sheering Road (B183), and adjacent to Pincey Brook. No impact is therefore predicted on the setting of this asset during construction.

Construction of the proposed Sheering Road and Pincey Brook Roundabouts and Westbound Eastbound Links would be approximately 540m south of Grade II* Listed Durrington Hall (Asset 107). There would be a visual impact on its rural setting due to the presence and operation of construction plant. This impact would be temporary and would cease on completion of the construction programme. The magnitude of this impact has been assessed to be Minor Adverse.

6.5.2 Operational effects

6.5.2.1 Archaeological remains

Temporary site compound CS1 south of Gilden Way would be returned to its present condition during operation of the Proposed Scheme. Consequently, no impact is predicted on the setting of the Scheduled bowl barrow Harlow Mound (Asset 59) during operation.

6.5.2.2 Historic buildings

The setting of the Grade II* Listed Sheering Hall (Asset 8) is defined by its relationship with the Grade II Listed Barns (Assets 6 and 7) and with the archaeological remains of Sheering Hall Ringwork (Asset 5). This relationship would not be affected. Views from these assets are restricted by surrounding mature vegetation and views of the Proposed Scheme would be largely screened. As traffic noise from the M11 already forms an attribute of the setting of Assets 6, 7 and 8, changes in noise levels resulting from operation of the Proposed Scheme would not affect this asset (see Chapter 11 - Noise and Vibration). The magnitude of this impact has been assessed to be Negligible for all three assets.

The relationship between Gilden Way and the Old Harlow Conservation Area (asset 49) and Churchgate Street Conservation Area (Asset 85) would be unchanged. However, potential loss of existing vegetation at their periphery, changes to lighting and signage, and changes in traffic volume in this area could result in an impact on their setting. The magnitude of this impact has been assessed to be Minor Adverse for both assets.

Grade II* Listed Aylmers (Asset 105) would continue to be screened from the Proposed Scheme by existing mature vegetation within its grounds, alongside Sheering Lower Road and Sheering Road (B183), and adjacent to Pincey Brook. No impact is therefore predicted on the setting of this asset.

The proposed Sheering Road and Pincey Brook Roundabouts, Westbound and Eastbound Links would form a prominent new element of infrastructure in the rural setting of Grade II* Listed Durrington Hall (Asset 107). The Proposed Scheme would not be visible at ground level from Asset 107, however, elements of Westbound and Eastbound Links would be visible in views south and south-east from the first and Attic floors, and visual impacts from lighting, signage and traffic movement could occur particularly at night or during winter months when screening from existing foliage cover is reduced. Views of agricultural fields beyond the fringes of the parkland surrounding Durrington Hall are an element of its designed landscape setting, and contribute to our understanding of the asset. Although distant, the Proposed Scheme would create a noticeable change to the setting of the asset when viewed from the first floor and attic rooms facing it. The magnitude of this impact has been assessed to be Minor Adverse.

Proposed noise barriers on the north side of Gilden Way would create a visual impact on the setting of 49 Mulberry Green (Asset 103) during operation. This asset is a former police station which was deliberately positioned at the roadside to advertise its presence, and the barrier would obscure views of it from the road affecting our understanding of its original function. The magnitude of this impact has been assessed to be Moderate Adverse.

The proposed Eastern Dumbell Roundabout on the M11 would form a prominent new element of infrastructure in the rural setting of Grade II Listed Housham Hall and Barns (Assets 112, 113 and 114), and would introduce further visual impact due to lighting, signage and traffic movement. This could be accompanied by a predicted negligible but long term increase in noise levels (see Chapter 11 - Noise and Vibration). The magnitude of this impact on all three assets has been assessed to be Minor Adverse.

6.5.2.3 Historic landscape

Construction of the proposed Sheering Road and Pincey Brook Roundabouts, Westbound Link, Eastbound Link and Dumbell Roundabout would remove short lengths of hedgerow defining parcels within the 20th Century Agriculture Historic Landscape Type (HLT1). The magnitude of this impact has been assessed to be Negligible.

6.6 Proposed Mitigation

All proposed mitigation measures are presented in Appendix 6.6.

6.6.1 Archaeological remains

A staged programme of archaeological investigation is proposed for the geophysical anomalies west and east of the M11 (Assets 98 and 115). Archaeological trial trenching would provide more detailed information on their extent, condition, depth, character, quality and date of any associated archaeological remains. Trial trenching would also be used to confirm the presence or absence of unknown archaeological remains where the geophysical survey did not identify anomalies of potential archaeological origin. The results of the trial trenching would inform the design of site-specific mitigation measures for archaeological remains, which would be likely to comprise a combination of detailed archaeological excavation and strip, map and sample excavation as appropriate. Archaeological fieldwork would be followed by a programme of assessment, analysis, and publication.

The Scheduled bowl barrow Harlow Mound (Asset 59) is surrounded by mature woodland, and no physical impact is predicted during construction or operation of the Proposed Scheme. However, due to the close proximity of the proposed site compound on Gilden Way (CS1) there is a possibility for accidental damage to

occur during construction. Therefore this asset would require protection through the use of protective fencing and signage.

6.6.2 Historic buildings

Due to the close proximity of Mayfield Farm (Asset 31) to construction works, there is a possibility for accidental damage to occur during construction. Therefore this historic building would require protection during construction through the use of protective fencing.

Woodland, tree and hedgerow planting proposed in Chapter 7 - Landscape and Visual mitigation section would also serve to integrate the Proposed Scheme into its surroundings and reduce its visual impact on the setting of historic buildings particularly 163 Sheering Road (Asset 99), Aylmers (Asset 105) and Durrington Hall (Asset 107).

Although it would not remove it, sensitive design and the use of materials similar to those of the asset would go some way to reduce the magnitude of impact from the proposed noise barrier on the setting of 49 Mulberry Green (Asset 103).

6.6.3 Historic landscape

Because of the small magnitude of impact assessed on the 20th Century Agriculture Historic Landscape Type (HLT1), no mitigation is proposed for this sub-topic.

6.7 Residual Effects

After mitigation, no significant effects on cultural heritage assets are predicted (i.e. where the effect after mitigation has been assessed to be of less than moderate significance). The full impact assessment is presented in Appendix 6.6, and residual effects are summarised in Table 6.4 below.

Table 6.4: Residual effects of the Proposed Scheme on cultural heritage

Sub-topic	Residual effect
Archaeological remains	Implementation of a staged programme of archaeological investigation, followed by assessment, analysis and publication of the results would mitigate or reduce the magnitude of impact from the Proposed Scheme on potential archaeological remains associated with Assets 98 and 115. The significance of this residual effect has been assessed to be Slight Adverse for both assets.
Historic buildings	Impacts on the setting of historic buildings during construction of the Proposed Scheme would be temporary and of Minor or Negligible magnitude. Photographic survey informed by the guidance contained in *Understanding Historic Buildings: A Guide to Good Recording Practice* is recommended to preserve a record of the setting of those assets affected (Historic England, 2016). The residual significance of this effect has been assessed to be either Slight Adverse (Assets 5, 6, 7, 8, 29, 31, 32, 99 and 107), or Neutral (Assets 49, 71, 76, 77, 85, 112, 113 and 114). Impacts on the setting of historic buildings during operation of the Proposed Scheme have been assessed to be of Minor or Negligible magnitude. Landscape planting to integrate the Proposed Scheme into its surroundings will reduce its visual impact. Sensitive design and use of materials would reduce the visual impact on the setting of 49 Mulberry Green. The residual significance of this effect has been assessed to be either Slight Adverse (Assets 5, 6, 7, 8, 103, 105 and 107), or Neutral (Assets 29, 31, 32, 49, 71, 76, 77, 85, 99, 112, 113 and 114).
Historic landscape	Impacts on the 20th Century Agriculture Historic Landscape Type (HLT1) from the removal of a small section of field boundary has been assessed to be of Negligible magnitude. The residual significance of this effect has been assessed to be Neutral.

6.8 Summary and Conclusions

A total of 82 cultural heritage assets have been identified within the study area; with an additional nine designated cultural heritage assets located outside the study area which have been considered due to potential indirect impacts associated with the Proposed Scheme.

After mitigation no significant effects are predicted. Less than significant effects are predicted for 23 assets during construction and 20 assets during operation. An assessment of these effects, along with mitigation proposed is presented in Appendix 6.6 within Volume C.

All cultural heritage mitigation should be undertaken in accordance with Written Schemes of Investigation which should be agreed in writing with the Historic Environment Consultant to ECC prior to the start of construction. These measures would also be included in the Construction Environmental Management Plan (CEMP).

7. Landscape and Visual

7.1 Introduction

This chapter considers the likely landscape and visual effects that would occur as a result of the Proposed Scheme. Landscape and Visual Impact Assessment (LVIA) is a means of identifying probable changes to landscape and views resulting from a proposed development, and assessing the scale and significance of those changes. Landscape and Visual Impact Assessment is concerned with two related issues, namely:

- effects on the landscape as a resource in its own right – landscape effects (Figures 7-1 to 7-4); and
- visual effects (Figure 7-5 to 7-12).

Landscape effects relate to changes in aesthetic and perceptual aspects of landscape character, as well as physical changes to constituent features or elements of the landscape which contribute to landscape character. Visual effects relate to changes to peoples' views and visual amenity, whether they are residents or users of Public Rights of Ways (PRoWs), using sports or leisure facilities, or at work, or travelling.

Additional information to support this chapter is presented in the following appendices:

- Appendix 7.1: Methodology for Landscape and Visual Assessment;
- Appendix 7.2: Schedule of Visual Effects;
- Appendix 7.3: Site Photographs; and
- Appendix 7.4: Tree Survey Report and Arboricultural Impact Assessment.

7.1.1 Legislative and planning context

Table 7.1: Planning policies relevant to the landscape and visual assessment of the Proposed Scheme

Policy	Text relevant to Proposed Scheme	Why it is relevant
National Planning Policy Framework (NPPF), Chapters 7, 9, 11 and 12.	Chapter 7 - Requiring Good Design Chapter 9 - Protecting Green Belt land Chapter 11 - Conserving and enhancing the natural environment Chapter 12 - Conserving and enhancing the historic environment	The relevance is indirect. The NPPF sets out the requirements/intentions of the national government regarding policies to be included in regional and local plans that affect the Proposed Scheme.
Epping Forest District Local Plan Alterations (July 2006)		
Core policy CP1 - Achieving sustainable development objectives.	"*Avoid, or at least minimise, impacts of development upon the environment, particularly in ways likely to affect future generations. Where negative impacts cannot be avoided, compensatory measures will be required to offset such impacts……*"	Clause covering all developments (including roads) and their effects on the environment.
Core Policy CP2 - Protecting the rural and built environment.	"*The quality of the rural and built environment will be maintained, conserved and improved by:* *(i) Sustaining and enhancing the rural environment, including conserving countryside character, in particular its landscape, wildlife and heritage qualities, and protecting countryside for its own sake;* *(ii) Enhancing and managing, by appropriate use, land in the metropolitan green belt and urban fringe;*	Clause covering all developments (including roads) and their effects on the environment.

Policy	Text relevant to Proposed Scheme	Why it is relevant
	(iii) Retaining the best and most versatile land for agriculture; (iv) *Safeguarding and enhancing the setting, character and townscape of the urban environment…….*"	
Green Belt policy GB1 - Green Belt Boundary.	"*The boundary of the Metropolitan Green Belt in this district is as defined on the Proposals Map.*"	The northern portion of the Proposed Scheme is within the Green Belt.
Green Belt policy GB2A - Development in the Green Belt.	"*Planning permission will not be granted for the use of land or the construction of new buildings or the change of use or extension of existing buildings in the green belt unless it is appropriate in that it is:* *….. For …. uses which preserve the openness of the green belt and which do not conflict with the purposes of including land in the green belt;……*"	Clause covering all developments (including roads) and their effects on the environment of the Green Belt. Green Belt policy aims to check unrestricted urban sprawl, prevent towns and villages from merging into one another and assist in safeguarding the countryside from encroachment. Green Belt policy does not seek to prevent or control road developments; however, major roads are the essential arteries of large scale building developments that Green Belt policy does seek to control.
Sustainable Transport Policy ST7 - Requirements for new roads and extensions to existing roads.	The council expects schemes for new roads or for extensions and improvements to existing roads to satisfy the following criteria: (i) Minimal environmental impact on sensitive areas (including open countryside and its management, sites of wildlife and built heritage interest, and residential areas) with adequate compensatory measures in those cases where environmental losses are unavoidable; (ii) Minimal adverse impact on road safety and traffic congestion; (iii) Minimal disruption to, or realignment of, the rights of way network; and (iv) Retention of a defensible green boundary and minimal loss of green belt land.	Clause specifically covering road schemes.
Sustainable Transport Policy ST9 - Stansted Aerodrome Safeguarding.	"*Within the aerodrome safeguarding zone around Stansted airport, development which will adversely affect the operational integrity or safety of the airport, or interfere with the operation of aeronautical navigation aids will not be permitted.* *17.42a Proposals which are covered by this policy include….. (iv) New or re-aligned roads that are close to runways.*"	The Proposed Scheme is within Stansted Aerodrome Safeguarding Zone but would not be close to the runways and is therefore, unlikely to receive objections from Stansted Airport.

Policy	Text relevant to Proposed Scheme	Why it is relevant
Epping Forest District Draft Local Plan (Recently in Consultation and Not Yet Adopted)		
Draft Policy SP2: Special Development Strategy 2011-2033.	"*Within the period 2011-2033 the Council will provide for approximately 11,400 new homes and approximately 10,000 new jobs through the Local Plan.* *The new homes will be delivered by:* *……the development of sites around Harlow and at other settlements as allocated through this Local Plan (as identified in Policy SP 3 and Chapter 5) as follows;* *Sites around Harlow: 3900* (homes)"	See below
Draft Policy SP3: Strategic Allocations Around Harlow.	SP 3.4 East of Harlow - Approximately 750 homes and the potential relocation of Princess Alexandra Hospital.	The east of Harlow Allocation is identified as Area J on Figure 3.7 of the Draft Local Plan. This comprises fields north of Moor Hall Road, east of Morgans Farm, also west of The Mores Wood extending north to include part of the site of the Proposed Scheme at Sheering Road Roundabout.
Draft Policy SP5 Green Belt and District Open Land.	"*The general extent of the Green Belt is set out in Figure 3.8."…… "The openness of the Green Belt will be protected from inappropriate development in accordance with national planning policy*." Figure 3.8 shows a large wedge of land proposed to be taken out of the Green Belt in the whole of the area enclosed by the M11, Sheering Road and Moor Hall Road with the exception of the woods and grounds at Sheering Hall which would remain part of the Green Belt.	Most of the site for the Proposed Scheme and surroundings in Epping Forest District is proposed to be taken out of the Green Belt. The purpose for this is to provide a reservoir of land available for current and future development allocations for housing and employment. In the coming years, if this policy is adopted, it would be possible for urban development to extend along the south side of Sheering Road from Harlow to the M11 at Sheering, effectively linking Harlow to Sheering.
Draft Policy SP6 The Natural Environment, Landscape Character and Green Infrastructure.	"*B. The Countryside:* *(i) The Council will conserve and enhance the character and appearance of the countryside. Landscape character assessments will be used to assist in judgements on the suitability of new development;* (ii) *The Council will act itself, and in relation to development proposals, to develop a multifunctional countryside, which is productive, rich in biodiversity at all scales, with a well-connected green infrastructure network that is accessible for quiet enjoyment, recreation and exercise.*"	As well as mitigating the landscape and visual effects of the Proposed Scheme, the woodland and screen planting of the Proposed Scheme would contribute to green infrastructure in the area, connecting with existing hedges and woods

Policy	Text relevant to Proposed Scheme	Why it is relevant
Draft Policy DM2 Landscape Character and Ancient Landscapes.	"*A. Development proposals will be permitted where applicants are able to demonstrate that the proposal will not, directly or indirectly, cause significant harm to landscape character or the nature and physical appearance of ancient landscapes.* *B. Proposals should:* *(i) be sensitive to their setting in the landscape, and its local distinctiveness and characteristics;* *(ii) use techniques to minimise impact on, or enhance the appearance of, the landscape by:* - *taking into account existing landscape features from the outset;* - *careful landscaping of the site; and* - *the sensitive use of design, layout, materials and external finishes.*"	The effects of the Proposed Scheme on landscape character and the extensive landscape mitigation proposals are set out in this landscape and visual assessment.
Adopted Replacement Harlow Local Plan (July 2006)		
Policy NE1 - Green Wedges.	Green Wedges will be protected from inappropriate development. Permission will not be granted, except for small scale development proposals and the replacement of existing buildings which do not have an adverse effect on the roles of the Green Wedges, which are identified below: 1. Providing a landscape design feature which is fundamental to the character of the town; 2. Protecting and enhancing the inherent qualities of the landscape and keeping areas as natural as possible; 3. Retaining the open character of existing uses and safeguarding the land from inappropriate development; 4. Preserving sites of ecological value and maximising potential for biodiversity in Harlow; 5. Separating neighbourhoods, housing areas and industrial areas; 6. Preserving the setting and special character of a number of historic sites and areas; 7. Contributing towards the amenities of local residents.	The Proposed Scheme along Gilden Way from Mulberry Brook/Mulberry Green to London Road passes through a Green Wedge area.
Policy NE3 - Metropolitan Green Belt.	Policy protecting the Green Belt	The Proposed Scheme does not pass through the Green Belt in Harlow.
Policies NE5/1 and NE6 - Special Restraint Area - Land north of Gilden Way.	NE5: "*The following Special Restraint Area has been identified on the Proposals Map: Ref. No. NE5/1: Land north of Gilden Way* *There will be a presumption against development in the Special Restraint Area unless:* *1. The development meets the Green Belt policy test, and does not prejudice the development of the site for longer term needs;*	The Harlowbury Development (shortly to start construction) occupies most of the Special Restraint Area. The Proposed Scheme on Gilden Way provides the main frontage and access points for the development.

Policy	Text relevant to Proposed Scheme	Why it is relevant
	2. *The land is shown to be needed for development resulting from a review of this Local Plan.*" NE6: "*If a need is established to develop land identified as Special Restraint Area following a review of this Local Plan the following shall be taken into account:* 1. *A Master Plan incorporating a detailed landscape survey shall be prepared for the Special Restraint Area;* 2. *At land at Gilden Way substantial Green Wedges shall be designated between the proposed area of development and Old Harlow and Churchgate Street and careful account should be taken of other considerations on the site*."	
Policy NE11-Trees and Hedgerows.	"*In considering applications for development affecting trees or hedges the Council:* 1. *May require a survey of the site and the trees and hedges concerned;* 2. *Will oppose the loss of trees and hedgerows of amenity value and wildlife importance;* 3. *Will serve Tree Preservation Orders to protect trees with public amenity value;* 4. *May impose conditions on planning permissions to ensure the retention or replacement of trees and hedgerows of amenity value or wildlife importance, and their protection during construction.*"	The Proposed Scheme would remove some sections of hedge and some mature trees near the road to permit the widening of Gilden Way. The scheme includes replacement tree and hedge planting.
Policy NE12 – Landscaping.	"*Major development proposals shall be accompanied by a detail [sic] of landscape features and wildlife habitats. Planning applications must include a landscaping scheme that indicates:* 1. *Measures to protect landscape features and wildlife habitats;* 2. *Measures to enhance landscape features and habitats;* 3. *Measures to mitigate against potentially adverse effects;* 4. *Measures to compensate where damage is unavoidable;* 5. *Measures for monitoring and a management scheme including funding to ensure the landscape is successfully established and maintained;* 6. *New landscape proposals;* 7. *Measures that address personal safety in the proposed landscape*."	This chapter, figures and appendices aims to fulfil these requirements for the Proposed Scheme, with the exception of the monitoring and management of the scheme, which is normally produced as part of detailed design.

7.1.2 Study Area

The study area is shown on Figure 7-1 ‘Landscape Context’. The area was delineated with reference to the Zone of Theoretical Visibility (ZTV) (Figure 7-5) and site verification to include the approximate extent of areas from which the Proposed Scheme would be visible as a significant feature in the view.

7.2 Assumptions and Limitations

Assessments of the landscape and visual effects of the Proposed Scheme were carried out on a number of visits to various parts of the site and surroundings in 2015 and 2016 (with the benefit of site visits in previous years to assess earlier route options). The landscape team walked the proposed route with permission from landowners and took photographs along the proposed route. Public rights of way with views of the route were also accessed. Effects on views from private properties including effects on views from some upper storey windows were estimated from publicly accessible viewpoints nearby, or from the line of the proposed route, without visiting the properties.

The term “visual receptor” is commonly used in visual assessment studies. Visual receptors are people whose views may be affected by a proposed development. For convenience they are normally identified by the places where their view would be affected. Thus the Schedule of Visual Effects does not identify the people whose views would be affected but their homes, the paths they use, their work places and recreational and commercial facilities they visit. The number of residential and commercial properties identified in the Schedule of Visual Effects in Appendix 7.2 and illustrated on Figures 7-6 Sheets 1-5 and 7.7 Sheets 1-4 has been compiled from base mapping and site assessment near the properties. Businesses at Mayfield Farm (including Mayfield Farm Bakery and Café, Churchgate Sausage Shop and Mutz Kutz Dog Grooming) have been recorded as one receptor group as they share and would continue to share a common access and would experience similar visual effects from the Proposed Scheme.

The visual assessment is based on visual receptors presented at the time of assessment. It does not include possible effects on views from properties planned but not yet built.

The detailed appearance of noise barriers has not been designed; therefore, assessments in this chapter regarding their landscape and visual effects are approximate and assume a predicted worst case. The depiction of noise barriers in Figure 7-8 Sheet 2 is only indicative. Proposed road signs are taken into account in the landscape and visual assessment but are not shown on the landscape drawings or photomontages.

Road lighting is included as part of the Proposed Scheme and has been taken into account in the landscape and visual assessment. It is briefly described and discussed in Section 7.5 (below). The lighting is mentioned in Appendix 7.2 where it would contribute to the visual effects of the scheme. In the columns for significance of effect, road lighting is noted in brackets where it would be the prime cause of the effect (for instance in Year 15 where proposed screen planting would substantially mitigate other effects from the road, and traffic etc.). Proposed lighting columns are shown on the photomontages in Figures 7-8 to 7-12.

No roads are classed as ‘scenic routes’; however, there are attractive views of the Pincey Brook valley from Sheering Road north of Pincey Brook. Visual sensitivity for road users along this stretch of road has therefore been rated as moderate and effects of the Proposed Scheme on the view assessed. Effects on views from other roads where visual sensitivity is low have not been assessed.

7.3 Methodology and Assessment Criteria

7.3.1 Methodology

This LVIA has been undertaken by chartered landscape architects with reference to criteria for assessment contained in the DMRB IAN 135/10 (Highways Agency, 2010a). Guidance has also been taken from guidelines for Landscape and Visual Impact Assessment Third Edition, April 2013 by The Landscape Institute and Institute of Environmental Management and Assessment (GLVIA3). The criteria tables for guidance on landscape and visual assessment are contained in Appendix 7.1.

The Harlow Area Landscape and Environment Study (2005) – (see baseline sources below) also sets out criteria for an area's landscape sensitivity to a specific type of change. The specific type of change referred to is urban development at the following scales:

- very large scale urban development;
- substantial urban development; and
- small-scale urban development.

The criteria for judging sensitivity the Harlow Area Landscape and Environment Study are as follows:

"High Sensitivity - Area unlikely to be able to accommodate the particular type of change without extensive degradation of character and value. Mitigation measures are unlikely to be able to address potential landscape/environmental issues.

Moderate Sensitivity - Area may be able to accommodate the particular type of change with some degradation of character and value, but mitigation measures would be required to address potential landscape/environmental issues.

Low Sensitivity - Area should be able to accommodate the particular type of change with only very limited, if any, degradation of character and value. Mitigation measures should be able to address all potential landscape/environmental issues."

Table 1 in Appendix 7.1 gives the DMRB (IAN 135/10) criteria used in this chapter for assessing landscape and visual sensitivity.

7.3.2 Assessment of magnitude and significance

This assessment broadly follows the methodology in Section 4.5, but uses the more detailed criteria specific to landscape and views found in Appendix 7.1 (from DMRB (IAN 135/10)). The methodology used for production of photomontages is also contained in Appendix 7.1.

7.4 Baseline Environment

7.4.1 Baseline sources

7.4.1.1 Harlow Area Landscape and Environment Study (2005)

Chris Blandford Associates were commissioned by a Steering Group of key stakeholders to undertake the Harlow Area Landscape and Environment Study. The study provides an evidence base for input to the review of Regional Planning Guidance for the East of England (RPG14). Stakeholders comprised planning and landscape representatives from Harlow Council, Epping Forest District Council, East Hertfordshire District Council, ECC, Hertfordshire County Council, the Countryside Agency and Government Office East.

Volume 1 analyses the strategic sensitivity of the Harlow area to development. Volume 2 provides a detailed analysis of Harlow's fringes, identifying areas of common landscape character at a finer scale. Volume 3 provides a strategic vision for the future and establishes landscape planning and management principles.

7.4.2 Baseline conditions

The baseline conditions comprise the existing situation in the study area together with any known changes likely to occur before completion of the Proposed Scheme. The landscape character of the study area is described through a review of published assessments along with a description of the local area affected by the Proposed Scheme. This section notes designations relevant to landscape assessment and outlines the local topography, hydrology, settlement, land use patterns, vegetation, historical and cultural associations and the context of proposed developments in the area.

Site photographs referenced in this chapter are contained in Appendix 7.3 and the viewpoint locations are shown on Figures 7-6 and 7-7.

7.4.2.1 Landscape character

Figure 7-2 depicts the Landscape Character. The study area falls within the national landscape character zone of the South Suffolk and North Essex Claylands. At a regional level, Essex Landscape Character Assessment (ECC, 2003) describes most of this area as glacial till plateau forming part of the Central Essex Farmlands. The Stort Valley character area includes land either side of the Pincey Brook west of the M11. Urban areas predominate to the southwest, in Harlow.

Farmland Plateau Areas C1 and C2 (Epping Forest District Council)

Epping Forest District Council Landscape Character Assessment (January 2010) divides the Central Essex Farmlands along the course of Pincey Brook with Area C1 (Sheering) to the north and Area C2 (Matching) to the south. There is little difference between these zones in the study area. Both are described as elevated gently rolling and mainly arable landscapes with small river valleys. Fields are medium to large-scale, often enclosed by hedges. Winding lanes and minor roads connect dispersed settlements including the village of Sheering. Area C1 includes Durrington Hall, an 18th century country house and park, and Area C2 includes Housham Hall, a 16-17th century farmhouse. There are several deciduous woods. Former estate lands belonging to Moor Hall (demolished 1960) include an entrance lodge, stables, two ponds, a wood (The Mores Wood) and belts of trees. There are long distance views across valleys. There is no tranquillity near the M11 and Harlow, or near busy traffic along the B183 Gilden Road and Sheering Road, but tranquillity increases with distance from these roads. Sensitivity to change (development) is rated by Epping Forest District Council as low to moderate for area C1 and moderate for area C2.

Magdalen Laver and Moreton Area F6 (Epping Forest District Council)

The northwest corner of this area covers land east of the M11 and south of Matching Road (eastward continuation of Moor Hall Road). Away from the M11 it is a peaceful rural area. Old villages and farms are linked by narrow rural lanes lined with mature hedgerows and hedgerow trees. Mainly arable fields are small to medium sized, enclosed by hedges and ditches. There are a few small pockets of pasture. Small patches of broadleaf woodland punctuate the landscape and create an intermittent sense of enclosure. Panoramic views across gently undulating farmland are characteristic of the area. Sensitivity to change is rated by Epping Forest District Council as moderate.

River Stort Area B1 (Epping Forest District Council)

This area extends to include Pincey Brook as far east as the M11. The River Stort is gently meandering with a sense of enclosure from vegetation along the river corridor. There is a patchwork of pasture and wetland and a network of rural roads. The small linear village of Lower Sheering with historic buildings and a church contributes to the settlement pattern. Sheering Hall (15-16th century) is a large residential property on the north bank of Pincey Brook. Views are generally focused along the river/stream corridors, but are more open in the valley of Pincey Brook between Sheering Road and the M11. The area has a strong sense of tranquillity in places away from major transport corridors. The Gibberd Garden is a Registered Park and Garden with sculptures, ornamental trees shrubs and water gardens situated by Pincey Brook within the River Stort area. This garden of regional importance was created by Sir Frederick Gibberd, who was the architect and landscape architect responsible for the masterplan of Harlow New Town. The garden is accessed via Marsh Lane off Gilden Way. East Herts District Council Landscape Character Assessment (2007) identifies a similar River Stort character zone along the west bank of the river which forms the district boundary, extending north towards Sawbridgeworth. In the Epping Forest District Council landscape character assessment, the sensitivity to change of the River Stort area is rated as high. This area includes the Pincey Brook valley that would be affected by the Proposed Scheme.

Harlow Area Landscape and Environment Study (2005)

Several of the Landscape character areas identified in the report are relevant to the Proposed Scheme.

- Area 12 River Stort;
- Area 15 Little Hallingbury ridges and slopes;
- Area 16(b) Hatfield Heath plateau;
- Area 18 Harlow major urban area;
- Area 19 Matching plateau; and
- Area 20(b) Jack's Hatch to Church Langley ridge and slope.

The Harlow Area Landscape and Environment Study has been used as the basis for assessing the effects of the Proposed Scheme on landscape character areas, because it covers not only Harlow but also extends beyond the town boundaries and encompasses areas within Epping Forest District relevant to the scheme. The Epping Forest District Council assessment stops at the town boundaries. Although both studies were carried out by Chris Blandford Associates (for the local authorities) they assess the sensitivity of the character areas in slightly different ways. The Epping Forest District Council assessment notes the general sensitivity to change of each area whereas the Harlow study assesses sensitivity to urban development at three scales: very large, substantial and small scale. The sensitivity levels given for the same or very similar character areas in each study are often different. This assessment makes note of the sensitivity assessments in the Harlow and Epping Forest District Council documents but provides separate assessments of sensitivity for each of the character areas using the relevant criteria in Appendix 7.1, following the standard methodology in IAN 135/10.

The characteristics of the River Stort area in the Harlow study are similar to those described in the Epping Forest District Council Landscape Character Assessment, except that the area does not extend east along Pincey Brook. The area would not be affected by the Proposed Scheme and is not summarised here. In the Harlow study, Area 15 Little Hallingbury Ridges and Slopes forms a transition between the River Stort area and areas called the Hatfield Heath Plateau and the Matching Plateau. These plateau areas are similar in extent and character to the Epping Forest District Council Farmland Plateau areas (C1 and C2).

Area 15 Little Hallingbury Ridges and Slopes

The western end of the proposed link roads and Sheering Road Roundabout lie within the Little Hallingbury Ridges and Slopes area. This area extends southwest to the current developed edge of Harlow (within Harlow Borough including the site for the Harlowbury Development), and east along part of the Pincey Brook valley as far as the M11 (Views 1, 2, 3 and 4). The area is described as follows:

"*Undulating arable farmland ridges and slopes with winding lanes linking scattered farmstead and small-scale settlements. Generally open with small-dispersed patches of broadleaved woodland. This character area includes the eastern valley side of the River Stort"…"The area is dominated by medium to large open fields, which separate several areas of distinctive historic character.*"

Key characteristics are listed as follows:

- Landform - Undulating ridge and slope;
- Landscape pattern - Open and large scale;
- Character of skyline - Variable dependent on location;
- Inter-visibility - Moderate, but mixed with some interconnections;
- Rare landscape features - Some nature conservation and keynote historic features;
- Settlement pattern/communication routes - Dispersed historic pattern, generally intact;
- Sense of enclosure - Variable, reflecting topography;
- Sense of tranquillity/remoteness - Limited; and
- Historic landscape time-depth and stability - "Some notable elements"…"but generally very limited."

Sensitivity to: Very large-scale urban developments - Moderate

Substantial urban developments - Moderate

Small scale urban developments - Low

In addition to the information above taken from the Harlow Area Landscape and Environment Study, a further qualitative description is needed for the Pincey Brook valley. It is just one of the landform undulations of this character area but it is the context for the Proposed Scheme north of Harlow. The valley is oriented east/west crossed by the M11 and Sheering Road. The Proposed Scheme would mainly affect the area between those busy roads. The valley is quite shallow and open with large arable fields, but also with some blocks of mature woodland. The traffic on Sheering Road is partially screened by roadside tree belts and hedges. The M11 is also partially screened by trees and Pincey Brook is lined with trees and scrubs. The valley is accessible for walkers with a public footpath that follows the stream from Sheering Road then crosses and climbs northeast toward Sheering, crossing the M11 on a footbridge. It is an unremarkable but attractive rural valley.

The Epping Forest District Council landscape character assessment includes the Pincey Brook valley as part of the River Stort character area and assesses its sensitivity as high, whereas the Harlow Area Landscape and Environment Study (2005) rates its sensitivity (along with the remainder of the Little Hallingbury Ridges and Slopes character area) as moderate. The scale of the field pattern is smaller west of the road and hedgerows are more numerous. The Gibberd Garden and the Pincey Brook Meadows LWS and Ancient Semi-Natural Woodland border Pincey Brook west of the Sheering Road. For that reason, using the criteria for landscape and visual sensitivity in IAN 135/10 (in Appendix 7.1), this report assesses the sensitivity of the Pincey Brook valley to the east of Sheering Road as moderate and west of the road, to the point where it meets the River Stort, as high. The land west of Sheering Road would not be affected by the Proposed Scheme; therefore, for the purposes of this report the relevant area is east of the road and its sensitivity is moderate.

Area 16b Hatfield Heath Plateau (sub area B)

This area is in the north of the study area for the Proposed Scheme and includes the village of Sheering. It has a generally modern character, with some isolated areas of historic landscape interspersed with large areas of modern 20th century prairie fields created by the removal of field boundaries, and some areas of post-1950s enclosure adjacent to the M11. Several smaller extents of pre-18th century field systems are isolated within the broad swathe of prairie fields. The area also contains the visible and non-visible archaeological remains of a large number of moated sites, which cluster around Sheering, a settlement mentioned in the 1086 Domesday Book.

- Landform - Gently rolling;
- Landscape pattern - Medium to large scale and generally open;
- Character of skyline - Mixed but generally open and expansive;
- Inter-visibility - Generally high, but limited in areas;
- Rare landscape features - Limited concentrations;
- Settlement pattern/communication routes - Generally intact dispersed historic pattern;
- Sense of enclosure - Limited;
- Sense of tranquillity/remoteness - Limited; and
- Historic landscape time - depth and stability - Limited.

Sensitivity to: Very large-scale urban developments - High

Substantial urban developments - Moderate

Small scale urban developments - Low

These sensitivity levels differ from the low to moderate sensitivity assessed for the Farmland Plateau Area C1 (Sheering) in the Epping Forest District Council character assessment. For this scheme assessment, using the criteria for landscape sensitivity in IAN 135/10 (in Appendix 7.1), the sensitivity of the Hatfield Heath Plateau Area 16(b) is assessed as moderate.

Area 18 Harlow Major Urban Area

The portion of Gilden Way to be widened passes through the edge of this area (Views 14-18) with the following key characteristics:

- Landform - Topographic bowl forms key component of character;
- Landscape pattern - Highly structured dense urban form separated by important green space corridors/wedges;
- Character of skyline - Bowl provides important edge;
- Inter-visibility - Limited by topography;
- Rare landscape features - Few, some historic and nature conservation;
- Settlement pattern/communication routes - Subsumed into modern development;
- Sense of enclosure - High, with some long views down corridors;
- Sense of tranquillity/remoteness - None; and
- Historic landscape time-depth and stability - Limited, modern dominates.

Sensitivity to: Very large-scale urban developments - Low

Substantial urban developments - Low

Small scale urban developments - Low

The Harlow Area Landscape and Environment Study does not distinguish the core older parts of the urban area and is therefore not used as the basis for assessment of the Proposed Scheme in the urban areas. Instead, this report describes two local townscape character areas; these are the Harlow Environs and Harlow Core areas described below.

Area 19 Matching Plateau

The sites of the proposed M11 Junction 7A and the realignment of Sheering Road leading to Gilden Way are in the Matching plateau area which is summarised as follows.

"*Dominated by arable farmland and comprised of medium to large arable fields, this area is permeated by small patches of semi-natural ancient woodland"… "Within this character area, Pincey Brook minor river valley"… "Creates an intimate and attractive landscape corridor. A series of small historic settlements (which are often nucleated around a common or green) are connected by narrow winding lanes. Farmsteads and small roadside settlements punctuate the rural landscape.*"

The key characteristics are:

- Landform - Gently rolling;
- Landscape pattern - Medium to large scale and open;
- Character of skyline - Generally open;
- Inter-visibility - Moderate with views to surrounding areas;
- Rare landscape features - some historic fields, parks and features;
- Settlement pattern/communication routes - Dispersed historic settlement along road network;
- Sense of enclosure - Limited, generally open;
- Sense of tranquillity - Variable, affected by M11; and
- Historic landscape time - depth and stability - Variable, some pockets of considerable time depth, but generally moderate.

Sensitivity to: Very large-scale urban developments - High

Substantial urban developments - High

Small scale urban developments - Moderate

The high sensitivity ratings differ from the moderate sensitivity to change assessed for the Farmland Plateau – Area C2 (Matching) in the Epping Forest District Council assessment. For this scheme assessment, using the criteria for landscape sensitivity in IAN 135/10 (in Appendix 7.1), the sensitivity of Area 19 Matching Plateau is assessed as moderate.

Area 20(b) Jack's Hatch to Church Langley Ridge and Slope

The eastern end of the Proposed Scheme where Gilden Way approaches the roundabout with the A414 falls within Area 20(b), Jack's Hatch to Church Langley ridge and slope, which is summarised as follows:

- Landform - Gentle ridge
- Landscape pattern - Mixed, but generally moderate to large in scale
- Character of skyline - Open
- Inter-visibility - Visible from local areas, key aspect of the setting of areas 18 and 21
- Rare landscape features - Dense concentrations of historic and nature conservation assets
- Settlement pattern/communication routes - Limited settlement;
- Sense of enclosure - Open
- Sense of tranquillity/remoteness - Limited
- Historic landscape time-depth and stability - Generally good, but limited in places

Sensitivity to: Very large-scale urban developments - Low

Substantial urban developments - Low

Small scale urban developments - Low

For this scheme assessment, using the criteria for landscape sensitivity in IAN 135/10 (in Appendix 7.1), the sensitivity of Area 20(b) Jack's Hatch to Church Langley ridge and slope, is assessed as low.

7.4.2.2 Harlow townscape

Harlow was one of the first new towns to be designated and the Harlow Master Plan, approved in 1949, was the first to be approved. The master plan covered an approximate rectangle of 5.6km from north to south and 7.2km east to west (across its widest parts). It was contained to the west and north by the River Lee and River Stort. The boundary was set to retain as much of the good agricultural land to the east as possible. Sir Frederick Gibberd, the consultant architect-planner for Harlow, established key principles in the development of the master plan as follows.

Respect the existing landscape:

- retain valleys and their streams, fine trees and undergrowth;
- re-use older buildings to retain a link with Harlow's historic past;
- re-use some of the pre-existing road network, and retain other older routes as cycle lanes or footpaths; and
- conserve the character of the villages of Old Harlow and Potters Street and restrict urban development in existing hamlets to low-density infill in order to retain their rural character;

Landscape pattern

The master plan had a geometric pattern of four districts centred on the Town Park. The districts were separated by green wedges that penetrate to the heart of the town, all surrounded by the Green Belt. Southeast of Old Harlow the plan showed a wedge of agricultural land which remains in part today, slightly reduced by recent development between Sheering Road and Churchgate Street.

Open space, recreation and access to the countryside

The plan included an interconnected landscape of green routeways, linear parks and more traditional parks to provide natural landscape within walking distance for everyone. Tree planting and land shaping; tree planting was undertaken on a massive scale to enhance green spaces within the town for variety and contrast with the urban (built) landscape. Earth mounds were created as screens and interesting landforms.

Building contrast

Buildings of more than two storeys had a broad landscape setting to create variety and contrast across the town. This was a feature of the town centre which was designed to have vertical growth. Building groups were generally placed on higher ground leaving the valleys open between the built up areas. At the edges of town, contrast was achieved with a clear boundary between the urban areas and the countryside.

Building density

Housing was concentrated in relatively high density across the whole town with housing on the edge of town having the same density as housing near the town centre. This produced a strong visual contrast between the town and the surrounding Green Belt.

Other principles

There were several other principles in the masterplan, related to detailed design of districts, neighbourhoods and housing groups and the design of housing types. They are not discussed here because they are not relevant to the Proposed Scheme.

7.4.2.3 Harlow townscape character areas

For the purposes of this report the townscape character of Harlow has been divided into two zones comprising Harlow Environs and Harlow Core.

Harlow Environs

Developed areas surrounding the core generally date from the 20th century. There are historic routes, estates and settlements dispersed within this area but not sufficiently close to the Proposed Scheme to be affected by it. Development near the Proposed Scheme is a mixture of private housing, former/current council housing and schools. Characteristic street patterns and building configurations of each are apparent on the base map. The housing is interspersed with generous green spaces for sports, informal recreation, play areas and garden allotments. There are belts of trees along streams and old boundaries, and planted as part of the green infrastructure for the new town. Other land uses include a council works depot. Two large blocks of agricultural open land adjacent to Gilden Way are subject to imminent development with housing (Harlowbury and New Hall developments - labelled on Figure 7-2 'Landscape Character'). Land near Gilden Way in the New Hall development would be dedicated as recreation land with playing fields and belts of trees.

The Harlow Area Landscape and Environment Study rate the sensitivity of Harlow major urban area to urban development as low. In principle, additional urban development could be accommodated within the area with little effect on townscape character. Road development could also be accommodated without significant changes to townscape character. Using the criteria for landscape sensitivity in IAN 135/10 (in Appendix 7.1), the sensitivity of Harlow Environs is assessed as low.

Harlow Core

Figure 7-2 identifies a core area of old Harlow including Old Harlow Conservation Area and Churchgate Street Conservation Area. Not all the houses within this area are old but the character of the townscape is slightly different from the Harlow Environs. Houses built along the historic roads are often larger, more varied and with larger gardens and mature trees compared to modern areas of Harlow. Parts of Sheering Road and Mulberry Green within Harlow Core retain features of a country road with hedges, trees and a grass verge or a ditch on one side and a narrow footway on the other side. Mainly two storey buildings on Churchgate Street are not as large and front directly on to pedestrian pavements. They vary in age from half-timbered medieval to 18th and 19th century, with orange or buff brick or white painted clapboard. Many buildings are painted white with black details. Roofs are pitched with tiles or slate.

Sheering Road was the route into Harlow from the northeast before the construction of Gilden Way in 1970. It took a winding course leading directly to Mulberry Green and Old Harlow. Gilden Way cuts through the old settlement pattern with a turning for Mulberry Green and the High Street, but severing Sheering Road. Churchgate Roundabout and link road further northeast on Gilden Way provides an alternative access to Churchgate Street and Sheering Road.

The Harlow Area Landscape and Environment Study (2005) does not separately distinguish the older parts of Harlow within the urban area when it assesses the sensitivity of the area as low. However, the Harlow Core area is different and further urban or road development could impact on its character. This assessment rates the sensitivity of the Harlow Core area as high.Table 7.2 below lists the landscape and townscape character areas used as a basis for assessing the effects of the Proposed Scheme and states their level of landscape sensitivity according to criteria given in IAN 135/10 (in Appendix 7.1)

Table 7.2: Sensitivity of Landscape/Townscape Character Areas

Landscape/Townscape Character Area	Landscape and visual Sensitivity
Area 15 Little Hallingbury Ridges and Slopes	Moderate
Area 16(b) Hatfield Heath Plateau (sub area B)	Moderate
Area 19 Matching Plateau	Moderate
Area 20(b) Jack's Hatch to Church Langley Ridge and Slope	Low
Harlow Environs (townscape)	Low
Harlow Core (townscape)	High

7.4.2.4 Designations and landscape elements

Open countryside within the study area was shown in the 1998 version of the Epping Forest District Council Local Plan Proposals Map as part of the Green Belt, protected from urban development. The Green Belt is not shown in the proposals map for the Local Plan Alterations (2006). The forward to a document titled Planning our Future - Community Choices - Issues and Options for the Local Plan (EFDC, 2012) says (in summary) that changes to national policy means that the existing Local Plan ceases to be in effect from April 2013. It adds that there is a need as soon as possible to adopt a new Local Plan that makes provision for new houses and jobs while protecting the rest of the Green Belt. The extent of the "rest of the Green Belt" has not yet been established; however, the Epping Forest District Council Draft Local Plan (recently in public consultation and not yet adopted) proposes to remove land from the Green Belt between Sheering Road and the M11 north of Moor Hall Road as described in Table 7.1. Harlow Adopted Replacement Local Plan identifies most of the open land on the fringes of the town as Green Belt; it also establishes Special Restraint Areas which are areas where development may be required for the next plan period. One of these is adjacent to Gilden Way north verge and is the site of the Harlowbury housing development.

The Conservation Areas of Harlow Old Town and Churchgate Street are described above under Harlow Core.

The Gibberd Garden, home of the late Sir Frederik Gibberd is on the list of Registered Parks and Gardens. The property, which is accessed via Marsh Lane off Gilden Way, has an extensive sculpture garden, arboretum and tearoom. The garden is open to the public on weekends and Wednesdays from April to September.

Harlow Local Plan designates an area that includes the Gibberd Garden as well as meadows and hedgerows between the railway and the River Stort as a Special Landscape Area. Special Landscape Areas possess a special visual quality that distinguishes them from other countryside areas.

Two sites near the Proposed Scheme are designated in the Epping Forest DC Local Plan as LWSs as follows:

- Pincey Brook Meadows – on Pincey Brook west of Sheering Road, contains Hornbeam and Ash woodland in parts of this area. The key quality feature is a series of grasslands and wetland vegetation either side of Pincey Brook.
- Moorhall Wood - east of the M11, ancient woodland dominated by Hornbeam coppice with occasional Sycamore coppice and Ash standards. There is a cluster of Small-leaved Lime coppice stools in the northwest corner. The shrub layer is varied and the ground flora is dominated by Dog's Mercury with concentrations of Bluebells.

Epping Forest District Council are responsible for Tree Preservation Orders (TPO) protecting blocks of woodland, shelter belts and pond-side trees on land that belonged to the former Moor Hall Estate. They are numbered W1, 2, 3 etc. on Figure 7-1.

The whole of the study area is within a zone called Stansted Aerodrome Safeguarding which requires that the aerodrome operator will be consulted on all developments likely to attract birds.

Pincey Brook and tributary stream

Pincey Brook is a slow moving stream that passes under the M11 with a sinuous course through the study area, bending around Sheering Hall (View 13). West of Sheering Road it passes through meadows with a pond, and continues through the Gibberd Garden and under the East Coast Main Line railway to join the River Stort. It supports a wide variety of native trees, shrubs and wetland plants. It is a locally attractive feature and an important component of the landscape character of the area.

A small tributary stream that emerges from the north end of The Mores Wood and continues to Pincey Brook has much less presence in the landscape. The first 200m out of the wood appears as a ditch with scrub vegetation and the remaining section is invisible beneath an arable field.

Trees and hedges

Existing trees along Gilden Way are an eclectic mixture of native and foreign species and horticultural hybrids including, Ash, Scots Pine, Pedunculate Oak, White Poplar, Black Poplar, Leyland Cypress, Norway Maple, Silver Maple, Horse Chestnut, Flowering Cherries, Black Poplar, Sycamore etc.

Sheering Road north of Mayfield Farm is enclosed with mature trees and shrubs on the east side and by brick garden walls, shrubs, hedges and trees in residential properties on the west side (View 6). Species on the east side include Oak, Elm (saplings), Sycamore, Ash, Elder, Blackthorn, Field Maple, Norway Maple, Hawthorn, Horse Chestnut, Copper Beech, Sweet Chestnut, Hornbeam and Scots Pine. Ash is the most frequent, especially in lengths near Pincey Brook. The wide variety of species, some of which are not native, indicates they are probably plantations of the former Moor Hall Estate.

The mature woodland at The Mores Wood also part of the Moor Hall Estate, includes Oak, Sycamore, Ash, Willow, Scots Pine, Alder, Beech, Cherry, Large Leaf Lime, Hazel (formerly coppiced) and Apple and Hawthorn.

There are not many hedges near the scheme in the rural section north of Harlow. One hedge extending east from a wood near Sheering Road south of Pincey Brook is a mix of Hawthorn, Elm, Elder and Hornbeam with some Viburnum. This hedge contains three mature Oak trees which are attractive features in local views.

The bank-side vegetation along Pincey Brook has a broad range of native species including Hazel, Hawthorn, Field Maple, Blackthorn, Ash, Elm saplings, Elder, Willow and Dogwood. Individual specimens of Trembling Aspen, Large Leaf Lime, Spindle and Guelder Rose, were also noted. This vegetation appears to have developed naturally, not as part of a woodland plantation.

The cuttings and embankments of the M11 are clothed in some sections with dense blocks of young trees and shrubs but there are also more open sections with intermittent trees, shrubs, long grass and bramble. Species include Sycamore, Ash, Oak, Hawthorn, Blackthorn, Elm, Field Maple, Goat Willow, Scots Pine and Larch and Gorse.

7.4.3 Value of receptors

Table 7.3 below assesses the sensitivity of receptors (landscape features) to the proposed development.

Table 7.3: Value of receptors to development

Receptor	Description	Sensitivity
Landform and landscape of Pincey Brook Valley	The valley has gentle slopes. The stream is lined with trees and scrub. The slopes are arable and open with contrasting blocks of woodland and mature oak trees in a remnant hedge. Moor Hall Road and Sheering Road are hidden behind hedges. An unremarkable but unspoilt rural valley - apart from the M11.	Moderate - Local Importance
Trees with Tree Preservation Orders (TPO)	Mature mixed woodlands on the former Moor Hall Estate, including The Mores Wood and several other belts and clumps of mature trees and individual mature trees.	Moderate - Local Importance
Trees and Shrubs on the M11 verges	Mixed semi-mature woodland, mainly of value for screening motorway traffic in local and long distance views.	Low - Local Importance
Trees and hedges along Gilden Way	Mature and semi-mature trees and hedges of value for screening traffic on Gilden Way from nearby residential properties in Harlow.	Moderate - Local Importance

Receptor	Description	Sensitivity
Individual Mature Trees	Three mature oak trees in a hedge contribute to the rural scene in the valley, south of Pincey Brook, east of Sheering Road. (Trees T155, T169 and T171, rated Grade A - high quality to be retained (but not TPO protected) - Tree survey in Appendix 7.4).	Moderate - Local Importance
The Gibberd Garden	Non-statutory Registered Park and Garden with sculptures, pots, ornamental trees shrubs and water gardens, created by Sir Frederick Gibberd architect-planner responsible for the masterplan of Harlow New Town. Grade II listed garden accessed via Marsh Lane off Gilden Way.	High - Regional Importance
Sheering Hall	Grade II* 15th-16th century house with outbuildings and gardens on Pincey Brook.	High - Local Importance
Old Harlow Conservation Area	Historic centre of Harlow with Market Street, High Street and Mulberry Green. Gilden Way passes very close to the southeast corner of the Conservation Area.	High - Local Importance
Churchgate Street Conservation Area	East end of Old Harlow with numerous mature trees and listed buildings on Churchgate Street including the medieval church of St Mary and St Hugh. The area includes Sheering Road east of Gilden Way which passes very close to the northwest end of the Conservation Area.	High - Local Importance

7.5 Significant Effects

In this chapter, statements of the levels of magnitude of changes and significance of effects on landscape and views should be understood to be adverse unless they are stated as neutral or beneficial. Tree Preservations Orders and other protective designations are shown on Figure 7-1 ‘Landscape Context’. Photo views are in Appendix 7.3 and viewpoint locations are shown on Figure 7-6 Sheets 1-5.

Lighting, noise barriers and signage

Proposed lighting is shown on the road lighting layout plans and is not shown on the landscape figures. The roads would be lit with LED luminaires on 10m high columns (apart from a few 6m columns at a sensitive location for bats near The Mores Wood). The columns would be positioned at the back of the verge or footway. The luminaires would be of a full cut-off type mounted horizontally on 1m brackets, limiting light spill to adjacent areas. The colour of the lighting would be neutral white. Effects of road lighting are described as part of the landscape and visual assessment of the scheme.

A need for measures to mitigate increases in traffic noise for adjacent and nearby properties has been identified along many parts of Gilden Way (for further detail see Chapter 11 - Noise and Mitigation Section 11.6 Proposed Mitigation). Indicative barriers are shown on Figure 7-3 ‘Landscape Mitigation’ Sheets 1-4. They range in height from 2m to 3m and are proposed in four types: timber reflective barriers, absorptive barriers (materials not yet defined), brick wall barriers and barriers with transparent panels. Their indicative extent, size and positioning is a result of discussions between the acoustics specialists and specialists for other environmental disciplines. Consultation with affected residents and Harlow Council would be required before deciding the extent, layout and details of any noise barriers in the Proposed Scheme. Gaps for public access through the barriers that could be a safety hazard requiring detailed design to address public safety and security are identified on Figure 7-3. Where practicable, without negating their effectiveness for noise mitigation, the barriers are shown set back slightly on the road verge leaving room to plant a hedge in front. Climbing plants have been proposed to soften the appearance of the barriers in places where there is no opportunity to set them back. Although the barrier

proposals are only indicative, their probable landscape and visual effects have been described as part of this assessment.

7.5.1 Construction effects

7.5.1.1 Landscape effects

Vegetation clearance

Sheets 1-7 of Figure 7-3 'Landscape Mitigation' - show the approximate extents of woody vegetation that would be cleared for construction. Details of the trees potentially affected are covered in the Tree Survey Report and Arboricultural Impact Assessment in Appendix 7.4.

The widening of Gilden Way would encroach marginally on trees, shrubs and hedges on both sides of the road at various points in the 1.8km distance through the edge of Harlow. However, the design with narrower traffic lanes allows the increase from 2 to 3 lanes within the existing highway boundary without permanent encroachment on adjacent private properties. A small clump of roadside trees would be lost near the boundary fence of houses in a recently completed development at Mulberry Gardens (View 16). Continuing northeast, the existing noise barrier/fence on the road frontage of Long Barn Cottage (View 18) and Nos. 8 and 10 Sheering Drive, would be replaced with a 2.5m high absorptive noise barrier, entailing losses of boundary vegetation. Proposed drainage pipes, petrol interceptors and outfalls require the removal of trees on public land near Harlowbury Brook. Roadside hedges, trees and amenity planting would be removed either side of the road near the pedestrian underpass at The Oxleys and Gilden Close (View 15 and Section A on Sheet 1 of Figure 7-4). Existing boundary fences on the southeast side of Gilden Way would be replaced with new 2.5m absorptive noise barriers. Certain trees close to the scheme within adjacent properties on the southwest side would be felled because their root zones would be substantially damaged by proposed road widening and/or they are leaning over the road. Affected properties are No. 3 Sheering Drive, Walnut Cottage and No. 25 Sheering Road. A small clump of trees would be removed at the frontage of 122 Sheering Road (View 11). The new layout of the Churchgate Roundabout would require the removal of the trees and shrubs in the central island.

Two drainage attenuation ponds would be excavated in green-space areas on Gilden Way, requiring a group of mature trees to be felled near the entrance to the playing fields near Churchgate Roundabout, and felling of large evergreen decorative trees in a small clearing on the southeast side of Gilden Way at Chainage 650-700 approx. The magnitude of landscape change due to these and other marginal vegetation losses along Gilden Way would be Minor. In physical terms the significance of effect would be Slight Adverse, but the visual effects would be greater and are described below in Section 7.5.1.2 Visual Effects.

Semi-mature trees and shrubs on the M11 verges would be lost to construct M11 Junction 7A (View 7). This vegetation would be replaceable with new planting on regraded side-slopes. The magnitude of the change would be Minor and the significance of effect would be Slight Adverse. The M11 would continue to have a Major local effect on the pattern and character of the landscape.

The eastern edges of two mature copses of deciduous trees (and the hedgerow that links them) near the M11 would be cleared from area W5 of Epping Forest's collective TPO 55/09, pertaining to trees and woodlands of the former Moor Hall estate (View 8 and Section E on Sheet 2 of Figure 7-4). Some of the trees that would be lost have intrinsic landscape value as mature trees and as such their loss is undesirable. Eighty metres of hedge and two hedgerow trees would be lost on the east side of the junction. Vegetation losses to construct the junction would be marginal and the greater part of the TPO protected copses would be retained with a Minor magnitude of change and Slight Adverse significance of effect on the local landscape pattern.

The southern branch of the proposed link road would be built on embankment close to mature trees on the northwest corner of The Mores Wood (W4 of TPO 55/09). The embankment would not affect the trees or their root zones but a highway drainage ditch and a construction haul route along the foot of the embankment could affect parts of the root zones of trees at the corner of the wood. Some clumps of small trees, shrubs and bramble along a small stream that emerges from The Mores Wood would be removed to construct the link road. The magnitude of change to the vegetation would be Minor and significance of effect would be Slight Adverse.

Parts of mainly deciduous woodland areas W1 and W2 of TPO 55/09 would be removed. Mature trees would be felled on the western edge and southwest corner of woodland W1 (View 12) to allow for the widening and realignment of Sheering Road to join the new Sheering Road Roundabout. Most of the mature trees in the small woodland W2 would also be felled to construct the new Gilden Way/Sheering Road realignment. These losses are assessed as a whole along with the proposed clearance of other trees within the belt of estate planted woodland along Sheering Road as follows;

Part of the belt of mature trees on the east verge of Sheering Road south of Pincey Brook would be removed to create a new access turning for homes along on the old road. Trees in the same belt would also be felled to construct a turning head for refuse and delivery vehicles near No.63 Sheering Road. These trees are mainly deciduous, with a range of native and some foreign species, and are not protected by TPO. The large gaps created at intermittent points in the tree belt along Sheering Road including clearance of parts of TPO woodlands W1 and W2 would locally erode the pattern of the landscape. The magnitude of the change and significance of effect would be Moderate Adverse.

Three mature Oaks that are prominent and attractive in views from the public footpath 204/17 along Pincey Brook would be retained and protected (View 5). Most of the existing hedgerow in which they grow would also be retained, but a 60m stretch of the hedge starting from the southeast corner of TPO woodland W1 would be removed to construct a highway drainage attenuation pond. Roadside trees and scrub along Sheering Road near commercial and residential properties at Mayfield Farm would be felled to allow for the widening and realignment of Sheering Road with a retaining structure to limit encroachment on the property (Views 9 and 10). A new realigned access to the property from Gilden Way would entail the loss of a few medium sized trees and shrubs. The magnitude of these vegetation changes would be Minor and the significance of effect on the landscape would be Slight Adverse. Table 7.4 provides an approximate measure of the canopy areas of woodland, scrub and hedge that would be removed to construct the scheme.

Table 7.4: Areas of vegetation to be removed

Existing woody vegetation (canopy area) to be removed	Hectares
Mature woodland protected by Tree Preservation Order	0.43
Semi-mature woodland and scrub vegetation on the M11 cuttings and embankment slopes	1.62
Other woodland and scrub vegetation	1.50
Hedges: 446 linear metres at an estimated average width of 2.5m = 1115m^2	0.11
TOTAL	**3.66**

Landform and landscape pattern

The widening of Gilden Way would be carried out slightly above its existing level with insignificant effects on landform. Two highway drainage attenuation ponds are proposed; one to be excavated in the corner of a sports field near Churchgate Roundabout and another in greenspace on the southeast side at Chainage 650-700. The magnitude of change due to drainage infrastructure works on Gilden Way would be Minor and the significance of effect on the landscape Slight Adverse. Vegetation losses due to proposed road widening would have a Slight Adverse landscape effect as already described, but would not have a significant effect on the landscape pattern of this suburban area. Works to install the proposed noise barriers (height, type and location shown on the landscape mitigation Figure 7-3 Sheets 1-4) would be part of the general disturbance of construction to views and landscape character especially in places where existing boundary fences would be removed and replaced with barriers.

The construction of M11 Junction 7A (with 85m wide roundabouts) would encroach on arable fields either side of the M11. The Eastern Dumbell Roundabout would be located near the boundary between two arable fields with little effect on their viability for agriculture or on the local landscape pattern which is already affected by the M11. The Western Dumbell roundabout would sit close to existing woodlands (described above) helping to integrate the junction into the landscape.

The proposed southbound off-slip from the M11 would start diverging north of Pincey Brook. To limit land take and preserve some of the existing trees and shrubs on the motorway embankment a sheet-pile retaining structure up to 1.5m high would be installed to support the slip road verge on the existing embankment slope. Potentially this structure and the works to construct it could be intrusive but it would be partially screened by existing vegetation to be retained on the slope below. There are no residential properties or locations with public access with a view of this side of the M11 for a distance of 900m. Furthermore, existing woodlands at Heathen Wood and Glyn's Spring Wood provide substantial screening.

The junction would be sited as close as possible to the deepest point of the M11 cutting, so that the levels of the proposed roundabouts and bridge would be no higher than 4.4m above the existing high ground. Engineering standards control the longitudinal profile of the link road, which would slope gradually down from the Western Dumbell Roundabout, crossing the side of the Pincey Brook valley and reaching roundabouts near Sheering Road at existing ground level. However, the existing landform slopes more steeply than the link road so that the apparent height of road embankments would increase to a maximum of 8.5m above natural ground (Section D on Sheet 2 of Figure 7-4). The link road would also diverge into two roads isolating approximately 2.5ha of arable field that would become part of highway land.

Pincey Brook Roundabout, the smaller of the two roundabouts at the west end of the link roads, would sit at existing grade on a spur of slightly raised ground, prominently visible 100m south of Pincey Brook (Section C on Sheet 1 of Figure 7-4 and Photomontage 3 on Figure 7-10). The larger Sheering Road Roundabout would be at a similar level, slightly cut into the hillside south of TPO woodland area W1. The realigned Sheering Road would continue south from the roundabout to merge with Gilden Way, generally at existing ground level but slightly below existing grade on the southeast side near Mayfield Farm. A 1.7m high sheet pile retaining structure would be installed to resolve the level difference.

An earth mound would be constructed on open land enclosed between the existing and realigned Sheering Road avoiding further encroachment on existing mature trees (Section B on Sheet 1 of Figure 7-4). The mound would help to screen the roundabouts and traffic in views from properties and the realigned footpath on the old Sheering Road.

A drainage attenuation pond to be excavated near the Sheering Road Roundabout would enlarge the footprint of the scheme. Another drainage attenuation pond would be sited west of the M11 near the south bank of Pincey Brook.

Stream relocation

The unnamed watercourse 1 (a small stream that emerges from the north side of The Mores Wood) would be diverted and placed into culverts under the link roads. It would have a varied bank profile across the land between the roads. Emerging from the northern culvert the realigned stream would continue in a gentle curve to Pincey Brook, in contrast to the continuation of the existing course which is piped under the field. Even though there would be two culverts under the link roads, the realignment would result in a net landscape improvement for the stream. Measures would be specified to prevent silt or pollution from being transported along the stream from the construction works to Pincey Brook, or from spreading directly from the works into Pincey Brook (see Chapter 13 – Road Drainage and Water Environment for further details)

Construction compounds, haul routes and materials storage

Phasing and detailed proposals for construction are described in Chapter 2 Section 2.4 'Construction Strategy'. The proposed locations of construction compounds and storage areas are also shown on Figure 7-6 Visual Effects at Completion of Construction (Year 1). The Phase 1 Construction Compound on Gilden Way is proposed on the site of a former plant nursery belonging to Harlow Council with access off Gilden Way (Chainage 500 – 630). Separate haul routes are not proposed as construction traffic would use parts of the existing carriageway.

Construction compounds for Phase 2 works (which extend from Sheering Road at Mayfield Farm to the M11) are proposed in the arable field between The Mores Wood and the site for the new Sheering Road Roundabout; also in the land to be severed between the two carriageways of the link road. Another small compound is

proposed in arable land east of the M11. Soil storage areas are proposed in numerous locations either side of the route between Sheering Road and the M11 and to the east of the M11. Haul routes for construction traffic would skirt the edges of most of the earthworks, connecting the works, compounds and storage areas to the M11 and Gilden Way.

Construction effects on landscape and townscape character

Gilden Way

Widening works on Gilden Way would be concentrated on the existing busy arterial road through the edge of the town with a marginal loss of roadside vegetation and a locally slight effect on the townscape character of Harlow Core and Harlow Environs areas. The proposed construction compound would continue to be substantially screened by the existing trees that surround it. Disturbance caused by excavations for drainage attenuation would be local with Slight Adverse effect on the landscape character of the surroundings.

Works to erect noise barriers along Gilden Way would contribute to landscape disturbance from construction, but the effects of the barriers would mainly be felt at completion when they would enclose substantial portions of the road, visually separating it from landscape and properties on either side. These effects are addressed under Section 7.5.2 ‘Operational Effects’.

The effect of the portion of Gilden Way widening that falls within landscape character Area 15, Little Hallingbury Ridges and Slopes outside the developed area and subject to the planned Harlowbury development, would be locally Slight Adverse. The effect of the Phase 1 road widening works on these character areas as a whole would be Negligible.

Conservation Areas

Gilden Way does not pass through the Harlow Old Town or Churchgate Street Conservation Areas. Although the scheme works would come as close as three to five metres from them, these points are at boundary corners of the Conservation Areas in the back gardens of residential properties. The construction works would not impinge on publicly accessible locations in the Conservation Areas. Effects on residential properties within Conservation Areas would be limited to the felling of trees overhanging the road and replacement of existing boundary fences with noise barriers at two residential properties at Millhurst Mews within Churchgate Street Conservation Area. The trees and the boundary fences are outside the Conservation Area but the houses are within it. The scheme would have no physical effect on the Conservation Areas, and the limited visual effects at the properties (detailed below under visual effects) would not affect the townscape character of the Conservation Areas.

Phase 2 works in Pincey Brook valley

The Phase 2 construction works would transform the appearance of the Pincey Brook valley at the boundary between landscape character Area 15 Little Hallingbury Ridges and Slopes, and Area 19 Matching Plateau, both identified in the Harlow Area Landscape Character Assessment. Approximately 19ha of arable land between the M11 and Sheering Road would be disturbed. Most of the activity would be concentrated on higher slopes around The Mores Wood and away from Pincey Brook, but one of the larger soil storage areas would be 28m from the river at its nearest point. Spoil heaps and embankments under construction as well as construction vehicles would be prominent in this shallow relatively undisturbed valley. Landscape disturbance would include the excavation of two large drainage attenuation ponds. Tree felling in intermittent sections on the east side of Sheering Road, would break up the continuity of the tree belt and hedge that borders the farmland, eroding the local landscape pattern. Some of the existing mature trees in woodland near the M11 would be lost. Traffic on the M11 would be exposed to view with the removal of existing motorway trees to construct the new junction. The effect of scheme construction on the landscape character of Area 15 Little Hallingbury Ridges and Slopes would be locally large and for the area as a whole it would be Slight Adverse. For Area 19, Matching Plateau which includes the existing M11 and the site of proposed Junction 7A, the effect on landscape character would locally be Moderate Adverse and on the whole area it would be Negligible to Slight Adverse.

Summary

The magnitude of landscape impact of Phase 1 works to widen Gilden Way would be Minor and the significance of effect would be Slight Adverse. The magnitude of landscape impact of the Phase 2 works would be Major and the overall significance of effect would be Large Adverse.

7.5.1.2 Visual effects

The Schedule of Visual Effects in Appendix 7.2 provides details of effects on views from residential and commercial properties and PRoWs during construction. Sheets 1-5 of Figure 7-6 show the locations of the visual receptors. It should be noted that the visual effect symbols on this figure are not for the construction phase, but for the operational phase at completion of construction (Year 1). Although the word 'significance' is not used in the visual effects quoted below, each assessment level represents the significance of visual effect taking into account the magnitude of change to the view and the sensitivity of the receptor site. The magnitude of change to views is recorded on the Schedule of Visual Effects in Appendix 7.2. As with the assessment of landscape effects, the stated levels are Adverse unless stated as Neutral or Beneficial.

The proposed widening of Gilden Way would entail marginal losses of roadside trees and hedges and demolition and construction works for noise barriers. The works would affect views from several nearby residential properties. Thirteen properties have views that would be subject to Large Adverse visual effect, including 49 Mulberry Green (receptor R03), Long Barn Cottage and No. 8 Sheering Drive (R04), No.1 The Oxleys (R06A), Nos. 1-6 Gilden Close (R08), a two storey house at Mayfield Farm (R14) and Nos. 3 and 4 Millhurst Mews (R09). The two houses on Millhurst Mews are Grade II listed and within Churchgate Conservation Area. Although the scheme would not take land from these properties some of the existing trees in their gardens (but outside the Conservation Area) near the highway boundary would be felled and the existing close-board fence would be replaced with a 2m high timber noise barrier. Traffic on Gilden Way would be temporarily exposed to view at ground level. Visual effects at eleven properties would be Moderate Adverse, and at approximately 32 properties they would be Slight Adverse.

Loss of a stretch of boundary hedge and excavations for a drainage attenuation pond near Churchgate Roundabout would be visible from adjacent public playing fields with Moderate Adverse effect. Views from the playing field at Fawbert and Barnard Primary School at the London Road end of Gilden Way would be subject to Slight Adverse effect due to the loss of a short section of boundary hedge exposing more of the traffic (and construction works) to view.

Effects on views from public footpaths would generally be limited to the ends of the paths where they meet Gilden Way and the effects would be Slight Adverse. The construction compound on the site of a former plant nursery would be visible from Harlow public footpath 185-168 (P01), through a narrow strip of trees outside the fenced compound with Moderate Adverse effect. A few existing trees within the compound would be removed, and the compound would be filled with stored materials, vehicles, construction equipment, temporary offices, employee facilities and lighting. Views from a short section of public footpath 185-20 (P03) near Chainage 890 would be subject to Moderate Adverse effect due to excavation works for a drainage attenuation pond visible through trees.

The effect on the attractive middle distance view of the Pincey Brook valley from the rear of Nos. 1 and 2 Sheering Hall Cottages (R23, view 1) would be Large Adverse, with most of the construction works, compounds and storage areas openly visible on the opposite side of the valley. Oblique views toward the scheme from four other nearby properties (R22, R24) would be substantially screened by nearby vegetation limiting visual effects to Slight Adverse. Durrington Hall (R21, two storey + attic windows) is a Grade II* listed country house in parkland. It has several windows overlooking the valley partially screened by mature trees. The construction works would be visible between the trees with Moderate Adverse effect. The rural character of the view at this property and at Sheering Hall Cottages (R23) would be degraded permanently.

Construction would have mixed effects on views from residential properties along Sheering Road northwards from Mayfield Farm. Busy traffic would continue to run on Sheering Road close to the properties while the new realigned portion of the road would be under construction. Felling of trees on the opposite side of the road from the properties would take place early to allow construction. Seven houses at R13, R15 and R16 that front on to

the road already have close views of the traffic filtered by front garden vegetation. During construction the effect on their view would be moderate due to some tree clearance and construction of a greater width of road corridor with retaining structures and the excavation and construction of a realigned access to Mayfield Farm. Goldings (R17) is a one storey building with a garden wall that screens the traffic apart from high vehicles. The view over the wall would be subject to Slight Adverse effect due to clearance of mature trees opposite the property and probable visibility of some of the site traffic. The Red House (R17A) is another low building behind a wall with passing high vehicles visible from within (View 6). Trees opposite this property would be retained and the visual effect during construction would be Neutral.

Construction of the new turning to link the proposed realigned Sheering Road with the old Sheering Road for residential access would take place opposite Campions (R18) with the removal of a strip of trees. This is a large house divided into flats. Dense trees and a tall hedge in the front garden screen the existing road and all but fragmentary glimpses of the traffic. However, the loss of the trees on the opposite side of the road would affect the view from first floor windows, probably revealing aspects of the construction works. The effect on the view during construction would be Slight Adverse. Two nearby houses at R18A with high front walls but open/gated driveways facing the road would have slightly oblique views of construction works through the same gap created in the tree belt. The visual effect would be Large Adverse for these properties. The view from a small two-storey house facing Sheering Road at No.63 (R19, View 12) is dominated by busy traffic, and would continue to be affected during the construction phase. The road embankment and highway drainage would be designed in detail with measures to avoid encroachment on this property. Tree felling in the woodland across the road, as well as widening works, traffic management, signage, and works traffic would have a moderate effect on the view.

The construction works would affect views from other scattered properties including Sheering Hall (R25) a Grade II* listed property near the scheme surrounded by dense trees, Ridgedale and Pondfield (R26, R27) at the edge of Sheering at 1.5km distance, Aylmers (R20) opposite Durrington Hall, the Grade II listed Housham Hall (R28) screened by trees east of the M11 and four properties on Moor Hall Road (R29, R29A, R30, R31): Construction effects on the views from these properties range from Slight to Moderate Adverse and are detailed on the Schedule of Visual Effects in Appendix 7.2 .

Construction effects on views from four commercial properties would be as follows:

- C01 3 businesses at Mayfield: Large Adverse;
- C02 Gardencare tree services at Sheering Hall: Slight Adverse;
- C03 The Coffee Officina at Housham Hall: Moderate Adverse and
- C04 Morgans Farm Estate: Slight Adverse.

The Phase 2 works would dominate views from Sheering public footpath 204-17 (P07), which follows Pincey Brook before crossing the stream and climbing to a footbridge over the M11. Seen from the path west of Sheering Hall, the existing attractive view up the sloping field toward The Mores Wood (View 5) would be interrupted with soil storage heaps compound fencing, construction vehicles and the earthworks for the roads and roundabouts. The effect on the view would be Large Adverse. In the stretch of path east of Sheering Hall the effect would be Moderate Adverse and in the portion continuing further up toward the footbridge it would be Slight Adverse.

The Phase 2 works would affect distant views across the valley from the north, from Sheering public footpath 204-15 (P08) near the village, and from the northeast on Bridleway 2 off High Lane. The works for the slip roads, roundabouts and bridge at Junction 7A and the construction compounds and earthworks for the scheme would be visible near the horizon and the visual effect would be Slight Adverse.

Road users in high wheelbase cars, vans, lorries or buses on a stretch of Sheering Road (P11, P12) north of Pincey Brook have attractive views of the Pincey Brook valley over the roadside hedge (Views 3, 4). The construction works and compounds would be conspicuous on the opposite side of the valley with some screening provided by intervening trees and occasional roadside copses. The effects on the view would range from Slight to Moderate Adverse depending on distance and screening from the intervening trees.

7.5.2 Operational effects

7.5.2.1 Landscape effects

The effects of vegetation clearance would remain after completion of the construction works. Temporary compounds and haul routes would be removed and the land occupied would be restored to the former state. There would be no further encroachment on adjacent lands. The scheme effects on landform would reduce with the removal of the storage heaps. The proposed Gilden Way construction compound would see the least change, having been in use until recently as a plant nursery and fenced compound for Harlow Council. The effects of the indicative proposed noise barriers would be mainly visual and are included in the Schedule of Visual Effects in Appendix 7.2, but they are also discussed below under effects on landscape and townscape character.

Gilden Way would be one lane wider than existing, with new lighting and capacity to carry more traffic. For the urban section southwest of the Churchgate Roundabout, the new lighting would replace existing street lighting with little perceptible change, but northeast of the roundabout the lighting would add to intrusive effects of the Proposed Scheme. This effect from lighting would be mediated by the imminent construction of the adjacent Harlowbury housing development. The new streets in that development would be lit.

The effect of the Proposed Scheme would be greatest on the countryside of the Pincey Brook valley between the M11 and Sheering Road. The link roads and the traffic they carry would stand out on embankment and the new roundabouts would be prominent. The finished scheme would have a large footprint occupying approximately 13.3ha of farmland in this area, including 2.5ha isolated between the link roads. The proposed lighting on 10m high columns throughout most of the scheme would have an urbanising influence in an area with little lighting apart from the few lights at scattered properties. The breaks created in the continuity of the tree belt along Sheering Road near The Campions would slightly erode the pattern and quality of the landscape.

The course of the unnamed watercourse 1 would be improved from 204m of open channel to a total of 374m open channel; there would remain 74m of culverted channel spilt into two sections. The landscape setting of the stream would be improved over 134 metres (net).

The M11 junction would be sited on high ground such that the bridge and roundabouts would be slightly above existing grade and partially shielded by adjacent woodland. Loss of some of these trees to the junction would be perceptible but marginal in effect. Nevertheless, the proposed junction would be large and the proposed road lighting would be prominent in this area where the M11 is currently unlit.

Operational effects on landscape and townscape character

Effects on landscape character Area 20(b), Jack's Hatch to Church Langley Ridge and Slope, (south of Moor Hall Road) are discussed under the local character areas of Harlow Core and Harlow Environs.

The proposed noise barriers would erode the parkway character of Gilden Way by enclosing the road and visually separating extensive stretches of it from the townscape, woodlands and spaces on either side. This would be to the benefit of noise affected residents but detrimental to the streetscape and the character of the area as experienced by walkers, cyclists and drivers on Gilden Way. The character of the townscape along Gilden Way would be slightly altered due to the marginally greater width of the road and the separating effect of the noise barriers. The change would be most noticeable at the bus stops and pedestrian underpass near the Oxleys and Gilden Close. The public landscaped areas on either side would be retained and access to the bus stops via paths from the pedestrian underpass would continue, but the 2m and 2.5m high barriers would be visually intrusive. Transparent panels are proposed on the Oxleys side for visibility and to limit overshadowing but they could be vulnerable to vandalism and graffiti near the bus stops. Roadside vegetation lost along various sections would not yet be restored so that the noise barriers would appear bare and the road and its traffic would be slightly more exposed in the stretches without barriers.

Given that Gilden Way is already a busy arterial road, the magnitude of the change would be Moderate Adverse and the local effect on the character of the Harlow Core and Harlow Environs character areas would also be Moderate Adverse. There would be a Slight Adverse effect on the character of the (high sensitivity) Harlow Core

area taken as a whole. The effect on the whole Harlow Environs area (low sensitivity) would be Neutral. As set out under the Section 7.5.1 'Construction Effects', the Proposed Scheme at completion of construction would still not affect the character of the Harlow Old Town and Churchgate Street Conservation Areas.

The effects of the Proposed Scheme on vegetation, landform, landscape patterns and streams are detailed above. The Pincey Brook valley is in the Little Hallingbury Ridges and Slopes character area. At completion of construction and opening of the road to traffic, the link roads on the embankments and roundabouts with lighting and signage would dominate and have an urbanising effect on the character of the valley. The relative tranquillity of the valley away from the M11 would be noticeably reduced by the presence of traffic on the link roads and new roundabouts. The local effect on the character area would be Large Adverse but on the area as a whole the effect would be Slight Adverse.

The new M11 junction would increase the presence of the M11 on the Matching Plateau character area, especially at night and twilight due to the addition of lighting. Although the junction would be visible over a large distance from the north and east, its position near a copse of trees with the M11 in quite deep cutting would partially integrate it into the landscape. The realigned Sheering Road from Mayfield Farm north to the proposed Sheering Road Roundabout would also fall within the edge of the Matching Plateau. This portion of the scheme would constitute a small aspect of the Slight Adverse local effects on the Matching Plateau. However, the effect on the whole of the Matching Plateau area would be Neutral.

7.5.2.2 Visual effects

See Sheets 1-5 of Figure 7-6 and the Schedule of Visual Effects in Appendix 7.2. The operational visual effects have been assessed for winter in the first year after completion of construction (Year 1) before the bulk of the proposed landscape planting would have grown large enough to be effective. The ZTV on Figure 7-5 shows the extent of visibility of the Proposed Scheme and its traffic and lighting at completion of construction. The pale beige solid hatch represents the visibility of any part of the scheme including its traffic and lighting taking into account the topography of the land ignoring the screening effects of existing trees and buildings. As the proposed junction sits on relatively high ground the theoretical visibility extends more than 2km in most directions. The magenta hatch areas represent a landscape architect's assessment of the extent of significant visibility of the scheme including its traffic and lighting, taking into account local woods, hedges and buildings. This was drawn with reference to experience from site visits, site photos, digital satellite views, contour mapping, a model of existing trees and hedges in the area, buildings and structures on the base plan, and the engineering model of the Proposed Scheme. The zone of significant visibility is much smaller, especially within the developed areas of Harlow, but still covers most of the Pincey Brook valley.

Photomontages 1 to 5 on Figures 7-8 to 7-12 provide indicative illustrations of the effect of the scheme on key views. The viewpoints for the photomontages are shown on the Visual Effects Figures 7-6 and 7-7.

At completion of construction the visual effects at the southwest end of Gilden Way would be similar to the effects during construction; Slight or Moderate Adverse for most properties, due to the slightly wider road, the noise barriers and marginal losses of roadside vegetation. A 2m high brick noise barrier with entrance gates would be built along the front boundary of the house at No.49 Mulberry Green (R03) near the junction with Gilden Way. This is an attractive locally listed building of Edwardian appearance (formerly a magistrates courthouse). It is built of red/purple brick with ochre brick detailing and tall decorative chimneys. Currently the building is fronted with a low brick wall and privet hedge with small pillars at two entrances. The proposed brick wall barrier would screen Gilden Way traffic but would enclose the front garden and obscure views of the house from the street. The wall and gates would be designed and detailed with respect for the aesthetic quality of the building, using similar brick colours and detailing. The Year 1 effect on views at the property has been assessed as Moderate Adverse.

Views from Longbarn Cottage (View 18) and the Grade II listed No.8 Sheering Drive (R04) would be subject to Moderate Adverse effect due to removal of vegetation on the boundary to install a 2.5m high absorptive noise barrier. Visual effects due to the proposed noise barriers and losses of amenity planting partially screening the road from houses at the Oxleys (R06, 06A, 07 and 07A, PM1) would vary from Slight to Moderate Adverse. The visual effect would be Large Adverse for residents of six terrace houses at Gilden Close (R08) due to removal of the existing dense roadside hedge and its replacement with a 2.5m absorptive noise barrier slightly closer than

the hedge was. Flowering cherry trees in the grass area in front of these properties would be lost to install highway drainage pipes. Upper floor windows of Nos. 1 to 4 Millhurst Mews (R09 and 9A, View 15) in Churchgate Street Conservation Area would overlook Gilden Way with the trees near the highway boundary removed and the boundary fence replaced with a new 2m high timber barrier. The effect on these views before establishment of proposed landscape mitigation has been assessed as Moderate Adverse for numbers 3 and 4, and Slight Adverse for numbers 1 and 2. Effects at Walnut Cottage (R10) and No. 25 Sheering Road (R10A) would be Moderate Adverse due to felling of trees on the boundary with Gilden Way, and replacement of existing fences with a 2m high timber noise barrier on the highway boundary.

The visual effect for the resident of the house at Mayfield Farm (R14, View 9) would be Large Adverse due to encroachment of the scheme at the entrance to the property, as well as loss of existing vegetation screening the road and intrusion from new road lighting. Effects on views from Campions Lodge (R15) and Nos.133 and 135 Sheering Road (R18A) would be Moderate Adverse due to losses of mature trees along Sheering Road exposing traffic on the realigned road with road lighting. A 2m high timber noise barrier would provide partial screening in the view from Campions Lodge. Views from The Red House (R17A, View 6) would be slightly improved by relocating the traffic to the realigned route, passing behind a dense belt of retained trees. The visual effect for that property would be Slight Beneficial.

The house at 163 Sheering Road with a small front garden has a close view of traffic on the existing road (View 12). The new road would be slightly higher than existing and would move slightly further from the property to avoid encroachment on it. A large strip of the opposite woodland would be felled and the proposed Sheering Road Roundabout with 10m light columns would be visible nearby, framed by remaining trees along Sheering Road with a Moderate Adverse visual effect.

The route and the road lighting would be visible across the valley from south facing windows at Durrington Hall (R21) with partial screening by landform and trees in the foreground. The visual effect at completion of construction would be Moderate Adverse. The effect at the two Sheering Hall Cottages would remain Large Adverse with the route, traffic and lighting intrusively visible across the valley (PM5). The effect on views from Moor Hall Lodge (R30), Morgans Farmhouse (R31) and the bungalow at R29A, all accessed from Moor Hall Road, would be Moderate Adverse. Slight Adverse effects during construction at other scattered properties would remain Slight Adverse at completion. The operational effects for the four commercial properties (C01-C04) would be similar to the effect during construction except for the businesses at Mayfield Farm where the visual effect would reduce from Large Adverse during construction to Moderate Adverse at completion of construction.

The completed highway, with its traffic, road lighting and roundabouts would dominate views from Sheering public footpath 204-17 (P07) with a Large Adverse effect for most of the path along Pincey Brook east of Sheering Road (View 5, PM2, PM3, PM4). The effect on views from (Sheering footpath 204-30 (P06)) and isolated sections of paths and a bridleway east of the M11 would be Slight Adverse.

The effect on views from Sheering Road north of Pincey Brook (P11, P12 – Views 3, 4) would be improved with removal of the construction and storage compounds, but the new road, traffic and road lighting would be conspicuously visible. Visual effects would remain in a range from Slight to Moderate Adverse depending on distance and intervening trees.

7.6 Proposed Mitigation

7.6.1 Construction mitigation

The landscape mitigation proposals are shown on Figure 7-3 Sheets 1-7. Mitigation measures to be installed as part of construction would include landscape mounds between the existing and realigned Sheering Road/Gilden Way northeast of Mayfield Farm. These would be built with gentle slopes to a height of approximately 1m-1.5m above existing grade without encroaching on the remaining woodland to be preserved along Sheering Road. The proposed retaining structure at Mayfield Farm would be faced with brick in a red/orange colour matching as closely as possible to the colour and texture of the brick wall on the road boundary of residential properties at No.129 Sheering Road, and Eaves, Goldings and The Red House on Sheering Road. A new 2m high noise barrier with climbing plants and support wires would be installed to provide some separation in the narrow strip

between the realigned Sheering Road/Gilden Way and the adjacent residential access drive. Proposed noise barriers along Gilden Way would provide traffic screening for local residents but they would have the disadvantage already described of separating substantial parts of the road from its attractive woodland and parkland setting.

The footways along Gilden Way would be retained but reconstructed and widened to 2.5m accommodating cyclists and new footway surfacing would be added on parts of the realigned public footpaths. A 3m high noise barrier proposed to be installed along that boundary would over shadow the path. However, this is indicative at this stage and would liable to change. For public safety, the existing northward diversion of the Gilden Way footway running behind trees along the boundary with the allotment gardens at Chippingfield would be moved forward to the road side. The old path would be removed and replaced with infill woodland planting.

Proposed drainage attenuation ponds would be constructed with banks and margins of natural appearance where practicable. Excess excavated material would either be removed and integrated into other landscape areas of the site with a topsoil layer above, or spread to a natural profile with a topsoil layer above in adjacent areas avoiding root zones of existing trees. Waterproof linings to the attenuation ponds would be concealed under soil, grass and marginal/aquatic planting.

The interface between the existing M11 cutting slope and the earthworks of the new slip roads would be rounded to a smooth profile.

7.6.2 Mitigation planting

See Figure 7-3 Sheets 1-7, and Landscape Sections on Figure 7-4 Sheets 1-4. Woodland planting and tree and shrub belts would generally consist of native species found in the area, This general rule would be varied in the urban section where there is already a broad mix of native and foreign species and horticultural hybrids. For instance it could be desirable in a residential context to replace hybrid flowering cherries with new hybrid flowering cherries rather than with native trees, and a resident might wish to see a beech hedge rather than a mix of native hedgerow species.

Similarly, in the rural section once part of the Moor Hall estate the majority of new species would be native but slightly more varied than would normally occur, with a greater proportion of slightly less common species. Rural plots could include a proportion of Large Leaf Lime instead of Ash which cannot be planted due to Ash Die-back disease. New rural hedges would consist of Hawthorn with a mixed proportion of other native hedgerow species.

The majority of the woodland trees, shrubs and hedges would be planted as two year transplants with a small proportion planted at larger sizes, such as Feathered or Standards for early visual effect. Trees planted in hedges would be Standard size and individual trees in grassland would be Extra Heavy Standard or Semi-Mature size.

The bulk of the proposed landscape planting would be carried out towards the end of construction. New roadside planting would replace some of the vegetation lost along parts of Gilden Way. It would be planted either as woodland or with semi-mature large trees where space and existing services permit, or as hedges. Hedges would be planted in front of noise barriers where there would be sufficient space. Where there would be no space for hedges, wires would be installed on the noise barriers to support climbing plants. Amenity planting lost on either side of Gilden Way behind the proposed noise barriers near the Oxleys and Gilden Close would be restored with trees, shrubs, hedging, groundcover planting and grass (Section AA on Sheet 1 of Figure 7-4). The verge adjacent to the future Harlowbury housing development is currently proposed as a native hedgerow with trees in front of 2.5m high absorptive noise barriers on the highway boundary, but the exact detail of the landscape treatment there would be agreed with the developer. The development plans include extensive tree and shrub planting and a serpentine path along the Gilden Way frontage.

The new mounds between the realigned and existing Sheering Roads would be densely planted with woodland to reinforce the existing belt of trees in that area (Section BB on Sheet 1 of Figure 7-4). Individual large trees would also be planted there. An informal row of individual trees would be planted along a wide landscape verge

on the east side of the realigned Gilden Way/Sheering Road north and south of Mayfield Farm with a native species hedge on the new boundary.

The Sheering Road and Pincey Brook Roundabouts would be enclosed/screened with dense deciduous woodland. The middle of the Sheering Road Roundabout would be planted with informal groups of Extra Heavy Standard trees in species-rich grassland; conversely, a circular strip of native shrubs enclosing species rich grassland would be planted in the middle of Pincey Brook Roundabout (Section CC on Sheet 1 of Figure 7-4).

Excavation of the proposed drainage attenuation pond north of Sheering Road Roundabout would remove a 65m portion of an existing hedgerow extending between the small wood near Sheering Road (south of Pincey Brook) and the scrub lined stream emerging from The Mores Wood. Three mature oaks and a field maple currently growing in this hedge would survive in the isolated portion of hedge. A new hedgerow with trees would be planted to enclose the attenuation pond and restore the continuity between the wood and the remainder of the hedge and mature trees. The hedge would also be extended slightly eastwards with further planting to reach the realigned course of the stream.

The south facing embankment of the Westbound Link Road would be sown as species-rich grassland including valued locally rare plant lost from the Churchgate Roundabout site (Betony). It would include informal groups of Extra Heavy Standard trees planted at the top of the embankment for partial screening. The middle and lower slopes would remain as open habitat for reptiles.

A copse of trees and shrubs would be planted on the embankment of the Westbound Link Road near The Mores Wood and the realigned stream. In addition, a hedge and a row of Extra Heavy Standard trees would be planted along the crest of the embankment in the same area. Similar planting would be carried out on the opposite north verge and on both sides of the Eastbound Link Road where it would cross the realigned stream. The purpose would be to protect bats that fly and feed on insects above and along streams, and deflect their flight paths above the traffic. In addition, 5m high hop-over fences (created for bats and birds) would be installed at the back of verge. After ten years of growth the trees would be sufficiently high and dense to obscure the hop-over fence.

The northern embankment slope of the Eastbound Link Road would be densely planted with belts of woodland to screen traffic in views from the nearby footpath 204-17 and in longer distance views across the valley (Section DD on Sheet 2 of Figure 7-4). For variety, two oblique gaps in the tree belt would provide views of the adjacent field for eastbound drivers with minimal exposure of the traffic in views from the path and other views from the north and northeast.

A native hedge would be planted in a curving line, wandering through areas of scattered scrub and species rich grassland between the two link roads (Section CC on Sheet 1 of Figure 7-4). West of the realigned stream and near the roundabouts the hedging would appear as scattered fragments in an apparently random array. Initially, the land between the link roads would have an open character with partial screening from scrub and hedges, but with time the disparate fragments of hedge and scrub would begin to grow together as scrub woodland with clearings. Small clumps of native shrubs would be planted at points along the realigned stream along with aquatic and marginal herbaceous planting. Proposed attenuation ponds would be designed to retain at least a small amount of standing water year-round and would be planted with aquatic and marginal plants.

The Dumbell Roundabouts of the M11 junction would be surrounded with densely planted trees and shrubs. The planting around the Western Dumbell Roundabout would adjoin the remaining portions of TPO protected woodland W5 with a belt of new woodland restoring the link between two copses. A 10m wide belt of trees and shrubs would be planted to screen the western slip road and M11 north of the bridge in views from footpath 204-17 and from Sheering Hall. A pocket of woodland extending to an existing hedge would be planted east of the Eastern Dumbell Roundabout. Trees and shrubs in the M11 cutting felled to construct the slip roads would be replaced with woodland between the M11 and the slip roads (Section E on Sheet 2 of Figure 7-4). Cutting slopes outside the slip roads south of the proposed bridge would be planted with scattered scrub in species rich grassland. Hedges would be planted on the boundaries along the eastern and southwestern slip roads, linking with existing vegetation north and south of the junction.

Most of the existing trees and shrubs on the embankment slope of the M11 south bound off-slip north of the accommodation underpass would be retained, but a narrow strip of vegetation would be lost to construct a sheet pile retaining structure (height up to 1.5m). Ivy would be planted along the base of the structure to grow up it and soften its appearance, and additional tree and shrub planting would be carried out to infill gaps in the existing screen of trees and shrubs. There would be no room for planting at the top of the structure.

Table 7.4 in the Construction Effects section records the total probable loss of vegetation canopy as 3.66ha. The approximate area totals of proposed landscape planting are set out on Table 7.5 below.

Table 7.5: Areas of proposed planting: woodland; hedges; shrubs; amenity planting; scrub and individual trees

Planting types	Hectares
Native woodland planting: 90% transplants at average 2m spacing with 10% Feathered size plants	16.72
Native hedge planting: double staggered line of transplants (5 plants per linear metre), 4411 linear metres with average 2.5m canopy width when grown = 11,027m^2	1.10
Native shrub planting: transplants at average 1.5m spacing	1.01
Amenity shrub and groundcover (dense planting)	0.94
TOTAL PLANTATION AREAS	**19.77**
PLUS	
Proposed areas of scattered native scrub planting (clumps of scrub transplants in open grassland (including the grass areas) 1.83ha X 0.25 to get approximate planted area	0.46
361 Individual trees	N/A

7.7 Residual Effects

7.7.1 Landscape effects

After 10 to 15 years of growth the proposed infill and replacement planting would restore some of the lost vegetation along Gilden Way and screen and soften the appearance of the noise barriers such that the effects on the character areas of Harlow Core and Harlow Environs would be reduced to Slight Adverse. This takes into account the completion (by then) of the Harlowbury housing development, and in that expanded urban context, the insignificant effects on landscape character of proposed lighting on Gilden Way northeast of Churchgate Roundabout.

Proposed woodland planting and individual trees between the existing and realigned Sheering Roads would partially repair the continuity of the tree belt along Sheering Road and with time offset the losses of TPO protected trees. The existing Sheering Road between Mayfield Farm and Pincey Brook would become a leafy backwater linking public footpaths in the area and used by occasional residential traffic to the benefit of local residents who would no longer have heavy traffic passing close to their properties.

Proposed woodland, individual tree planting and hedges would soften the profile of the road embankments on the slope of the Pincey Brook valley and visually integrate the scheme with mature woodland at The Mores Wood. Belts of trees planted around the Sheering Road and Pincey Brook Roundabouts near Sheering Road and the Dumbell Roundabouts at the M11 Junction would screen the traffic and link with nearby existing woods. Nevertheless, the landscape pattern of the valley would be altered by the road even when disguised by trees (PM5), and the road lighting would continue to be visible across the valley at night and twilight maintaining an urbanising effect on the character of the valley.

Planting around the M11 Junction and slip roads would restore the M11 roadside vegetation across the Pincey Brook Valley but the proposed road lighting on the slip roads and at the roundabouts would be visible above the screen planting for many years.

The local effect on the Little Hallingbury Ridges and Slopes character area would be reduced from Large Adverse at completion of construction to Moderate Adverse 15 years after completion, and the effect on the character area as a whole would be Slight Adverse. The Slight Adverse local effect of the Proposed Scheme on the character of the Matching Plateau area would remain Slight Adverse taking into account the growth of the proposed landscape mitigation. The effect on the whole of the character area would be Negligible.

7.7.2 Visual effects

Residual visual effects are normally assessed for a point 15 years after completion of construction, giving time for proposed screen planting to grow and become effective. This is referred to as Year 15 for simplicity and the year of completion of construction is referred to as Year 1.

Proposed reinstatement of roadside hedges and other planting to screen traffic and noise barriers along Gilden Way would mitigate the visual effects of the scheme (PM1). Notwithstanding the proposed transparent panels in the barrier on the northwest side near the Oxleys, the barriers in this area would remain intrusive and vulnerable to vandalism. The Year 15 effect on the view from a locally listed house at 49 Mulberry Green (R03) has been assessed as Moderate Adverse but could be less, depending on the sensitivity of the design, construction detailing and workmanship of the proposed brick wall noise barrier. No residential properties would have views subject to a Large Adverse effect in Year 15. Moderate Adverse effects would remain at four properties along Gilden Way, due to felling of trees near the road exposing the traffic and noise barriers to view. Off-site tree planting could be offered to the owners of several properties where space is lacking for replacement screen planting on highway land. Off-site planting cannot be counted in a landscape and visual assessment but it could help to off-set the loss of the trees on the boundaries of those properties. Views from 36 residential properties in Harlow would remain subject to Slight Adverse effects by Year 15.

The proposed noise barrier and planting at the entrance to Mayfield Farm and along Gilden Way would provide partial screening in the view from the house and garden (R14) reducing the Large Adverse visual effect at Year 1 to Moderate Adverse by year 15. Proposed mitigation would help lessen effects on views from nine other homes along Gilden Way/Sheering Road near Mayfield Farm (R12, R13, R15 and R16) but the Slight Adverse effect assessed at Year 1 (for all except R15) would remain Slight Adverse at Year 15 mainly due to the proposed road lighting. Visual effects would be Slight Beneficial at Goldings (R17), The Red House (R17A) and the flats at Campions (R18) with the downgrading of the existing Sheering Road to a residential access lane and the proposed woodland planting between the new and old roads. Moderate Adverse Year 1 effects at R18A and R19 (three properties facing Sheering Road) would be reduced to Slight Adverse by Year 15.

Belts of trees planted to screen the link road and roundabouts in the Pincey Brook valley would reduce effects on views from Nos 1 and 2 Sheering Cottages from Large Adverse at Year 1 to Moderate Adverse by Year 15. Visual effects at Durrington Hall would reduce from Moderate Adverse to Slight Adverse by Year 15. The effect on the view from Morgans Farmhouse (R31) off Moor Hall Road would remain Moderate Adverse due to the visibility of the road lighting and because this large two storey house overlooks the valley. Slight Adverse effects in Year 1 at other scattered properties would remain Slight Adverse in Year 15 mainly due to the proposed road lighting.

For Sheering footpath 204-17 along Pincey Brook, the length with views that would be subject to Large Adverse visual effect would be reduced, changing to Moderate Adverse in Year 15 due to the screening and softening provided by proposed woodland planting (PM2, 3, 4). Much of the length subject to a Moderate Adverse effect in Year 1 would change to Slight Adverse in Year 15, and more distant sections assessed with Slight Adverse visual effects for Year 1 would be Neutral in Year 15 due to distance and proposed screen planting. The slight adverse effect for Sheering path 204-30 near Mayfield Farm would remain Slight Adverse due to the proposed road lighting.

Screen planting along the Proposed Scheme would mitigate the visual effects for road users on Sheering Road (P11 and P12) north of Pincey Brook. The road embankments and traffic on the link road and roundabouts would be screened from view, but road lighting would remain visible at night. Year 1 Moderate Adverse effects would reduce to Slight Adverse and the extent of Slight Adverse effects would be reduced by Year 15.

7.8 Summary and Conclusions

7.8.1 Landscape effects

The description of effects, mitigation and residual effects for landscape are summarised in Table 7.6 below

Table 7.6: Summary of landscape effects

Description of effect	Significance of effect (prior to mitigation)	Proposed mitigation	Residual effect (after mitigation)
Loss of mature woodland protected by Tree Preservation Orders (TPOs) (0.43ha).	Moderate Adverse	Proposed woodland planting totalling over 16ha. Woodland planting could not fully mitigate for the loss of mature trees.	Moderate Adverse
Loss of semi-mature woodland and scrub along the M11 (1.62ha).	Slight Adverse	Proposed replacement woodland planting.	Neutral
Loss of other woodland/hedges and scrub (1.50ha), some of which includes mature trees.	Moderate Adverse	Proposed woodland hedge and other native planting totalling over 19ha, (including the 16ha of woodland planting noted above) plus planting areas of scattered scrub and 361 individual trees at larger size. Woodland planting could not fully mitigate for the loss of mature trees.	Slight Adverse
Effect of proposed lighting in Harlow area, taking into account existing street lighting and lighting in the Hallingbury development about to be constructed.	Neutral	Proposed planting would not mitigate for new lighting. The new LED lighting would have full cut-off lanterns focused on the road and limiting light spill to adjacent properties.	Neutral
Effects of Proposed Scheme earthworks on landform in the Pincey Brook valley.	Moderate Adverse	Proposed earth mounding would not mitigate effects on landform but landscape planting would soften and disguise the embankments and cuttings.	Moderate Adverse
Effect of proposed road lighting in the Pincey Brook valley.	Moderate Adverse	Proposed planting would not mitigate the effect of road lighting The new LED lighting would have full cut-off lanterns focused on the road and limiting light spill to adjacent properties.	Moderate Adverse
Reduction of tranquillity (mainly in the Pincey Brook valley) taking into account existing disturbance from the M11.	Moderate Adverse	Extensive screen planting with woodland, hedges, scrub and planting of many individual trees.	Slight Adverse.
Effect on the townscape character of the Harlow Core local character area due to	Moderate Adverse (local)	Replacement hedge and tree planting, hedges and climbing plants to screen noise barriers,	Slight Adverse (local)

Description of effect	Significance of effect (prior to mitigation)	Proposed mitigation	Residual effect (after mitigation)
vegetation losses and the visual severance effect of road widening and noise barriers.		and amenity planting.	
Effect on the townscape character of the Harlow Environs local character area due to vegetation losses and the visual severance effect of road widening and noise barriers.	Moderate Adverse (local)	Replacement hedge and tree planting, hedges and climbing plants to screen noise barriers, and amenity planting.	Slight Adverse (local)
Effect on the landscape character of the Little Hallingbury Ridges and Slopes area in the Pincey Brook valley due to encroachment of roads, roundabouts, lighting and traffic into the Pincey Brook valley.	Large Adverse (local)	Earth mounding, extensive screen planting with woodland, hedges, scrub and planting of many individual trees.	Moderate Adverse (local)
Effect on the landscape character of the Matching Plateau area taking into account the proposed M11 junction and road lighting.	Slight Adverse (local)	Earth mounding, extensive screen planting with woodland, hedges and scrub.	Negligible (local)
The effect of the scheme as a whole on the landscape.	Large Adverse	Extensive screen planting with woodland, hedges, scrub and planting of many individual trees.	Moderate Adverse

7.8.2 Visual effects

Effects on views are summarised in the following Table 7.7, recording the numbers of receptors with views affected by different levels of effect at completion of construction (Year 1 in winter), and 15 years later (Year 15 in summer) taking into account the establishment and growth of the proposed landscape planting. For PRoW, where a range of visual effects has been anticipated for one receptor (on the Visual Effects Schedule in Appendix 7.2 and in the visual effects Figures 7-6 and 7-7), this schedule records the worst case effect for that receptor and does not record the lesser effects.

Table 7.7: Summary of Visual Effects

Receptor type	Sensitivity	Numbers of receptors with views affected									
		Significance of visual effect Year 1 (winter)					Significance of visual effect Year 15 (summer)				
		Slight Beneficial	Neutral	Slight Adverse	Moderate Adverse	Large Adverse	Slight Beneficial	Neutral	Slight Adverse	Moderate Adverse	Large Adverse
Residential	High	1	0	76	23	9	9	20	73	9	0
Commercial	Low	0	0	2	4	0	0	2	4	0	0
Public Rights of Way	High	0	0	13	0	1	0	4	9	0	1
Sheering Road north of Pincey Brook	Moderate	0	0	0	1	0	0	0	1	0	0
Playing Fields	Moderate	0	0	1	1	0	0	1	1	0	0

8. Nature Conservation

8.1 Introduction

The Proposed Scheme has the potential to impact upon important ecological receptors such as protected habitats and species. It should be noted that in this assessment the term “ecological receptor” is used in preference to “ecological feature” as is used in the Chartered Institute of Ecology and Environmental Management (CIEEM) guidelines. This is to provide consistency in terminology between different discipline chapters within the Environmental Statement. This chapter assesses whether or not potential impacts upon receptors are likely to lead to significant effects. Where an effect is assessed as being significant, mitigation measures are presented in the assessment to reduce such effects as far as practicable.

Additional information to support this chapter is presented in the following appendices:

- Appendix 8.1: Legislative Compliance Report;
- Appendix 8.2: Technical Report: Breeding Bird Survey;
- Appendix 8.3: Technical Report: Bat Survey;
- Appendix 8.4: Technical Report: Dormouse Survey;
- Appendix 8.5: Technical Report: Riparian Mammal Survey;
- Appendix 8.6: Technical Report: Great Crested Newt Survey;
- Appendix 8.7: Technical Report: Reptile Survey;
- Appendix 8.8: Technical Report: Badger Survey;
- Appendix 8.9: Technical Report: Phase 1 Habitat Survey; and
- Appendix 8.10: Technical Report: Gilden Way Roundabout Botanical Survey.

8.1.1 Receptors considered within the assessment

Surveys to inform the EIA have been focussed on:

- receptors that were assessed as being of at least local nature conservation value based on pre-existing information; or
- receptors for which information was required to ensure compliance with protected species legislation.

Surveys to establish the baseline commenced in 2013 prior to the formal consultation exercise (in January, 2016) and considered the following receptors:

- European protected sites (Natura 2000 sites), National Nature Reserves (NNRs), Local Nature Reserves (LNRs), Sites of Special Scientific Interest (SSSI) and Ancient and Semi-Natural Woodland within 2km;
- locally designated wildlife sites, such as Lower Wildlife Site (LWS) (County level designation) and Protected Wildlife Verges (PWV) (Harlow Town designation) within 1km;
- habitats within the study area; and
- protected and notable species within the study area.

During the Phase 1 Habitat Surveys of the study area, no habitats considered to be important in their own right (i.e. by virtue of being protected by legislation or policy, or being of conservation concern) were recorded. Hence habitats within the Proposed Scheme study area were scoped out of the assessment, with the focus directed on protected species. One locally designated site, Gilden Way PWV, would be directly affected by the Proposed Scheme. Consequently, this site (a roundabout) was subject to a targeted botanical survey, and is considered within this assessment.

Additional work was requested by the Environment Agency (EA), Natural England (NE) and ECC through their responses to the formal consultation exercise and, where appropriate, further surveys to establish protected species presence/likely absence has been included in the assessment. Additional information regarding legislative compliance and technical ecological reports is contained in Appendices 8.1 to 8.10 within Volume C.

8.1.2 Legislative and planning context

The following legislation and national policy are relevant to the Proposed Scheme:

- Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (Habitats Directive);
- Directive 2009/147/EC on the Conservation of Wild Birds (Birds Directive);
- the Conservation of Habitats and Species Regulations 2010 (as amended);
- the Wildlife and Countryside Act, 1981 (as amended);
- the Protection of Badgers Act, 1992;
- the Hedgerows Regulations, 1997;
- the Countryside and Rights of Way Act, 2000;
- the Natural Environment and Rural Communities Act, 2006; and
- National Planning Policy Framework, 2012.

This chapter focusses on how the Proposed Scheme could impact upon the nature conservation status of relevant habitats and species. Additional detail concerning the actions required to facilitate legislative compliance in relation to species protected under the Wildlife and Countryside Act 1981 (as amended), the Conservation of Habitats and Species Regulations 2010 (as amended) and the Protection of Badgers Act 1992 is provided in Appendix 8.1.

The following local plans are relevant to the Proposed Scheme:

- adopted Harlow Local Plan, Harlow Council (2006), particularly policies NE11 (protection of trees and hedgerows of wildlife importance), NE15 (protection of UK and Local Biodiversity Action Plan (BAP) species), NE18 (protection of LWS, including NE18/21 Gilden Way Meadow LWS) and NE19 (protection of PWV, including NE19/6 Gilden Way Roundabout PWV); and
- emerging strategy and options for the Harlow Local Development Plan, Harlow Council (2014).

In addition, in 2011 the European Community adopted the Biodiversity Strategy, aimed at halting biodiversity loss by 2020. The main targets include the protection of species and habitats, maintenance and restoration of ecosystems and the prevention of biodiversity loss.

The Essex Local BAP 2010-2020 provides useful information on species and habitats considered to be a priority for conservation at the county level. The Essex Local BAP takes a habitat based approach, containing Action Plans for the following habitats which are considered to be a conservation priority at the local level, and are of relevance to the Proposed Scheme; hedgerows, lowland meadows and ponds.

The Proposed Scheme affects areas of HE land such as lengths of the M11 embankments. Highways England has a Biodiversity Plan which sets out a strategy to halt biodiversity loss by 2020 and to implement biodiversity gain by 2040. There is currently no HE BAP with specific targets for specific habitat types or species.

8.1.3 Study areas

The 2013/ 2014 study area was centred on the parcel of land between Sheering Road and the M11 motorway, referred to herein as “the Link Area”. The Link Area originally covered a sufficiently large area to accommodate all potential routes under consideration at that time. As the Proposed Scheme evolved during 2015, the route became fixed and consequently the study area contracted. Therefore, during the design and programming of the 2015 ecological surveys, some habitats lying beyond the 2015 study area have been scoped out.

Towards the end of 2015, the Gilden Way widening proposals emerged and thus there was a requirement to undertake further ecological surveys in this area. This area is referred to herein as “the Gilden Way”.

Due to the varied behaviours and sensitivities of the ecological receptors potentially affected by the Proposed Scheme, a number of study areas were adopted specific to certain receptors. Due to the urbanised surroundings of Gilden Way, and the limited scale of work proposed, a smaller buffer for bat roost surveys was adopted, in comparison to that for the Link Area (see below). The buffers considered for each of the ecological receptors are described below:

- 30km buffer from the Proposed Scheme for Special Areas of Conservation (SACs) designated specifically for bats;
- protected wetland sites directly connected hydrologically to and downstream from the Proposed Scheme regardless of distance;
- 2km buffer from the Proposed Scheme for all other European protected sites, RAMSAR sites, NNRs, LNRs, SSSIs and Ancient and Semi-Natural Woodland;
- 1km buffer from the Proposed Scheme for locally designated sites (LWSs and PWVs) and protected species records;
- 500m buffer from the Proposed Scheme for waterbodies with potential to support Great Crested Newt (GCN) (*Triturus cristatus)*;
- 500m buffer from the Proposed Scheme for habitats with potential to support dormice (*Muscardinus avellanarius*);
- 250m buffer from the Proposed Scheme for watercourses with potential to support otter (*Lutra lutra)* and water vole (*Arvicola amphibious)*;
- 50m buffer from the Proposed Scheme for badger (*Meles meles)* setts;
- 100m buffer from the Link Area study area for potential bat roosts and 10m buffer from the Gilden Way study area; and
- within the Proposed Scheme/development footprint for all receptors including breeding birds and reptiles.

8.2 Assumptions and Limitations

The collation of baseline data, upon which this assessment was based, was subject to the following limitations:

- Access – it was not possible to access some parts of the study area because permission could not be obtained from the landowner, or it was not safe to do so, or due to the presence of impenetrable vegetation. Where possible, data relating to inaccessible areas have been gathered from other sources (i.e. desk based studies) and there has been no significant constraint on the quality of the assessment.
- Weather – despite checking forecasts, the occasional survey was constrained by sub-optimal weather conditions. However, it was possible to reschedule most surveys and no significant constraint on the quality of the assessment is considered likely to have arisen.

It is considered that, although there are minor limitations to some baseline data sets, this has not constrained the quality of the assessment. Specific limitations concerning access, weather and timing of surveys are presented in the Appendices containing the baseline Technical Reports.

The assessment was constrained by the absence of detailed noise assessments for the Proposed Scheme, which were not available at the time of writing this chapter.

8.3 Methodology and Assessment Criteria

8.3.1 Scoping and consultation

A formal consultation exercise was undertaken in January 2016, setting out the scope of the assessment for the Proposed Scheme. A formal Scoping Opinion document was returned, containing ecological comments from the EA, NE and ECC. No feedback was received from Harlow Council or Epping Forest District Council.

The EA (through comments contained within the Scoping Opinion) requested the following:

- survey of additional watercourses for riparian mammals;
- consideration of the inclusion of an 8m buffer around all surface water receptors, to be included as a receptor within the assessment; and
- targeted survey of invasive species along watercourses.

Natural England requested that a Habitats Regulation Assessment (HRA) be undertaken to assess the potential for increased traffic leading to increased NO_x deposition and acidification on the Epping Forest SAC. The Screening Exercise is presented separately. The Air Quality chapter concluded that there were unlikely to be any significant effects upon the Epping Forest SAC and it was not considered necessary to undertake an Appropriate Assessment.

Essex County Council requested that the Essex Biodiversity Validation Checklist be completed. The checklist will be submitted separately at the time of the planning application.

Essex County Council also requested that the assessment should include protected sites downstream of the Proposed Scheme beyond 2km from the Proposed Scheme boundary, such as the Lee Valley Special Protection Area (SPA) (located 8.1km from the scheme). Effects on downstream receptors more than 2km from the Proposed Scheme boundary were scoped out, as it was considered that best practice construction practices and appropriate standard mitigations, especially regarding sediment and water quality treatment designed into the Proposed Scheme as embedded mitigation, would be sufficient to prevent impacts on any such receptors. Furthermore, Chapter 13 - Road Drainage and Water Environment presents the results of the Highways Agency Water Risk Assessment Tool (HAWRAT) assessment, which assesses highway drainage water discharges. The Proposed Scheme passes for HAWRAT, with mitigation measures, and would not have a significant effect upon water quality at the point of discharge. Therefore, the Proposed Scheme would not have a significant effect on the Lee Valley SPA, which is many kilometres downstream.

8.3.2 Baseline data gathering methods

The starting point for any assessment of impacts is to determine which receptors should be included. This selection process is achieved in conjunction with the scoping exercise. Ecological receptors selected for detailed assessment should be:

a) of sufficient importance that impacts upon them could be significant; and

b) potentially vulnerable to significant impacts arising from the development (CIEEM, 2006).

This approach is consistent with EIA Regulations and the NPPF (2012) which only require investigation of impacts likely to have significant effects.

Baseline data were gathered through the following studies:

- desk study - including record requests submitted to local data repositories and searches of readily available web-based data;
- field study - including Phase 1 habitat survey, hedgerow survey, and surveys for breeding birds, bats, dormice, otter, water vole, GCN, reptiles and badgers.

Habitat and species surveys were undertaken with reference to the relevant best practice guidance. The methodologies adopted and results of the surveys are detailed within the technical reports presented as Appendices 8.2 to 8.10 within Volume C. Table 8.1 summaries key information relating to the baseline surveys.

Table 8.1: Baseline survey and overview

Receptor	Methodology and source	Year and area	Appendix
Breeding birds	Transect survey British Trust Ornithology (BTO) (updated) [online]. The Breeding Bird Survey. http://www.bto.org/volunteer-surveys/bbs [Accessed October 2014]	2014 – Link Area 2016 – Gilden Way	Appendix 8.2
Bats	Dusk emergence/dawn re-entry surveys of structures and trees Ground-based, endoscope and aerial tree assessments and inspections Walked and driven transects Vantage point surveys (to detect crossing points) Static detector deployments Bat Conservation Trust best practice guidelines (Hundt, 2012; Collins, 2016)	2014 - 2016 – Link Area 2016 – Gilden Way	Appendix 8.3
Dormice	Nut searches and nest-tube survey Dormouse Conservation Handbook (Bright, 2006)	2014 – Link Area	Appendix 8.4
Riparian mammals (otter and water vole)	Water vole and otter survey Ward D, Holmes N and José P (1994), The New Rivers and Wildlife Handbook. RSPB, Bedfordshire. Water Vole Conservation Handbook 3rd Ed. (Strachan, 2011)	2014 – Link Area 2016 – Gilden Way	Appendix 8.5
Great Crested Newts (GCN)	Habitat Suitability Index (HSI) assessment Evaluating the suitability of habitat for the great crested newt (Oldham, R.S. *et al*., 2000) Presence/likely absence surveys (bottle trapping, torch survey and egg search) Great Crested Newt Mitigation Guidelines. (English Nature, 2001). eDNA sampling for GCN Analytical and methodological development for improved surveillance of the Great Crested Newt (Biggs *et al*., 2014)	2014/2015 – Link Area 2016 – Gilden Way	Appendix 8.6
Reptiles	Presence/ likely absence surveys Froglife (1999) Reptile Survey: An introduction to planning, conducting and interpreting surveys for snake and lizard conservation. Froglife Advice Sheet 10. Froglife, Halesworth.	2014 – Link Area 2016 – Gilden Way	Appendix 8.7
Badger	Walkover search for evidence Hill, D., Fasham, M., Tucker, G., Shrewry, M., and Shaw, P. (2007). Handbook of Biodiversity Methods: Survey, Evaluation and Monitoring. Cambridge University Press, 4th Edition.	2014 / 2015 – Link Area 2016 – Gilden Way	Appendix 8.8
Habitats (including invasive species	Phase 1 Habitat Survey Joint Nature Conservation Committee, 2010	2013 / 2014 – Link Area 2016 – Gilden Way	Appendix 8.9

Receptor	Methodology and source	Year and area	Appendix
survey)	Botanical site inventory of Gilden Way Roundabout PWV (not NVC quadrat method)	2016 – Gilden Way PWV	Appendix 8.10

8.3.3 Ecological Impact Assessment

The assessment method is broadly based on the approach described in the DMRB Volume 11, Section 3, Part 4(Highways Agency (1993a) and IAN 130/10 (Highways Agency, 2010b) as described in Chapter 4, aligned with guidance published by the CIEEM (Guidelines on Ecological Impact Assessment: Terrestrial, Freshwater and Coastal, second edition, 2016).

The CIEEM guidelines indicate that the Ecological Impact Assessment (EcIA) process should include the following stages:

- determine the importance of ecological receptors affected;
- identify potential impacts upon important receptors;
- characterise the impacts;
- identify cumulative impacts; and
- identify any ecologically significant effects of impacts.

8.3.3.1 Determining importance of ecological receptors

The first step of the assessment of impacts is to determine which ecological receptors are present (establish the baseline) and whether they are important and likely to be affected by the proposals. The guidance suggests that to be characterised as important, receptors should be protected by legislation or policy, or otherwise be of conservation concern, for example through inclusion on relevant published lists, or through professional knowledge of local rarity or distinctiveness.

The guidance suggests that importance is described in terms of geographical context, for example a SPA could be considered to be important at a European level, whereas a small population of common toad (*Bufo bufo*) may be considered to be important at the local level. Table 8.2 presents the valuations provided in IAN 130/10 (Highways Agency, 2010b) used in this assessment.

Table 8.2: Geological valuations as provided by Ian 130/10

International or European value
Natura 2000 sites including: Sites of Community Importance (SCIs); SPAs; potential SPAs; SACs; candidate or possible SACs; and Wetlands of International Importance (RAMSAR sites), Biogenetic Reserves, World Heritage Sites and Biosphere Reserves. Areas which meet the published selection criteria for those sites listed above but which are not themselves designated as such. Resident, or regularly occurring, populations of species which could be considered at an International or European level where: • the loss of these populations could adversely affect the conservation status or distribution of the species at this geographic scale; • the population forms a critical part of a wider population at this scale; or • the species is at a critical phase of its life cycle at this scale.
UK or National value
Designated sites including: SSSIs; marine protected areas including marine conservation zones; and NNRs. Areas which meet the published selection criteria for those sites listed above but which are not themselves designated as such. Areas of key/priority habitats identified in the UK BAP, including those published in accordance with Section 41 of the NERC Act (2006) and those considered being of principal importance for the conservation of biodiversity. Areas of Ancient Woodland i.e. woodland listed within the Ancient Woodland

Inventory. Resident, or regularly occurring, populations of species which could be considered at an International, European, UK or National level where: • the loss of these populations could adversely affect the conservation status or distribution of the species at this scale; • the population forms a critical part of a wider population at this scale; or • the species is at a critical phase of its life cycle at this scale.
Regional value
Areas of key/priority habitats identified in the Regional BAP (where available); areas of key/priority habitat identified as being of Regional value in the appropriate Natural Area Profile (or equivalent); areas that have been identified by regional plans or strategies as areas for restoration or re-creation of priority habitats (for example, South West Nature Map); and areas of key/priority habitat listed within the Highways Agency's BAP (HABAP)[7]. Resident, or regularly occurring, populations of species which could be considered at an International, European, UK or National level and key/priority species listed within the HABAP where: • the loss of these populations could adversely affect the conservation status or distribution of the species at this scale; • the population forms a critical part of a wider population; or • the species is at a critical phase of its life cycle.
County or unitary authority area value
Designated sites including: Sites of Nature Conservation Importance; County Wildlife Sites; and LNRs designated in the county or unitary authority area context. Areas which meet the published selection criteria for those sites listed above but which are not themselves designated as such. Areas of key/priority habitats identified in the Local BAP; and areas of habitat identified in the appropriate Natural Area Profile (or equivalent). Resident, or regularly occurring, populations of species which could be considered at an International, European, UK or National level where: • the loss of these populations could adversely affect the conservation status or distribution of the species across the county or unitary authority area; • the population forms a critical part of a wider population; or • the species is at a critical phase of its life cycle.
Local value
Designated sites including: LNRs designated in the local context; Trees that are protected by Tree Preservation Orders (TPOs)[8]; Areas of habitat; or populations/ communities of species considered to appreciably enrich the habitat resource within the local context (such as veteran trees), including receptors of value for migration, dispersal or genetic exchange.

8.3.3.2 Identify potential impacts on important receptors

For this assessment, impacts have been assessed in detail for receptors of at least local value, or that are otherwise subject to some form of legal protection.

The identification of potential impacts has been undertaken through a review of the following data/documents:

- Construction Programme, as presented Appendix 2.2 'Construction Programme';
- Construction Plans, as presented Appendix 2.3 'Construction Methodology';
- Drainage Layout Plans;
- Road Lighting Layout Plans;
- Landscaping Mitigation Figures;

[7] The Highway's Agency has now been replaced by Highways England and there is no current Biodiversity Action Plan, although a high level strategy for the reversal of biodiversity loss is set out within Highways England's document '*Our Plan to protect and increase Biodiversity (*June 2015)'.
[8] Impacts upon trees covered by TPO's are considered within Chapter 7 Landscape and Visual and within the Tree Report.

- Chapter 5 - Air Quality; and
- Chapter 11 - Noise and vibration.

8.3.3.3 Characterise potential impacts

Both positive and negative impacts have been identified and are characterised according to their extent, magnitude, duration, timing, frequency and reversibility.

Both direct and indirect impacts are considered:

- direct impacts are changes directly attributable to a defined action such as the physical loss of a habitat or the immediate mortality of an individual of a particular species; and
- indirect impacts are attributable to an action, but which affect ecological resources through effects on an intermediary ecosystem, process or receptor. An example of this would be an impact on an aquatic species located downstream of the site due to polluted runoff from construction entering the river catchment and affecting its prey species.

8.3.3.4 Identify cumulative effects

The assessment has attempted to identify actions which could create cumulative effects. This has included consideration of:

- additive/incremental actions resulting from multiple projects progressing in close geographic or temporal proximity; and
- associated or connected actions, such as discrete (in terms of consent) development which facilitates, or is part of, further development.

The assessment has considered all consented but not constructed schemes, along with development allocations identified in the Adopted Harlow Local Plan 2006.

8.3.3.5 Identify ecologically significant effects

This chapter aims to identify significant effects upon important ecological receptors arising from the proposed development. The CIEEM guidance suggests that significant effects upon important habitats and wider ecosystems are associated with changes to structure and function (and the ability of the site to meet conservation objectives if designated), and that for species, ecologically significant effects are synonymous with changes in conservation status.

Further guidance on assessing the significance of effects is provided in IAN 130/10 which is reproduced below. This provides an approach to relate effects on receptor at different levels of value to significance categories. As illustrated in Table 8.3, effects categorised as ‘large’ and ‘very large’ are those which are likely to be key factors in the decision making process.

Table 8.3: Guidance on assessing significance of effects as provided in IAN 130/10

Significance category	Typical descriptions of effect (nature conservation)
Very Large	Effect on one or more receptor(s) of international, European, UK or national value. **NOTE: only negative effects are normally assigned this level of significance. They should be considered to represent key factors in the decision-making process.**
Large	Effect on one or more receptor(s) of regional value. **NOTE: these effects are considered to be very important considerations and are likely to be material in the decision-making process.**
Moderate	Effect on one or more receptor(s) of county or unitary authority area value. **NOTE: these effects may be important, but are not likely to be key decision-making factors.**
Slight	Effect on one or more receptor(s) of local value. **NOTE: these effects are unlikely to be critical in the decision-making process, but are important in enhancing the subsequent design of the project.**
Neutral	No significant effect on key nature conservation receptor. **NOTE: absence of effects, or those that are beneath levels of perception.**

The assessment has considered historic data regarding trends and conservation status and available research relating to resilience, to help predict where impacts leading to significant ecological effects would occur. Where there is insufficient information available to inform this assessment, the precautionary principle has been applied and areas of uncertainty have been identified (Section 8.2 - Assumptions and Limitations).

Any significant effects remaining after mitigation (the residual effects), together with an assessment of the likelihood of success in the mitigation, are factors to be considered against legislation, policy and development control in determining the application.

8.3.3.6 Protected species legislation

This chapter focusses on how the Proposed Scheme could impact upon the nature conservation status of relevant habitats and species. Additional detail relating to the actions required to ensure legislative compliance concerning species protected under the Wildlife and Countryside Act 1981 (as amended) and Conservation of Habitats and Species Regulations 2010 (as amended), is provided in Appendix 8.1.

8.4 Baseline Environment

This section summarises existing ecological receptors within the study area as they are currently understood and the value of those receptors. Detailed desk study and field study results are provided within specific technical reports for each receptor (Appendices 8.2 to 8.10).

The key ecological receptors identified during the desk study and the baseline surveys are illustrated on Figure 8-1.

8.4.1 Designated sites

There are no SACs designated for bats within 30km of the Proposed Scheme, and there are no European protected sites (SACs, SPAs or RAMSAR sites), NNRs, LNRs or SSSIs within 2km of the Proposed Scheme.

The Air Quality assessment concluded that there would unlikely be any significant effects upon the Epping Forest SAC, consequently this site is not considered further.

There are six LWSs within 1km of the Proposed Scheme; of particular relevance are Gilden Way Meadow LWS and Gilden Way Roundabout PWV. The remaining four are not considered further due to a lack of pathways for impacts or sensitive receptors.

8.4.1.1 Gilden Way Meadow LWS

Gilden Way Meadow LWS is located 100m to the south of Gilden Way. The site is referred to as a LWS (NE18/21) within the Adopted Replacement Harlow Local Plan (2006), but as a potential LWS in the more recent LWS Review (EECOS, 2010)[9]. The EECOS report presents data relating to potential LWSs. The entry for the Gilden Way Meadow is as follows:

> *'PHaLoWS8 Gilden Way Meadow (3.3 ha) TL 478111*
>
> *None of the habitats present is currently known to support flora and fauna of sufficient importance to merit LoWS designation. If the pond is demonstrated to hold a significant population of GCN or, alternatively, three amphibian species then it and the adjacent semi-natural vegetation could be considered for inclusion. The grasslands are not especially species-rich and are currently suffering from over-management.'*

As described in subsequent sections, a medium population of GCN was recorded within the pond in the LWS during baseline surveys, along with smooth (Lissotriton vulgaris) and palmate (L.helveticus) newts and common frog (Rana temporaria). Therefore, it is considered that the pond meets the criteria for LWS designation and Gilden Way Meadow is treated as a LWS for the purposes of this assessment.

8.4.1.2 Gilden Way Roundabout PWV

The Adopted Replacement Harlow Local Plan (2006) lists NE19/6 Gilden Way Roundabout PWV, and describes it as a *'Prominent roundabout at the entrance to Harlow'*. Further detail relating to the special character of the PWV was provided by Harlow Council (email from Landscape & Biodiversity Manager, ECC, with a scanned unreferenced document dated 02/11/2015 attached) as follows: *'Very diverse grassland flora within the roundabout island on a range of slopes and banks, with varying aspects and soil water conditions, includes some species found on very few other sites in the district for example Yellow Rattle.'.*

No detailed description of the habitat or criteria for selection could be obtained and it is apparent from discussions with Harlow Council and EECOS that there were no defined criteria for selection of PWVs at the time of selection (1990's), and that no detailed survey data for this site could be located. It is therefore assumed that it was designated on the basis of notable species diversity and the presence of locally rare species.

The botanical survey of the Gilden Way Roundabout PWV (reported in Appendix 8.10) recorded the presence of betony (*Stachys offinialis),* a locally rare plant, in an otherwise unremarkable grassland/scrub mosaic. The report assessed the habitat against the LWS criteria (in the absence of any criteria for PWVs) and determined that it was not worthy of designation, although it was noted that to reverse the decline of betony at the local level, all populations should be protected.

8.4.2 Habitats within the study area

8.4.2.1 Link area

The Link Area study area is predominantly agricultural land dominated by large fields supporting arable crops, bordered by hedgerows/tree lines or areas of broadleaved plantation woodland. There are several water bodies including ponds and a large lake, and Pincey Brook which is located in the northern part of the Link Area study area.

[9] The Report states that: '*This Review is a technical report which would inform and support the policies in the existing Local Plan as well as those emerging in the Local Development Framework (LDF). The Review has identified some sites in the current Local Plan that no longer meet the selection criteria for LoWS. This would be a material consideration when assessing development proposals affecting those sites.'*

8.4.2.2 Gilden Way

Gilden Way is a two-lane carriageway with amenity grass verges and a pedestrian footway along the majority of its length, with well-managed hedgerows along some sections. The road passes through arable farmland to the east and into more urbanised and residential areas to the west, including gardens and green spaces with mature trees.

As discussed above, a small population of betony was recorded on Gilden Way PWV.

8.4.3 Protected species recorded within the study area

8.4.3.1 Birds

In total, 44 species of bird were recorded in the Link Area, with 29 species recorded along the Gilden Way.

Kingfisher (Schedule 1, WCA) were incidentally recorded along the Pincey Brook, however no suitable nesting habitat was recorded within the study area. Four species recorded were Red List species on the Birds of Conservation Concern (BoCC) list (Gregory *et al*., 2002): starling (*Sturnus vulgaris)*; house sparrow (*Passer domesticus)*; skylark (*Alauda arvensis)*; and song thrush (*Turdus philomelos)*, and three were Amber List species: dunnock (*Prunella modularis)*; swift (*Apus apus*); and common whitethroat (*Sylvia communis)*. In addition, Dunnock, skylark, house sparrow, starling and song thrush are also listed as UK BAP species. Furthermore, house sparrow, skylark and song thrush are also on a priority species as listed under Section 41 of the NERC Act.

The majority of the species recorded are considered to be widespread and common and use a wide range of habitats. However, skylark and yellowhammer (*Emberiza citrinella)* recorded within the Link Area could both be classed as 'farmland specialists' and are more strongly associated with the agricultural habitats found within the Link Area. The population assemblage assessments indicate that the Link Area is of Local value for birds; however, the number of bird species recorded along Gilden Way falls below the threshold for sites of Local value for birds. In addition, neither the Link Area nor Gilden Way meets the criteria for designation as a LWS on the basis of their respective bird populations.

8.4.3.2 Bats

At least seven species of bat were recorded within the study area during the 2014, 2015 and 2016 surveys: common pipistrelle (*Pipistrellus pipistrellus)*; soprano pipistrelle (*P. pygmaeus),* Nathusius' pipistrelle (*P. nathusii)*; *Myotis* bats (*Myotis* sp.); long-eared bat (assumed to be brown long-eared bat (*Plecotus auritus)* due to geographical location); noctule (*Nyctalus noctula)*; big bat (a bat from either the *Nyctalus* or *Serotinus* genus that could not be identified to species level due to overlapping call characteristics); and barbastelle bat (*Barbastellus barbastellus).*

Five non-breeding summer roosts were recorded as follows:

- Mayfield Farm Barn – approximately 30 droppings recorded during internal/external inspection and a maximum count of two common pipistrelle bats recorded during dusk emergence/dawn re-entry surveys;
- Tree 61A (Link Area) – two long-eared bat droppings recorded during climbing surveys indicating a roost;
- G103 (Gilden Way) – pipistrelle bat possibly emerged from the group of trees during dusk emergence/dawn re-entry surveys;
- Tree 46 (Gilden Way) – maximum count of one Myotis sp. and two soprano pipistrelle bats recorded during dusk emergence/dawn re-entry surveys;
- Tree 75 (Gilden Way) – one unidentified bat emerged (at 21:38 on 29/06/2016, sunset at 21:22) during dusk emergence/dawn re-entry survey - timing indicative of pipistrelle species; and
- Tree 101 (Gilden Way) – a maximum count of four common pipistrelle bats recorded emerging during dusk emergence/ dawn re-entry surveys.

The greatest activity within the Link Area was recorded along the tree-lined Sheering Road, the edges of The Mores Wood, and the ponds to the south of The Mores Wood. However, with regard to *Mytois* sp. and long-eared bats, the hedgerow/ditch leading north from The Mores Wood is the key area of activity within the site.

A number of bat crossing points were identified along the Gilden Way, with the majority of bats recorded crossing above the street lights. *Pipistrelle* and *Nyctalus* species were commonly recorded; however, light-shy species were largely absent, with only one long-eared bat pass recorded across the season.

8.4.3.3 Riparian mammals

No evidence of water vole was recorded during the surveys.

An otter spraint was recorded on Pincey Brook during the survey in 2014; however, due to the presence of dense vegetation, access was limited and the presence of a holt or couch in that area could not be ruled out. The Pincey Brook was surveyed again in 2016, and the original spraint site re-visited. No evidence of otter was recorded during 2016, although access was again constrained, as it was in 2014.

No evidence of otter (or water vole) was recorded along Harlowbury Brook or the adjacent ditch.

8.4.3.4 Great crested newts

No GCN were recorded within ponds within the Link Area study area during the presence/likely absence surveys, and none were detected using eDNA testing.

A medium population of GCN was recorded within the pond in the Gilden Way Meadow LWS, with a maximum count of 17 adult GCN. The eDNA testing did not identify the presence of GCN in any other pond surveyed in the Gilden Way area in 2016.

8.4.3.5 Reptiles

A peak count of one common lizard (*Zootoca vivipara*) and two grass snakes (*Natrix natrix)* was recorded for the Link Area, and a peak count of one common lizard and one grass snake was recorded for Gilden Way.

During the GCN surveys of the pond within Gilden Way Meadow LWS, a peak count of four grass snakes was recorded. The snakes were displaying breeding behaviour.

8.4.3.6 Badgers

Data collected during surveys for badgers in 2014-2015 identified active setts within the Link Area with the location of active sets changing across the years. During both years, however, an active main sett was recorded within The Mores Wood and on the western edge of Moorhall Wood LWS to the east of the M11.

No active setts were recorded along the Gilden Way.

8.4.3.7 Other species

No dormice were recorded during the baseline surveys and due to the presence of North American signal crayfish (*Pacifastacus leniusculus)* (observed during the riparian mammal surveys) the absence of white-clawed crayfish (*Austropotamobius pallipes*) was assumed.

8.4.4 Value of receptors

The importance attributed to each of the receptors considered within this assessment is set out in Table 8.4 below:

Table 8.4: Importance of receptors

Receptor	Description	Importance
Breeding birds	A number of bird species listed under Section 41 of the NERC Act, and the BoCC Red and Amber lists have been recorded.	Local
Bats	Occasional, non-breeding, summer roosts used by low numbers of common species have been recorded in trees/buildings near to, and within, the Proposed Scheme boundary. The bats within these roosts are likely to be associated with natal roosts beyond the Proposed Scheme boundary and therefore impacts at the site-level could affect roosts at the local level. Therefore the bats and roosts within the Proposed Scheme are considered to be of local importance. Some bat species are susceptible to collision with traffic, and are sensitive to habitat loss beyond the roost site, and to disturbance such as lighting. Some habitats to be impacted by the Proposed Scheme support foraging and commuting by a number of bat species including the rare species barbastelle and Nathusius' pipistrelle, which commute long distances. The foraging and commuting habitat within the site could therefore be of importance to bats beyond the local population level.	Roosts - Local Linear habitat - County
Otters	Evidence of otter has been recorded along the Pincey Brook. No holts or couches have been recorded, but not all riparian areas were accessible to survey. Otters are susceptible to collision with traffic and sensitive to changes in water quality and disturbance such as noise generated by elevated levels of traffic, increased lighting and pedestrians. Otters have large ranges and are generally present at low densities and therefore any otter using habitat within the Proposed Scheme could be vital to the breeding success of other otters within the local area.	Local
Great Crested Newts (GCN)	No GCN were detected within a 500m buffer around the Link Area, but a medium population of GCN was recorded adjacent to Gilden Way. Proposals do not directly affect aquatic habitat, but the location of the Phase 1 site compound within 100m of a breeding pond could affect habitats that could be used by GCN in their terrestrial phase and lead to direct impacts upon GCN if present.	Local
Badgers	An active main sett was recorded within The Mores Wood, and another within Moorhall Wood LWS. There are outlier/subsidiary setts within the study area, along with widespread evidence of badgers using habitats for foraging and commuting across the Link Area. Badgers are susceptible to collision with traffic. No active badger setts were recorded within 50m of Gilden Way. There are many records of badgers from the local area, and badgers are generally common and widespread; therefore, the	Site

Receptor	Description	Importance
	population within the study area is unlikely to be key to sustaining the local badger population.	
Reptiles	Very low numbers of common lizard and grass snake have been recorded in both the Link Area and habitats adjacent to Gilden Way. These species are widespread and abundant; therefore the small numbers recorded within the site are unlikely to contribute significantly to the local population. They are therefore considered to be important at Site level only.	Site
Gilden Way Meadow Local Wildlife Site (LWS)/Local Biodiversity Action Plan (BAP) Habitat - Ponds	The LWS contains a pond supporting a medium sized population of GCN and breeding grass snakes, and contains habitats with potential to support other protected species.	Local
Gilden Way Roundabout Protected Wildlife Verge (PWV)/Local BAP Habitat – Lowland Meadow (semi-improved grassland)	The botanical survey identified the presence of a locally rare plant within the Gilden Way PWV, in an otherwise unremarkable grassland/scrub mosaic. Betony is listed on the Essex Red Data List (Essex Field Club, 2014), and is described as having undergone a 'drastic decline, and likely to be on the verge of extinction within the next few decades'. The Adopted Replacement Harlow Local Plan (July 2006), Policy NE19 protects the site unless outweighed by the need for development.	Local
Local BAP Habitat - Hedgerows	The hedgerows within the Link Area and Gilden Way are considered likely to fall within the Essex BAP habitat description for Hedgerows.	Local

Those receptors with importance at the local level or above have been considered in this assessment. For receptors valued at the site level (i.e. reptiles and badgers), but which are subjected to legal protection, measures to be implemented to ensure that the Proposed Scheme is legally compliant are set out in Appendix 8.1: Legislative Compliance Report.

8.5 Significant Effects

There are a number of ways in which a highways scheme could impact on nature conservation during construction and operation phase. The impact could be temporary or permanent.

8.5.1 Construction effects

The main pathways to impacts are listed below and these are considered in relation to specific receptors in Section 8.5.1.1 to 8.5.1.5.

Habitat loss

The impact of habitat loss is partially reversible, in that compensatory planting would create habitats such as species-rich grassland and deciduous woodland which are, for the main part, more ecologically valuable than those proposed to be replaced. However, the area taken to construct the new road/additional lane, would no longer be available to wildlife, and therefore there would be a long-term reduction (albeit small) in available habitat.

Pollution of the water environment

During the construction phase, there is a risk that run-off from the disturbed ground and stored construction materials could contaminate surface water receptors such as Pincey Brook, Harlowbury Brook and the pond within the Gilden Way Meadow LWS. Contaminants associated with construction machinery, such as engine oil and diesel, and with the construction personnel welfare facilities, could also contaminate surface water if left uncontrolled.

Contamination events would be likely to last as long as rainwater takes to drain from the Proposed Scheme area since it is the surface water run-off which would carry the contaminant. Therefore the weather (in addition to the working/materials storage methods) during the construction phase would influence the extent, magnitude, duration and frequency of this potential impact. The construction of the Proposed Scheme would be split into three main phases (Phase 1, Phase 2A and Phase 2B) taking place over approximately two years. Therefore at least some periods of soil stripping/soil storage would be likely to coincide with periods of heavy rainfall.

Light pollution

During the construction, the majority of the work would be undertaken during the day. However, some night time working is required near to Pincey Brook. Artificial lighting would be required to illuminate the works area in this vicinity for a period of around one month. If additional night-time lighting is required in other locations, the lighting and construction plans would need to be re-assessed to determine whether there would be any additional impacts on light-sensitive species. During the operation of the new roads, the carriageways would be lit during the entire night period.

Noise pollution and vibration

During the construction phase heavy plant equipment would be in operation throughout the Proposed Scheme, heavy goods vehicles would be transporting materials and generators and other static items of plant could also be present. These factors would contribute towards an increase in noise and localised vibration.

Air pollution

During the construction period, dust generated by construction activities and construction traffic could create widespread air pollution unless properly controlled. In addition, if inappropriately sited, the exhaust fumes from generators (such as those used to power temporary traffic lights or welfare facilities within construction compounds) could create a localised impact upon sensitive receptors located nearby.

Invasive species

During the construction phase, there would be potential for site preparation and construction activities to spread non-native invasive plant species within and beyond the Proposed Scheme. Further surveys for such species would be undertaken to inform the control measures to prevent spread, and these measures would be itemised within the CEMP.

8.5.1.1 Locally designated sites

Gilden Way Roundabout Protected Wildlife Verge

Churchgate Roundabout is designated at a Local level as Gilden Way Roundabout PWV. In the absence of mitigation, the population of betony on the Gilden Way Roundabout PWV would be lost, along with a small area of semi-improved grassland. Betony is listed as Least Concern Nationally (Stroh, *et al*., 2014) but is listed on the Essex Red Data List (Essex Field Club, 2014). In line with Table 8.3 this loss would lead to a Slight Negative effect.

Gilden Way Meadow Local Wildlife Site

In the absence of mitigation, the pond within the Gilden Way Meadow LWS could be affected by contaminated or silt-laden surface water run-off from the Phase 1 compound. This could impact water quality and the

amphibian populations of which the LWS is designated for. The site is important at the local level and therefore a Slight Negative effect would occur.

The population of GCN which the LWS supports could also be affected. Effects upon GCN are detailed in Section 8.5.1.5 below.

8.5.1.2 Birds

In the absence of mitigation, nesting birds and active nests could be directly impacted and areas of bird nesting habitat lost. The baseline surveys established that the bird populations within the Proposed Scheme were of local importance. Therefore the loss of habitat supporting these populations would lead to a Slight Negative effect.

8.5.1.3 Bats

The Proposed Scheme would lead to the loss of four recorded bat roost trees located adjacent to Gilden Way. These trees were occasionally used as non-breeding summer roosts by low numbers (maximum count four) of common and widespread species of bat (common pipistrelle, soprano pipistrelle and a *Myotis* sp. bat). Other trees with potential roost receptors, but not found to support bat roosts at the time of the surveys, would also be removed.

The Proposed Scheme would also require the removal of trees within the Link Area, along the eastern edge of The Mores Wood and along Sheering Road, in the vicinity of Pincey Brook. No bat roosts were recorded within the trees to be directly/partially impacted. However, a long-eared bat roost was recorded within The Mores Wood (in a tree not impacted by the Proposed Scheme) and static detector surveys indicate the presence of roosts of common and soprano pipistrelle, big bats (*Nyctalus* or *Eptisicus*), *Myotis* sp. and long-eared bats within The Mores Wood. It is acknowledged that bats uses large number of tree roosts throughout the year and the chance of surveying a tree whilst a bat is present is small. Therefore, it is possible for a roost tree to be surveyed and for no bats to be recorded on that occasion i.e. there can be only low confidence in a negative survey result.

Without mitigation, lighting associated with night-time working, construction noise and air pollution, such as dust or vehicle/generator exhaust fumes could also affect bats roosting within trees near to the Proposed Scheme.

These impacts would affect roosting bats assessed as having local importance, and would therefore lead to a Slight Negative effect.

The removal of habitats within the Proposed Scheme used by foraging and commuting bats, and assessed as being of county importance, would lead to a Moderate Negative effect.

8.5.1.4 Otter

Without mitigation, light and noise disturbance in the vicinity of Sheering Road Bridge, could disturb otters if a holt is present nearby, and could prevent otter from commuting along the Pincey Brook during the works. Otters are considered to be of local importance therefore, these impacts could lead to a Slight Negative effect.

8.5.1.5 Great crested newts

In the absence of mitigation, individual GCN could be killed or injured and the pond within the Gilden Way Meadow LWS could be contaminated leading to negative impacts upon GCN habitat. The population of GCN within the Proposed Scheme has been assessed as being of local importance, therefore these impacts would lead to a Slight Negative effect.

8.5.2 Operational effects

The main pathways to impacts are listed below and these are considered in relation to specific ecological receptors in Section 8.5.2.1 to 8.5.2.5.

Increase in traffic – fauna collision risk

The baseline (2014) and predicted vehicle movements are presented in Table 8.5 below.

Table 8.5: Baseline and predicted vehicle movements

Road	Baseline (2014)	Predicted (2021)
Gilden Way, average per day	12891	27116
Link roads, average per day	N/A	28665

A comparison of vehicle movements/ hour across the day and night period for the baseline and 2021 prediction is set out in Table 8.6 below.

Table 8.6: Baseline and predicted vehicle movements per day/night period

	AM (8-10am)	Inter peak (11am-4pm)	PM (5-7pm)	Off peak (7pm-7am)
Gilden Way 2014	1272	826	1271	266
Gilden Way 2021	2348	1998	2478	559
Link roads 2021	2096	1779	2304	550

The new link roads within the Link Area are likely to lead to collision impacts upon fauna travelling across the site, as is the increase in traffic volumes along Sheering Road and Gilden Way on fauna attempting to cross that road.

Pollution of the water environment

During the operational phase, vehicles using the new roads would deposit a range of contaminants onto the road surface via exhaust fumes and leaks, and during rainfall events. These contaminants would drain via carriageway drainage systems into surface water channels. De-icing salts are also likely to be contained in carriageway drainage water. In addition, if an accident were to occur on the new roads, i.e. such as involving a milk tanker or vehicle carrying toxic substances, it is possible that large quantities of contaminants could make their way into surface water channels via the carriageway drainage system.

During normal operating conditions, it is likely that contaminants would be transported from the road surface to the surface water channels during rainfall events throughout the year, contributing to a long-term increase in baseline levels of such contaminants. Abnormal pollution events, by definition, would be likely to occur only very occasionally, but could have a major impact on surface water receptors receiving carriageway drainage and also on sensitive aquatic receptors downstream (depending on the availability, persistence and toxicity of the contaminant).

This impact could lead to effects on otters and GCN.

Air pollution

During the operational phase, the increase in traffic volumes experienced within the Link Area (along the new link roads) and along the widened Gilden Way, would lead to an increase in traffic exhaust fumes and deposition of particulates associated with these. With regards to habitats, the key ecological impact is enrichment as a result of an increase in nitrogen deposition.

For the most part, the habitats along Gilden Way are amenity grassland and residential gardens, habitats of low ecological value and of low sensitivity to enrichment. However, within their own right, and by virtue of the species that they support, the Gilden Way Meadow LWS (comprising a small area of woodland and a pond that supports GCN) and The Mores Wood (supporting at least one bat roost) are ecologically valuable and could have some sensitivity to enrichment.

Chapter 5 - Air Quality indicates that there would be a reduction in NO_x levels within the Gilden Way Meadow LWS between 2014 and 2021. Impacts upon the water quality of the pond within Gilden Way Meadow LWS and the GCN therein, as an indirect result of air pollution, are therefore not considered further.

Concerning The Mores Wood, the Air Quality Team advise that the NO_x levels in the extreme northeast corner of The Mores Wood, nearest to the link road would be reduced between 2014 and 2021. However, despite the reduction, the level of deposited nitrogen would remain above the recommended limit (taken from the APIS website) for broad-leaved woodland. Due to the decrease in NO_x, enrichment effects as a result of air pollution are therefore not considered further.

Noise pollution

During operation, traffic using the new link roads would generate a completely new impact in this area, whereas an increase in traffic levels on the Gilden Way would represent an increase in the magnitude of an existing impact.

The increase in noise and vibration associated with the operational phases has the potential to affect noise/vibration sensitive animals using habitats within and adjacent to the Proposed Scheme boundary such as otter using the Pincey Brook and bats roosting within trees adjacent to Gilden Way.

Exact figures relating to the baseline and predicted noise levels at key habitats (the Pincey Brook and The Mores Wood) were not available at the time of writing.

Increase in night-time light levels

Night-time light levels would increase within the Link Area during the operation of the Proposed Scheme due to the introduction of luminaires along the link roads and around junctions, which would be operational during the hours of darkness.

Luminaires would generate 20lux average illuminance. For comparison, a full moon on a clear night produces 0.25lux illuminance. As the Link Area, Sheering Road and the section of the M11 to the east, are currently not lit, the brightest night-time conditions within the Link Area are currently likely to be associated with illuminance from a full moon.

Illumination of the link roads and junctions has the potential to affect nocturnal birds and bats using the Link Area. The species may avoid lit areas, reducing available foraging habitat and creating a barrier to dispersal.

Without mitigation replacement of street lighting along the Gilden Way could lead to an increase in night-time light levels.

8.5.2.1 Locally designated sites

The operation of the Proposed Scheme would affect Gilden Way Roundabout PWV and Gilden Way Meadow LWS. Gilden Way Roundabout PWV would have been removed during construction so is not discussed further here. As the main reason for designation of Gilden Way Meadow LWS is the population of GCN within the pond, the assessment is presented under the GCN section.

8.5.2.2 Birds

Increase in traffic

The introduction of traffic along the new link roads, and increased volumes of traffic along the Gilden Way suggests that direct mortality of birds due to collision with traffic would increase for the Proposed Scheme. Research (Jacobson, 2005) suggests that ground nesting birds, owls, scavengers and frugivores (fruit-eating) are more susceptible to direct mortality from traffic collision than other groups of birds. Bird species from these groups have been recorded within the Proposed Scheme footprint and therefore, there is a risk that the number and distribution of individuals of these species would be reduced at site level. However, the increase in traffic within the Proposed Scheme would be largely due to the fact that traffic would be diverted from other roads in the local area. For 'donor' roads, a reduction in traffic levels (i.e. along Sheering Lower Road and Sheering Road north) suggests that bird mortality would also decrease, and therefore the likelihood of bird fatalities incidence across the local area would unlikely change.

Additionally, there is likely to be a positive correlation between the speed of traffic and bird mortality, as faster traffic is more difficult to avoid. This impact would be more likely to affect slower flying birds, as indicated by a study undertaken by The Mammal Society, which found that speed limit had a significant effect on tawny owl (*Strix aluco)* mortality, but not on faster flying raptors such as kestrel (*Subuteo tinnunculus*).

The new speed limit for the link roads and Gilden Way would be 40mph.Currently the Gilden Way and Sheering Road are subject to a national speed limit of 60mph. The reduction in speed of traffic is likely to lead to a decreased risk of collision, although it is acknowledged that the increase in vehicle movements would be likely to lead to an increase in collision risk.

The section of Sheering Road by-passed by the link road would become an access road serving the properties to the west, and the speed of traffic on this section of road would be significantly reduced. As traffic moves east along Gilden Way, it would slow down due to the presence of the new Sheering Road Roundabout, before either continuing north along Sheering Road, or east onto the link roads, and vice versa. Thus, there would also be a reduction in the speed of traffic in this area, leading to a reduced risk of collision.

Increase in noise pollution

Research (Kociolek *et al.*, 2011) has shown that an increase in traffic noise can lead to a reduction in bird species diversity and abundance, reduced pairing and breeding success, a shift towards a younger population and a shift in territories and nest sites being located away from the road. The negative effects of the traffic-generated noise associated with the link roads could lead to a reduction in the number and diversity of birds in areas within the Link Area. However, the interior of the large arable field through which the link roads would pass, does not support large numbers of nesting birds, due to the absence of diverse nesting habitat such as scrub and trees. Therefore the effect of increased noise within the Link Area would likely be limited to ground-nesting birds recorded breeding in this area such as skylark.

Gilden Way is largely bordered by residential gardens which are currently shielded, albeit partially by tall boundary fences constructed from timber fencing panels or close boards from traffic-generated noise. Following the widening works, these boundaries would be reinstated/ upgraded to noise fencing.

Night-time lighting

Without mitigation, the replacement of street lighting along the Gilden Way could lead to negative impacts upon nocturnal birds, although as this area is already subject to night-time lighting the effects are likely to be negligible.

Individual species that are active at night, such as little owl *(Athene noctua)* and tawny owl were recorded within the Link Area, where there is currently no artificial night-time lighting. The introduction of lighting along the link roads and along the eastern part of Gilden Way would reduce the suitability of these areas for foraging and therefore could impact species like owls. However, the habitat affected (the interior of a large arable field and amenity grass verges) is generally suboptimal for foraging by these species. Given the abundance of dark rural

habitat to the north, east and south of the Link Area, there would likely be no effect on the conservation status of nocturnal species of birds.

On balance, without mitigation the operation of the Proposed Scheme would have a Slight Negative effect.

8.5.2.3 Bats

Increase in traffic

The bat vantage point/crossing surveys undertaken along Gilden Way indicated that the majority of crossing activity took place above the street lights and above the traffic swept zone, reducing the likelihood collision. The surveys indicate that active bats along Gilden Way have become accustomed to the presence of the road and associated traffic. As the majority of bats do not cross the Gilden Way within the traffic swept zone, the increase in traffic numbers along the Gilden Way is considered unlikely to have a significant effect on the conservation status of the local bat population.

Without mitigation the new link roads could sever bat flight paths used by low-flying and light-shy species such as long-eared and *Myotis* bats. This could lead to effects such as the direct injury and killing of bats through collision with traffic and isolation of roost sites.

Increased night-time light levels

Similarly to birds, without mitigation, the replacement of street lighting along Gilden Way could lead to negative impacts upon bats, although bats in this area are likely to have become accustomed to the current levels of night-time light.

Without mitigation, the proposed lighting along the link roads could disturb light-shy bat species and present a barrier to dispersal. The Mores Wood supports a long-eared bat roost. This species is sensitive to light disturbance and currently uses the unnamed ditch/hedgerow, which would be severed by the link roads, as a key flight line. In a worst case scenario, the unmitigated lighting of the link roads could lead to the abandonment of this roost.

Increase in noise

Exact figures relating to the predicted increase in noise levels are not available at the time of writing; however an increase in noise is anticipated given the predicted increase in traffic levels.

Research indicates that some species of bats are negatively affected by traffic noise (Abbot *et al*, 2015), which can interfere with echolocation and foraging success. Therefore, without mitigation, the likely increase in traffic-generated noise could have negative effects on bat roosts along Gilden Way and on bats foraging within and commuting through the Proposed Scheme.

On balance, without mitigation, the operation of the Proposed Scheme would be likely to have a Slight Negative (in respect to roosting bats) and Moderate Negative (in respect to commuting bats) effect on the local bat population.

8.5.2.4 Otter

Pollution of the water environment

Otters are semi-aquatic mammals and within Essex are known to predate amongst other things, fish and invertebrates, such as North American signal crayfish (Cousins *et al.*, 2011). Otters are therefore sensitive to the following impacts:

- direct poisoning though exposure to/consumption of polluted water;
- indirect poisoning through bioaccumulation of contaminants contained within fish/invertebrates; and
- reduction in foraging success due to decrease in prey numbers (caused by pollution directly affecting fish/invertebrate prey).

Chapter 13 - Road Drainage and Water Environment chapter identifies that there would be a Neutral to Slight Negative impact on water quality in the Pincey Brook and Harlowbury Brook in the long term i.e. throughout the operational phase. The Essex Otter Survey 2007 (Tansley, 2008), indicates that otter were present on the River Stort near Harlow in 2007, although this was one of nine sites on the Stort where evidence of otters was found. The 2011-2013 survey results indicate a similar pattern of distribution. The results, in the context of a rapidly expanding population at the county level, indicate presence at low densities. This suggests that the habitat provided by the River Stort is sub-optimal, or that there is some other factor at play making this area unfavourable for otter. It is considered unlikely that local conservation status of otter would have a Neutral to Slight Negative impact as a result of water quality, given that otter are present at only low densities and that there is an abundance of alternative aquatic habitat in the local area.

Increased traffic

Without mitigation, any otters attempting to cross the link roads would be at an increased risk of collision with traffic, potentially resulting in injury or death. The Essex Wildlife Trust co-ordinates annual surveys for riparian mammals within the county. The latest publication summarising results from 2011-2013 (Tansley, 2013) suggests that deaths due to collision with traffic have increased in Essex from "*3 - 4 per year a few years ago, to three times that figure"* annually during the period 2011–2013. Otters are known to use the Pincey Brook and could travel south from this watercourse to access the unnamed watercourse that runs through The Mores Wood towards the fish nursery lakes to the south.

Increased night-time light levels

Without mitigation, the lighting along the link roads could create a barrier to dispersal for otters attempting to cross this area.

On balance, without mitigation, the operation of the Proposed Scheme would likely have a Slight Negative effect on the local otter population.

8.5.2.5 Great crested newts

Increase in traffic

The increase in traffic movements associated with widening of the Gilden Way may reduce the success of GCN attempting to cross this existing partial barrier to dispersal, and therefore could effectively reduce habitat available to GCN in the wider area. However, the habitat to the south of the pond within the Gilden Way Meadow LWS is less urban and more optimal for GCN terrestrial activity. Therefore, reduced accessibility to the comparatively suboptimal habitat to the north of the Gilden Way, due to elevated traffic levels, is considered unlikely to have a significant effect upon the GCN population supported by Gilden Way Meadow LWS. With regards to breeding and the exchange of genetic material, it is likely that the small population of GCN identified within Gilden Way Meadow LWS (which would be unlikely to be viable in isolation) is part of a larger meta-population. A survey of ponds within Harlow (Jones & Sons Environmental Science Ltd, 2007) detected GCN breeding in 14 of 51 ponds surveyed. All breeding ponds identified lie to the south and south west of the Gilden Way (and Gilden Way Meadow LWS). Therefore, although there could be GCN breeding ponds located to the

north of Gilden Way, it is likely that the GCN population in Gilden Way Meadow LWS is reliant upon ponds to the south and southwest for genetic exchange.

Pollution of the water environment

There are no plans for carriageway drainage to be discharged to the pond within Gilden Way Meadow LWS. As this pond appears to be fed by rainwater, and is hydrologically separated from Harlowbury Brook, other surface water channels and the existing Gilden Way carriageway drainage system, it is considered unlikely that carriageway surface water drainage would affect the pond within the LWS or any GCN therein.

On balance, without mitigation, the operation of the Proposed Scheme would likely lead to a Neutral effect on the local GCN population.

8.6 Proposed Mitigation

The Proposed Scheme design has evolved as baseline information has emerged, and therefore it has been possible to adapt the design to mitigate and compensate for potential impacts. Table 8.7 sets out a summary of the proposed mitigation measures and the receptors which these relate to. These measures are shown, as appropriate, on Figure 8-2.

Table 8.7: Details of mitigation

Receptor	Description of mitigation
Breeding bird assemblage	Timings to avoid vegetation removal within the bird nesting season have been included in the Construction Programme. The Proposed Scheme would result in the loss of the approximately 3.66ha of trees, woodland and scrub which would be compensated for by the creation of approximately 19.77ha of woodland, hedgerow and shrub habitat (full details set out in Chapter 7 - Landscape and Visual, Tables 7.3 and 7.4). Additionally, the Proposed Scheme would deliver new habitats such as ponds (for attenuation and settlement of road drainage) and ditches, which would be planted to maximise their ecological value. It is anticipated that the hop-over created for bats (see below for description) would assist nocturnal birds in crossing the new link road safely. The column heights of street lights located near the hop-over would be reduced, with LED directional lighting such that light does not shine above the horizontal. This would ensure that (once established) tree canopies at these crossing points were dark (>6mAGL) and potentially used by bats and light-shy nocturnal birds crossing the road above the traffic swept zone. In addition, LED lighting has been selected to satisfy the technical specifications relating to spectral composition recommended by BCT (2014) to reduce disturbance effects upon wildlife. It is anticipated that the construction of noise fencing to prevent excessive noise pollution in residential gardens bordering the Gilden Way would ameliorate the negative effects of noise on nesting birds in those areas. The upgrading of street lighting along the Gilden Way from Low-Pressure Sodium lamps to LED directional lighting would also reduce the disturbing effects of lighting upon wildlife along this part of the Proposed Scheme.
Bats	European Protected Species (EPS) licence to cover removal of tree roosts and to provide suitable mitigation/compensation would be applied for from NE. Proposed timings to avoid disturbance of bats (whilst removing trees under licence) have been included in the Construction Programme. Measures to avoid disturbance impacts during the construction phase. Examples include the use of solid hoarding around the construction compound for Phase 1, to prevent noise disturbance and light spill onto surrounding mature trees and

Receptor	Description of mitigation
	retained/compensatory tree roosts along Gilden Way. Another example is the temporary provision of similar fencing along the Pincey Brook near to Sheering Road Bridge during Phase 2A Section A to prevent illumination of the Brook used by commuting bats (and possibly otter – see below). Dust suppression and air quality monitoring to prevent disturbance to trees confirmed as bat roosts through air pollution. Incorporation of large multi-species underpasses (2x2m box culvert with mammal ledge) under each link road (two in total), designed in combination with a hop-over (comprising fencing, tree planting and controlled lighting), to provide a safe dark route for bats (and other mammals) to cross below or bats and birds to cross above the link roads. The underpasses would channel the un-named watercourse beneath the two link roads and into a ditch prior to joining Pincey Brook to the north. The arrangement of the underpasses and fencing is illustrated on Figure 8-2. Landscaping (visual screening mounds and tree planting) ensuring that the old Sheering Road continued to be a dark, well-vegetated linear receptor functioning as a key flight line for bats. Landscaping would provide generous compensation for lost habitats, increasing habitat diversity within the Link Area. Landscaping proposals are predicted to result in an increase in invertebrate prey diversity and abundance for bats.
Otter	Chapter 13 – Road Drainage and Water Environment sets out the details of the embedded mitigation measures proposed to reduce/remove the risk of pollution of the water environment. In summary, these are covered by the following measures: • a Code of Construction Practice (CoCP) would be implemented; • all necessary consents and licences would be in place prior to the commencement of any works; and • adoption of good working practices and adherence to the EA's Pollution Prevention Guidance (PPG) and Construction Industry Research and Information Association (CIRIA) Reports (CIRIA, 2006; CIRIA, 2007a; CIRIA, 2010). During construction of Phase 2A Section A, temporary acoustic fencing would be erected to reduce noise and light disturbance along the Pincey Brook. The multi-species underpasses as described for bats (above) would also allow otters to pass beneath the proposed link roads. Fencing would be installed around the entrance to the culverts to funnel otters (and other terrestrial mammals) into the culvert and prevent them from crossing the embankment and the new carriageways of the link roads. Fencing would be constructed to the specification considered to be most appropriate for this purpose at the time of construction[10]. The landscape planting scheme has been designed to enhance this funnelling effect. No street lighting on Sheering Road bridge to ensure the banks and channel of Pincey Brook are not illuminated.
GCN	EPS licence to cover works to set up the Phase 1 construction compound and to provide suitable mitigation/compensation. Measures to reduce impact of compound fencing such as adoption of self-supporting hoarding.

[10] At the time of writing, the specification for the most appropriate type of fencing is as follows:

At least 1.2m high above ground level, comprising galvanised welded mesh (of at least 2.5mm gauge) with a maximum mesh size of 25x50mm. The mesh would be attached to fence posts and topped with barbed wire. Below ground, the mesh would be dug in to a depth of 300mm, or 100mm with a horizontal lap on the otters' side of 300-450mm. (SNH website, http://www.snh.org.uk/publications/on-line/wildlife/otters/mitigation.asp, accessed 24/08/16).

This specification should be adopted in the event that no better alternative can be proposed to exclude/funnel otters or badgers at the time of construction.

Receptor	Description of mitigation
	Timings to avoid ground disturbance during the hibernation period and for a two-staged approach to vegetation clearance have been included in the Construction Programme. Chapter 13 – Road Drainage and Water Environment sets out the details of the embedded mitigation measures to reduce/remove the risk of pollution of the water environment, as set out above for otters. The drainage strategy incorporates provision of attenuation/settlement ponds to hold surface water collected from the carriageway. Although it is noted that the quality of the water held in such ponds could be poor, these surface water receptors and marginal areas can support amphibians (Smith *et al.,* 2014). In addition to the attenuation/settlement ponds, the new link roads and junction would be served by open drainage ditches. Therefore the Proposed Scheme would deliver a net gain in surface water receptors.
Gilden Way Meadow LWS	The measures set out above in respect of GCN relate to the population recorded within the Gilden Way Meadow LWS.
Gilden Way Roundabout PWV/Essex Biodiversity Action Plan (BAP) Habitat – lowland meadows (semi-improved grassland)	Landscaping of the embankments of the two new link roads, and the area between the link roads has been designed to encourage species-rich grassland to develop. There would be approximately 3.5ha of species-rich grassland created within the Proposed Scheme. Topsoil and seed would be taken from Gilden Way Roundabout PWV and used in the profiling of these areas. It should be noted that the successful establishment and management of the species-rich grassland, and particularly populations of betony, would need to be secured through a planning condition.
Essex BAP Habitat - Ponds	Construction and planting of attenuation ponds to enhance ecological value would provide a net increase in pond habitat across the Proposed Scheme. See also the embedded mitigation described for GCN and Gilden Way Meadow LWS.
Essex BAP Habitat - Hedgerows	Removal would be timed to avoid impacts upon nesting birds, reptiles and amphibians as appropriate. The 446m of hedgerow lost would be replaced by 4411m hedgerow. All new planting would use native species and aim to create species-rich hedgerow.

8.6.1 Construction mitigation

8.6.1.1 Locally designated sites

Habitat loss – Gilden Way Roundabout Protected Wildlife Verge

The south-facing embankments of the new link roads would be seeded/planted using the material collected from Gilden Way Roundabout PWV and specialist seed-mixes, to create approximately 3.5ha of species-rich grassland. As a result of the timing lag between the loss of the PWV and establishment of the new species-rich grassland, there would likely be a short term reduction in the area of semi-improved grassland and flowering betony. However, in the mid-long term, there would be a net gain for biodiversity as a larger area of more diverse grassland habitat became established and the local population and distribution of betony would increase.

The Gilden Way Roundabout PWV has been assessed as having Local value and would be permanently lost and therefore there would be a Slight Negative effect**.** However, on balance, the Proposed Scheme would deliver an increase in the area of species-rich grassland, the benefits of which are considered to outweigh the loss of the small area of semi-improved grassland habitat within the PWV.

Pollution of the water environment – Gilden Way Meadow Local Wildlife Site

As the main reason for designation of this site is the population of GCN within the pond, the impact assessment is presented under the GCN section.

8.6.1.2 Birds

Habitat loss – general assemblage

The mitigation includes timing controls on vegetation clearance to ensure that bird nesting habitat is removed outside the nesting season, therefore no direct effects upon nesting birds are anticipated.

The proposed landscaping could not take place until the discrete construction phases, including completion of activities such as road widening, construction of new link roads, embankments, visual screening mounds, drainage channels and ponds. Therefore, there would be a period of time between the removal of vegetation and the establishment of the new landscaping, with a reduction in available nesting and foraging habitat. However, as the construction phases would overlap in timing, vegetation removal and landscape planting would happen at different times across the Proposed Scheme, such that some planting would have taken place before all the vegetation removal is undertaken. For example, the landscape planting within Phase 1 Section A (July 2020) would be undertaken prior to the vegetation removal for Phase 2B Sections A & B (January 2021).

There would inevitably be a short term reduction in available bird nesting/foraging habitat within the Proposed Scheme boundary, but once the landscaping establishes there would be a net gain in nesting and foraging habitat as detailed in Chapter 7 – Landscape and Visual, Tables 7.2 and 7.3. Therefore, as the habitat loss associated with the construction of the Proposed Scheme became generously compensated for within the landscape works, this impact would be unlikely to have a negative effect on the conservation status of the birds recorded within the Study Area.

Habitat fragmentation – skylark

The reduction in the openness of the arable field within the Link Area due to the construction of the link roads could reduce its suitability for farmland specialists such as skylark, as these species prefer to nest in large open fields with low boundaries. In addition, the reduced field size could influence the future management of the field, for example making cereal crop production a less viable economic option for the farmer. However, given the abundance of large, open, undisturbed (by road noise) arable fields dominating the wider landscape (particularly to the north, east and south of the Link Area), this impact would be unlikely to have an effect beyond the site level, and would be unlikely to affect the conservation status of the local skylark population.

Overall effects

On balance, the Proposed Scheme would be likely to have a Slight Negative effect on the local bird population. It would be likely to have a Slight Negative effect on the local skylark population; however, it would be unlikely to impact upon the conservation status of this species.

8.6.1.3 Bats

Habitat loss - roosts

The removal of the recorded bat roosts would be undertaken under a European Protected Species (EPS) licence, requiring that the works be undertaken in a sensitive way at a specific time of year and that compensatory roosting habitat, most likely in the form of bat boxes, would be provided. To compensate for any under-recording, it would be necessary to provide generous compensation for the loss of confirmed and high potential roost habitat. Given that a EPS licence needs to be obtained to permit the removal of trees, it is considered unlikely that the Proposed Scheme would be implemented in such a way as to lead to a negative impact on the conservation status of any bats associated with the tree roosts, as a licence could not be issued on this basis.

Appendix 8.1 discusses the damage, destruction and obstruction of roosts and potential injury and killing of bats in relation to legislation and sets out the rationale for obtaining a EPS derogation licence to cover the works in respect of this species.

Habitat loss - foraging/commuting habitat

The 2014 transect surveys and 2015 static detector surveys identified that the Link Area supports regular foraging/commuting activity by common and soprano pipistrelle, noctule and big bats, with occasional passes by *Myotis* sp. and long-eared bat and very low numbers of passes of Nathusius' pipistrelle and barbastelle recorded. The greatest activity within the Link Area was recorded along the tree-lined Sheering Road, the edges of The Mores Wood, and the ponds to the south of The Mores Wood. However, with regard to *Mytois* and long-eared bats, the hedgerow/ditch leading north from The Mores Wood is the key area of activity within the site.

To construct the new link roads and connect these to Sheering Road, the removal of some trees along Sheering Road would be required. However, to reduce the visual intrusion of the Proposed Scheme on the residential properties located along the west of Sheering Road, large vegetated bunds would be created. The bunds would be approximately 1.5m Above Ground Level (AGL), and planted with a mixture of native trees and shrubs as shown in Figure 7-3: Landscape Mitigation, Sheet 4 of 7. The creation of the bunds would reinforce the linear receptor along Sheering Road.

No habitat loss along the western or southern edges of The Mores Wood, or in the vicinity of the ponds to the south or The Mores Wood is anticipated. Some tree removal along the eastern edge of the woods would be needed to construct the north-bound off-slip of the proposed junction. The landscaping plans include provision for reinforcing the woodland in this area by 'gapping–up' areas, and by creating new planting along the link road embankments as shown in Figure 7-3: Landscape Mitigation, Sheet 7 of 7 a gap of 5m would be retained in hedgerow W186 to allow continued access for farm vehicles). There would be no net loss of woodland in this area.

The ditch leading north from The Mores Wood would be culverted beneath the new link roads. The landscaping plan includes proposals to reinforce the linear habitat leading to, and away from, the 2x2m culvert entrances, with planting. This would allow light-shy species of bats, such as *Myotis sp.* and long-eared bats, to be directed into the culverts and beneath the road, as shown in Figure 7-3: Landscape Mitigation, Sheet 5 of 7. The culvert has been designed in combination with a 'hop-over' such that bats flying at canopy height and above would be able to continue to cross the site, flying over the new link roads. The underpass and hop-over design is illustrated in detail in Figure 8-2. Until the culverts, embankments and link roads are constructed, bats attempting to cross the site would be likely to take an alternative route, such as the line of trees/ponds to the south of The Mores Wood.

Concerning Gilden Way, the 2016 vantage point/crossing surveys and driven transect surveys recorded bats crossing the road at several points, and indicated low levels of background activity in the area. During the vantage point/crossing surveys the majority of bats observed crossed the Gilden Way above the height of the street lights. To widen the road, individual trees would be removed creating a wider gap between the tree canopies either side of the Gilden Way in some places. Large gaps could act as a barrier to dispersal for some species, for example long-eared bats, which prefer to fly in close proximity to vegetation (Entwistle *et al.*, 1996). However, not all of the canopy along the Gilden Way would be modified, and 'gap-shy' species, such as long-eared bat, were very rarely recorded along the Gilden Way during the baseline surveys. This indicates that the effects of the Gilden Way works upon bats would likely be quite limited, as the species present are 'gap-tolerant', flying above the traffic swept zone and would be able to cross safely.

Due to the constrained nature of the Proposed Scheme along the western half of the Gilden Way, there would be very little area available for planting; however, hedgerows and occasional standard trees would be planted locally wherever possible to provide planting. Over the whole length, the landscaping would provide replacement trees and hedgerows such that there was no net loss of these habitats along the Gilden Way. In addition, the Proposed Scheme would involve the creation of large areas of new habitat, with potential to support bat foraging and commuting (for example, hedgerow, tree and shrub planting along the link road embankments and new drainage ponds). Therefore, habitat loss associated with the Proposed Scheme would be unlikely to affect the conservation status of the local bat population. Habitat creation associated with the

Proposed Scheme could be beneficial to the local bat population through the provision of additional foraging resources.

Overall effects

On balance, with mitigation, the construction of the Proposed Scheme is considered likely to have a Slight Negative effect upon the local bat population.

8.6.1.4 Otter

Pollution of the water environment

The proposed mitigation, namely the adoption of good practice construction methods, would ensure that the risk of water pollution during the construction of the Proposed Scheme would be minimised.

Increased night-time light levels

Otters are present at low densities along the River Stort and the tributary Pincey Brook. Although no holts were recorded along the Pincey Brook during the 2014 surveys, not all areas were accessible and, as otters are expanding their range in Essex (Tansey, 2013); there is a risk that a holt could be present in the vicinity of the bridge. During the construction of the section of link road directly connecting to Sheering Road (Phase 2A, Section A, sub-phase B), some night-time working would be required. Some of the illuminated work area (around Chainage 0.000) is immediately adjacent to Pincey Brook and the bridge that carries Sheering Road across it. The Construction Programme indicates that the duration of this work would be around 20 days. As surveys have not been able to establish the absence of a holt near to the proposed location of the night-time working (and illumination), there is a risk that if a holt is present, then otters could be disturbed. However, it is unlikely that such short-term disturbance would lead to a change in the conservation status of the local otter population.

Appendix 8.1 discusses potential disturbance of otters in relation to legislation and sets out the rationale for undertaking pre-construction surveys for this species.

Overall effects

On balance, with mitigation, the construction of the Proposed Scheme is considered likely to have a Slight Negative to Neutral effect upon the local otter population.

8.6.1.5 Great crested newt

Habitat loss

No loss of ponds, or good quality terrestrial habitat, would occur within 100m of a breeding pond as a result of the Proposed Scheme. Hence there would not be any direct loss of key GCN habitat. The Proposed Scheme would deliver an increase in surface water habitat (highway drainage/attenuation ponds and open ditches) which would likely benefit the local GCN population.

A potential site for the Phase 1 construction compound has been identified as a fenced area of hardstanding located approximately 15m due north of the GCN pond within Gilden Way Meadow LWS. The habitat is currently generally sub-optimal for GCN but there are some opportunities for GCN such as cracks within the hardstanding and rabbit burrows. Due to the proximity of the site to the GCN population within the pond, there is a risk that GCN could be present within the area. To prepare the site for use as a construction compound, some ground works would be necessary, although measures to reduce ground works as far as possible have been proposed as part of the construction methodology (for example the use of self-supporting hoarding and root protection surfacing) and the timing of works has been selected to avoid the GCN hibernation season. There is, however, a small residual risk that the preparation of the compound area could lead to the injury or killing of individual GCN, although any such losses would be unlikely to affect the conservation status of this species at the local level.

Appendix 8.1 discusses the potential injury and killing of GCN in relation to legislation and sets out the rationale for obtaining an EPS derogation licence to cover the works in respect of this species.

Pollution of the water environment

Embedded mitigation, namely the adoption of good working practices (as set out in Chapter 13 - Road Drainage and Water Environment), would ensure that the risk of water pollution during the construction of the Proposed Scheme would be minimised. Further to this, the pond within the Gilden Way Meadow LWS appears to be fed by rainwater, and is hydrologically separate from Harlowbury Brook, other surface water channels and the existing Gilden Way carriageway drainage system. It is considered unlikely that surface water run-off during the construction phases would affect the pond within the LWS.

Overall effects

On balance, with mitigation, the construction of the Proposed Scheme would be likely to have a Neutral effect upon the local GCN population.

8.6.2 Operational mitigation

8.6.2.1 Locally designated sites

Without mitigation, the operation of the Proposed Scheme would likely lead to a Neutral effect on the Gilden Way Meadow LWS. Gilden Way Roundabout PWV would have been removed during construction. Therefore, neither site would require further mitigation.

8.6.2.2 Birds

Increase in traffic collision risk

It is considered that the hop-overs provided on the link roads, the acoustic fencing along the Gilden Way, and the reduction in the speed limit along the Gilden Way and Sheering Road would go some way to off-setting the increased risk of traffic collision due to increased levels of traffic. However, it is acknowledged that the new link roads and the general increase in traffic levels are likely to lead to an increase in mortality as a result of collision.

Increase in noise pollution

Acoustic fencing along the Gilden Way would minimise noise disturbance on birds in that area. Within the Link Area, the provision of landscaping planting and visual bunds is likely to reduce disturbance to birds arising from traffic generated noise. No changes to the conservation status of any bird species recorded within the Proposed Scheme is anticipated as a result of increased levels of traffic generated noise.

Increased night-time light levels

Gilden Way is currently lit by luminaires with Low-Pressure Sodium lights and therefore the bird population in this area is likely to have become accustomed to this disturbance effect. The lighting proposals involve the replacement of the existing columns and luminaires with new columns and less disturbing LED luminaires (BCT, 2014) at the same locations. Therefore, there is unlikely to be a significant effect on birds along Gilden Way arising from night-time lighting.

The introduction of lighting in the Link Area would reduce the suitability of these areas for foraging and therefore could impact species like owls; however, no changes to the conservation status of any bird species recorded within the Proposed Scheme is anticipated as a result of abundance of dark rural habitat in the area and affected habitat being suboptimal for foraging of these species (see Section 8.5.2). No mitigation is required for light impact too birds in the Link Area.

Overall effects

On balance, the Proposed Scheme is considered likely to have a Slight Negative effect upon the local bird population.

8.6.2.3 Bats

Increase in traffic collision risk

With regard to the Link Area interior, at present there are no roads (i.e. it is a large arable field), therefore bats active within this area are more likely to be more sensitive to traffic collision risk than those habituated to Gilden Way. The underpass and 'hop-overs', including the associated planting and lighting measures, have been designed to enable bats to cross the proposed link roads without having to fly through the traffic swept zone. However, the uptake of underpasses and hop-overs on other schemes has been variable (O'Connor and Green, 2011; Berthinussen, Altringham, 2012). Therefore, some bats could elect to cross the link roads at other locations where bat–specific mitigation measures were not put in place.

The landscaping proposals include scattered large trees (with species-rich grassland i.e. no understorey vegetation) along the southern embankment with woodland screening along the north. Consequently, it is anticipated that most bats (not using the underpasses or hop-overs) would cross at canopy height, as observed for the Gilden Way. For the light-shy species, the embankments located away from the underpasses and hop-overs, would not be shielded from street lighting by dense shrub vegetation and would be unlikely to be attractive.

The 2021 predicted vehicle numbers for the link roads between 7pm and 7am (the period when bats are largely active during the spring, summer and autumn months) is 550 vehicle movements per hour, or a vehicle every 6.5 seconds (east and westbound traffic combined). If bats elected to cross the link roads within the traffic swept zone i.e. if bats did not use the underpasses or hop-overs and did not cross at canopy height (as per bats along the Gilden Way) and fly across the road below 5mAGL, there is a clear risk that they would be hit by a vehicle. It is not considered possible to completely design out this risk. However, it should be noted that the numbers of bats recorded using this flight line was low, and the species currently recorded there are typically light shy and expected to avoid the lit carriageway, therefore the likelihood of collision would be low.

Increased night-time light levels

No increase in night-time light levels along the Gilden Way has been predicted to occur and therefore it is unlikely that there would be any associated disturbance impacts upon bats as a result.

The interior of the Link Area is currently unlit, as is Sheering Road to the west and the M11 to the east. The new motorway junctions and link roads would be lit by 10m tall luminaires (reduced to 6m at bat crossing points, as shown on the Figure 2-4 'Construction Environmental Plan') with LED lamps, located at approximately 30m centres along the new link and slip roads. Therefore the Proposed Scheme would lead to the illumination of previously unlit areas, including habitat used by foraging/commuting bats, although the design of the luminaires and lamp specification have been selected to minimise light spill onto sensitive habitats.

Light-shy species such as long-eared and *Myotis sp.* bats were most frequently recorded along the hedgerow/ ditch leading north from The Mores Wood. The design of the lighting around the culverts and 'hop-overs' where the new link roads cross the ditch, has taken account of the sensitivity of these species to light. Low-flying long-eared bats, which usually fly close to vegetation, would be guided along planted flight lines into the dark culverts, passing beneath the link roads. *Myotis sp.* bats, which usually fly higher up in the canopy, would be able to follow new planting up the embankment slope, and be directed up and over the traffic swept zone, in the short term by a physical barrier to flight (such as golf netting or expanded chain mesh) and in the medium to long-term, by dense established shrubs and trees. The luminaires adjacent to the 'hop-over' would be of the shorter specification (6mAGL) and shielded to prevent light spill above the horizontal, thus preserving a dark flight line in the upper canopy. As discussed earlier, the success of underpasses and hop-overs has been variable on other schemes, therefore a proportion of light-shy species could elect not to use these measures,

and being inhibited in their movement north by the street lighting along the link roads, could choose to use other flight lines to gain access to the wider area, or abandon The Mores Wood as a roost site altogether.

Sheering Road was recorded as a key flight line within the Link Area, used by several species of bat. The proposed link road would be situated parallel and to the east of the existing Sheering Road. Earth bunds and a noise barrier would be constructed between the two roads to visually screen the Proposed Scheme from the properties to the west. The new Sheering Road would have luminaires installed along the western edge, shielded to prevent light from being cast onto habitats located to the west. These measures would preserve a dark corridor along the existing Sheering Road and protect this as a key commuting/ foraging route.

Low numbers of bats were recorded foraging/commuting along the M11 embankments. The embankments would be subject to illumination as a result of the Proposed Scheme and therefore a reduction in general bat activity along these receptors would be likely. However, this area is not considered to be key to bats for foraging or commuting purposes, and only very occasional passes by light-shy species were recorded in this area. Additionally, the proposed underpass/'hop-over' would provide an alternative commuting route north to south or vice versa, ensuring the site continued to be permeable to bats.

Increased noise

The acoustic barriers along the Gilden Way, the visual bunds and acoustic barriers along Sheering Road and the proposed landscaping of the link road embankments and gapping up of woodland in the vicinity of The Mores Wood would all be likely to ameliorate the negative effects of traffic noise. However, a net increase around the Link Area would be inevitable, given the fact that there is no road there at present.

Overall effects

On balance, with mitigation the operation of the Proposed Scheme would be likely to have a Slight Negative effect on roosting bats and a Moderate Negative effect on bats with respect to commuting habitats.

8.6.2.4 Otter

Increase in traffic collision risk

The provision of a purpose-designed multi-species underpass beneath both link roads installed in combination with fencing, planting and sensitive lighting would likely reduce the risk of otters colliding with traffic to negligible levels.

Increased night-time light levels

The sensitive lighting design, whilst maintaining a dark corridor along key routes (i.e. along the Pincey Brook and along the unnamed watercourse and culvert entrances), would not avoid increasing night-time light levels in the general area. Consequently, there would be a temporary impact upon the local otter population arising from night-time light disturbance in the short term i.e. at the beginning of the operation phase. However, it is anticipated that any otters visiting the Pincey Brook would eventually become accustomed to discrete areas subject to slight illumination at night. The impact would reduce in the mid-long term to a neutral impact.

Overall effects

On balance, the assessment indicates that there would likely be a Neutral effect on the local otter population.

8.6.2.5 Great crested newt

Without mitigation, the operation of the Proposed Scheme would likely lead to a Neutral effect on the local GCN population. Therefore, no mitigation would be required.

8.7 Residual Effects

Table 8.8 indicates residual effects of the Proposed Scheme on the nature conservation of the area after all mitigation has been implemented. Further mitigation is suggested for areas where a residual effect is identified.

Table 8.8: Residual effects of the Proposed Scheme on nature conservation

Receptor	Residual effect
Habitats	A Slight Negative residual effect is predicted for Gilden Way PWV as it would be removed.
Birds	A Slight Negative residual effect is predicted for the local bird population and for skylark.
Bats	A Moderate Negative residual effect is predicted for bats in respect of commuting habitat, and a Slight Negative residual effect is predicted for bats roosting within the Proposed Scheme.
Otter	A Neutral to Slight Negative residual effect is predicted for otter.
GCN	No residual effect.

8.7.1 Recommendations for additional mitigation measures

8.7.1.1 Gilden Way Roundabout Protected Wildlife Verge

It is not considered necessary to provide further mitigation for the loss of the Gilden Way Roundabout PWV, because the Proposed Scheme would provide a significantly larger area of more ecologically valuable habitat.

8.7.1.2 Local bird population and skylark

It is not considered possible to mitigate for the residual effects on the local bird population as these are inherent in the Proposed Scheme and cannot be designed out.

As an additional measure, consideration could be given to the management of arable fields to the north and south of the Link Area to benefit skylark. This could be achieved by providing skylark nest plots within areas of crops for this species.

8.7.1.3 Bats

It is not considered possible to mitigate for the residual effects on the local bat population as these are inherent in the Proposed Scheme and cannot be designed out.

The assessment has predicted an impact on commuting bats arising from an increase in night-time light levels along the proposed link roads. It is recommended that bat activity is monitored to measure whether activity was reduced. To do this, monitoring surveys would need to replicate the static detector surveys undertaken to compile the baseline within the Link Area.

If future monitoring demonstrated a reduction in bat activity, given that street lighting cannot be removed from the Proposed Scheme altogether, the only realistic alternative (based on information available at the time of writing) would be to reduce the speed limit along the link roads, thus reducing the distance from the roundabouts requiring lighting, based on the five second rule as advocated by the International Commission on Illumination (CIE 115/2010) and the Institute of Lighting professionals (PLG02)[11]. This could provide several dark 'gaps' along the Eastbound Link Road, and one large dark 'gap' on the Westbound Link Road.

[11] CIE 115/2010 and PLG02 recommend that the extent of road lighting should be the distance that a vehicle would travel for five seconds at the expected traffic speed.

8.7.2 Summary of mitigation required to ensure legislative compliance

A Legislative Compliance Report is presented as Appendix 8.1. The key measures necessary to ensure compliance concerning species and habitats considered within this EIA, includes:

- timing to avoid removal of bird habitat within the nesting season;
- application for EPS licence in respect to bats, including mitigation such as timing of works, pre-felling climbing inspections, soft-felling techniques and the presence of an Ecological Clerk of Works during sensitive works, and compensation for the loss of roost sites through bat box erection in retained trees;
- application for EPS licence in respect to GCN at the Phase 1 site compound, including mitigation such as timing of works, staged vegetation removal, translocation of GCN, destructive hand search of potential GCN refugia and the presence of an Ecological Clerk of Works during sensitive works;
- pre-construction checks for otter along the Pincey Brook (and application for EPS licence for otter if a holt is recorded within the zone of influence of the works); and
- post-development monitoring to ensure the efficacy of mitigation measures.

With regards to compliance with legislation pertaining to species presence within the study area but scoped out of this assessment, namely badger and reptiles, further work includes:

- pre-construction checks for badger within a 50m buffer of the construction footprint (and an application for a sett-closure licence if required); and
- habitat manipulation to displace reptiles from the Proposed Scheme boundary.

8.8 Cumulative Effects

Harlowbury and Newhall Farm are two large residential developments with planning consent located immediately to the north and south of Gilden Way respectively. Together, these developments would provide in the region of 3,500 new homes.

In addition, the Harlow local Plan indicates that the land around the Proposed Scheme (Link Area area) would be subject to commercial/light industrial use in the future.

In combination, these developments would be likely to lead to the following impacts:

- habitat loss and fragmentation, leading to reduction in habitat suitable for a range of protected species and isolation of some populations;
- increase in traffic leading to increased risk of collision (birds, bats, otter, badger, GCN), increased air pollution, increased risk of surface water pollution events (i.e. due to spillages on roads), increase noise;
- Increase in numbers of cats, leading to increase in predation of birds, bats, amphibians and reptiles; and
- Increased night-time light levels.

A Slight Negative effect might therefore be expected for birds, in respect of the loss of nesting habitat, for bats in respect of loss of flight lines and lighting impacts, and on birds, bats, amphibians and reptiles in respect of cat predation.

8.9 Summary and Conclusions

The proposed impacts, mitigation and residual effects for nature conservation and ecology are summarised in Table 8.9 below.

Table 8.9: Summary of impacts on ecological receptors

Receptor and effect	Significance of effect (after mitigation)	Possible additional mitigation	Residual effect (after additional mitigation)
Locally designated sites	Slight Negative	None	Slight Negative
Birds – other than skylark	Slight Negative	None	Slight Negative
Skylark – fragmentation of arable habitat leading to loss of nest sites	Slight Negative	Increased number of skylark plots in nearby arable fields	Neutral
Bats – increase in night-time light levels leading to loss of commuting habitat	Moderate Negative	Monitoring to assess success of underpasses and hop-overs. If unsuccessful, revision of lighting scheme along link roads would provide dark corridors through Link Area north of The Mores Wood	Slight Negative
Otter	Neutral to Slight Negative	None	Neutral to Slight Negative
GCN	Neutral	None	Neutral

9. Geology and Soils

9.1 Introduction

This Chapter presents the assessment of geology and soils undertaken at DMRB Stage 3 for the Proposed Scheme. It specifically describes the existing geological and hydrogeological baseline setting and identifies potentially significant impacts with the construction and operation of the Proposed Scheme. It also details any mitigation required to reduce those impacts.

Geology and soils are an integral part of the environmental characteristics of a location. Geology influences the landforms present and provides parent material from which soils are created. Bedrock strata (and occasionally superficial strata) can provide a source of groundwater abstraction used for domestic, agricultural and industrial water supply whilst soils provide the basis for food production and support for ecological habitats.

This Chapter also presents an assessment of the potential impacts of the Proposed Scheme on ground and surface water quality and the potential implications of the existing land quality on both the construction and operational phases of the Proposed Scheme. The assessment also considers potential sources of contamination identified from a desk-based assessment and from actual site investigation data to assess the risk to potential receptors.

Additional information to support this chapter is presented in the following locations:

- Appendix 9.1: Local Authority and Environment Agency Correspondence; and
- Envirocheck Report (available upon request).

9.1.1 Legislative and planning context

The following legislation, policy and guidance have been referenced in the production of this chapter:

- Design Manual for Roads and Bridges, Volume 11, Section 3, Part 11, Geology and Soils (HE, 2009), overall standard used for highways schemes EIAs;
- Part 2A of the *Environmental Protection Act (EPA) 1990*, Statutory Guidance - legislation on land contamination and Defra (2012) – supporting document on how legislation should be implemented;
- Contaminated Land Report 11: Model Procedures for the Management of Land Contamination, EA (2004) – primary guidance used for contaminated land assessment;
- The Water Framework Directive (WFD) (2015) - framework for the protection of inland surface waters (rivers and lakes transitional waters (estuaries), coastal waters and groundwater, which includes risks from contamination guidance - used for water quality assessment;
- Construction Industry Research and Information Association C665, 2007 – guidance used for gas assessment; and
- National Planning Policy Framework, National Planning Practice Guidance (NPPG) and the local planning policies of ECC, Harlow Council and Epping Forest District Council (detailed in Chapter 3 – Development of the Proposed Scheme, Section 3.4).

9.1.2 Study area

The study area for this assessment is defined as the route of the Proposed Scheme and the area in the vicinity of the route that could be impacted by the Proposed Scheme or the area for which ground conditions could impact the Proposed Scheme itself. For the purpose of this assessment this is generally considered to be approximately 250m on either side of the route; however, this could be increased or decreased depending on the potential magnitude of impact or the sensitivity of receptors. The study area, including the 250m buffer is shown on Figure 9-1.

9.2 Assumptions and Limitations

Part of this assessment is based on a desk based review of a number of sources of information that Jacobs has assumed to be reliable. The assessment is based on data available at the time of the study and the observations made at the time of the GI undertaken for the Proposed Scheme. It should be noted that ground and groundwater conditions could vary between the locations investigated in the GI. Ground gas monitoring was undertaken at boreholes along the M11 to the Gilden Way north (up to Marsh Lane) only. No gas monitoring was undertaken along the Gilden Way South (from Marsh Lane to the London Road Roundabout) due to access and traffic management restrictions at the time of the GI. Due to the absence of the gas data, a gas risk assessment has only been undertaken for the M11 to the Gilden Way north, see Figure 9-1 for a borehole location plan of the site.

Since M11 Junction 7A GI was completed, the Proposed Scheme design has evolved, including moving the Eastbound and Westbound Link alignments to the south, changing the location and alignment of the Pincey Brook Roundabout and extending the southbound off slip of the M11 motorway to the north (see Section 3.1). As the design changes were made after the GI was undertaken, some areas of the Proposed Scheme have not been specifically targeted by GI. Assumptions have therefore been made in this chapter on the anticipated ground conditions of these areas.

9.3 Methodology and Assessment Criteria

9.3.1 Methodology

The assessment of potential impacts on geology and soils has been undertaken in general accordance with the guidance provided in DMRB, Volume 11, Section 3, Part 11, Geology and Soils. However, DMRB provides limited detailed guidance on the assessment of potential impacts relating to geology and soils and some of the guidance has been superseded since the document was produced. Therefore, an element of professional judgement has been applied when assessing impacts and the DMRB guidance has been adapted to take account of current legislation and guidance as outlined in Chapter 4.

A number of different methodologies have been used in the studies to which this chapter refers. These are discussed below:

- Desk studies - desk studies were initially undertaken for the Proposed Scheme to gather relevant information on baseline conditions of geology and soils along the route. The topics researched and the sources of information consulted are given in Section 9.4 ‘Baseline Environment’ of this chapter.
- The GI data were assessed using the following methodologies:
  - Soils assessment (Human Health) (Defra, 2014a) - Category 4 Screening Levels and Suitable 4 Use Levels were used to assess the risks from soil contamination to human health. Given the nature of the Proposed Scheme, the site covers a range of land uses and therefore data have been screened against residential (with plant uptake), allotment and commercial/industrial end use screening criteria. It is considered that this is a conservative approach to assessment. The most relevant land use to the end use of the Proposed Scheme as a road is considered to be more closely modelled by a commercial/industrial use. However, assessment against residential and allotment end uses provides a useful indication of the significance of the chemical concentrations of soil samples for more sensitive uses of the land.
  - Soils assessment (Possible Waste Disposal) - a waste assessment for soils encountered during the GI was first made using HazWaste online. This uses WM3 (EA, 2015) methodology to classify waste as either “Hazardous” (European Waste Catalogue Code 17-05-03*) or “Non Hazardous” (EWC Code 17-05-04). Waste Acceptance Criteria (WAC) testing was also undertaken to assess the suitability of materials for the potential disposal to landfill, should this be required.
  - Groundwater assessment - results from the chemical testing of groundwater samples were assessed against Environmental Quality Standards (EQS) available within the ‘The Water Framework Directive’ Directions, 2015 or UK Drinking Water Standard (DWS).
  - Gas risk assessment - ground gas monitoring data collected from GI was assessed using the CIRIA C665, 2007b guidance.

- Contamination source - pathway - receptor risk assessment - the Contaminated Land Report 11 guidance was followed for the contamination risk assessment and Conceptual Site Model (CSM) (Figures 9-3 and 9-4). Preliminary risk assessments were developed in the two desk studies undertaken by Jacobs for the Proposed Scheme. These were then updated following the GI using the data obtained to refine the risks from soil, groundwater and gas. The updated CSM is included in this chapter.
- Consultation - to gather additional baseline information on geology and soils, ECC; Harlow Council; Epping Forest District Council; and the EA were all approached to obtain information on the route. Initial contact was made on 30th October 2015 with additional information requested on 26th July 2016.

  Information was requested regarding:

  - contaminated land issues/designations;
  - historical land uses/general knowledge of the area;
  - pollution incidents;
  - water abstractions;
  - ground gas and aggressive ground issues;
  - historical and recorded landfills and other waste management facilities;
  - environmentally sensitive sites; and
  - any other issues relevant to the environmental setting.

9.3.2 Assessment of value of receptors, magnitude and significance

Environmental impacts for geology and soils in this chapter are expressed in terms of the significance of their effect, both positive and adverse. Table 9.1 has been used to assess the magnitude of impacts and Table 9.2 to assess the value of receptors.

Table 9.1: Determining the magnitude of the impact

Magnitude	Typical criteria descriptors	Topic specific criteria
Major	Loss of resource and quality and integrity of resource; severe damage to key characteristics, receptors or elements	**Soil quality** Permanent loss or sterilisation of identified BMV soil resources. **Contamination** Chronic damage to human health likely to result in “significant harm” as defined by *Environmental Protection Act (EPA) 1990* Part 2A. Long term risk to sensitive water resource. Catastrophic damage to buildings/properties. A short term risk to a particular ecosystem or organism forming part of that system. **Site of geological importance** Severe damage to the site so that it is unrecognisable compared to baseline conditions. **Geological resources** Total loss/sterilisation of the identified reserve/resource. **Groundwater and surface water** Major permanent or long-term change to groundwater or surface water quality. Existing resource use irreparably impacted upon. Changes to quality or water table level would have an impact upon local ecology.
	Large scale or major improvement of resources quality; extensive restoration	**Soil quality** Permanent gain or creation of new BMV soil resources. **Contamination**

Magnitude	Typical criteria descriptors	Topic specific criteria
	or enhancement; major improvement of attribute quality	Removal of all identified pollutant linkages that pose a risk to identified receptors. **Site of geological importance** Improvements of the site so that key characteristics/receptors are significantly enhanced or new receptors of interest are exposed. **Geological resources** Extraction and beneficial reuse of the identified reserve/resource. **Groundwater and surface water** Major permanent or long-term improvement of groundwater or surface water quality, local ecology or available groundwater yield.
Moderate	Loss of resource, but not adversely affecting its integrity; partial loss of/damage to key characteristics, receptors or elements	**Soil quality** Reduction in quality of the BMV soil resources. Loss or sterilisation of other soil resources. **Contamination** Acute damage to human health. Pollution of sensitive water resource. Significant change to an ecosystem or organism forming part of that ecosystem. **Sites of geological importance** Partial loss of the key characteristics of the site. **Geological resources** Permanent sterilisation of a significant part (>50%) of the identified reserve/resource or extraction and beneficial reuse of a significant part (>50%) of the identified reserve/resource. Loss of access to the whole of the identified resource (although the reserve/resource remains intact). **Groundwater and surface water** Changes to the local groundwater regime or slight impacts to surface water quality, predicted to have a slight impact on resource use. Minor impacts on local ecology could result.
	Benefit to, or addition of key characteristics, receptors or elements; improvements of attribute quality	**Soil quality** Measurable reduction in quality of other soil resources. **Contamination:** Removal of the majority of identified pollutant linkages so that risks to receptors are reduced. **Sites of geological importance** Improvements to the key characteristics of the site. **Geological resources** Partial (greater than 50%) or total creation of a geological site of medium value by, for example, exposing geology previously obscured from view or creation of part (between 15% to 50%) of a geological site of high to very high value. **Groundwater and surface water** Changes to the local groundwater regime or surface water quality predicted to result in a moderate improvement to resources, water quality or to local ecology.

Magnitude	Typical criteria descriptors	Topic specific criteria
Minor	Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to minimal key characteristic, receptors or elements	**Soil quality** Measurable reduction in quality of other soil resources. **Contamination** Harm which may not be significant and may result in financial loss, or expenditure to resolve. No permanent effects to human health (preventable by PPE). Easily repairable effects of damage to buildings, structures and services. **Sites of geological importance** Minor loss of the key characteristics of the site. **Geological resources** Partial (less than 50%) loss of a geological site of medium value. **Groundwater and surface water** Changes to groundwater or surface water quality, groundwater levels or yields, not representing a risk to existing resource use or ecology.
	Minor benefit to, or addition of, one (or maybe more) key characteristic, receptors or elements; some beneficial effect on attribute or a reduced risk of negative effect occurring	**Soil quality** Measurable improvement in quality of other soil resources. **Contamination** Removal of some identified pollutant linkages so that risks to receptors are reduced slightly. **Sites of geological importance** Minor improvements to the key characteristics of the site. **Geological resources** Partial (less than 50%) creation of a geological site of medium value by, for example, exposing geology previously obscured from view. **Groundwater and surface water** Changes to groundwater or surface water quality, groundwater levels or yields, representing a minor improvement to existing resource use or ecology.
Negligible	Very minor loss or detrimental alteration to one (or maybe more) characteristic, receptor or element	Very slight or no change from baseline conditions.
	Very minor benefit to, or positive addition of, one (or maybe more) characteristic, receptor or element	Very slight or no change from baseline conditions.
No change		No loss or alteration of characteristics, **receptor**s or elements; no observable impact in either direction.

Table 9.2: Determining the value of the receptors

Sensitivity	Typical descriptors	Topic specific criteria
Very High	Very high importance or rarity on an international scale, and with very limited potential for substitution; and/or Very high sensitivity to change, or has very little capacity to accommodate a change	**Soil quality** - Agricultural Land Classification (ALC) Grade 1 land – excellent quality soil, Best Most Versatile (BMV). **Human receptors** Human Receptors i.e. construction workers, future site users, maintenance workers, adjacent land users and future construction workers. **Controlled waters - groundwater** Principal aquifer providing a valuable resource because of its high quality and yield, or extensive exploitation for public and/or agricultural and/or industrial supply. Source Protection Zone (SPZ) 1 (Inner Protection Zone). Designated sites of nature conservation dependent on groundwater. **Controlled waters - surface water** Internationally important watercourses. Public water supplies. **Listed sites of geological importance** Geology has an international designation (i.e. Geopark status) and/or has a very low capacity to accommodate change. **Geological resources** Geological resource safeguarding area (international importance).
High	High importance or rarity on a national scale, limited potential for substitution; and/or High sensitivity to change, or has little capacity to accommodate a change	**Soil quality** - ALC Grade 2 – very good quality (BMV) soil; and - ALC Subgrade 3a – good quality (BMV) soil. **Controlled waters - groundwater** Secondary A aquifer capable of supporting water supplies at a local scale and forming an important source of base flow to significant surface waters. SPZ 2 (Outer Protection Zone). Local areas of nature conservation known to be sensitive to groundwater impacts. **Controlled waters - surface water** Nationally and regionally important watercourses. Public water supplies. **Listed sites of geological importance** Geology has a national designation (i.e. SSSI) and/or has a very low capacity to accommodate change. **Geological resources** Category 1 Aggregates Safeguarding Area (National Importance).
Medium	High or medium importance or rarity on a regional scale, limited potential for substitution; and/or Moderate sensitivity to change, or moderate capacity to accommodate	**Soil quality** - ALC Subgrade 3b – moderate quality soil. **Controlled waters - groundwater** Secondary B aquifer and/or poor groundwater quality and/or low permeability make exploitation of groundwater unlikely. SPZ3 (Source Catchment Protection Zone). Changes to groundwater not expected to have an impact on local ecology.

Sensitivity	Typical descriptors	Topic specific criteria
	a change	**Controlled waters - surface water** Main rivers within a catchment. Locally important water courses. Private water supplies serving three or more properties. **Listed sites of geological importance** Geology has a local or regional designation (i.e. RIGS, LoGS) and/or has a low capacity to accommodate any change. **Geological resources** Category 2 Aggregates Safeguarding Area (local and regional importance).
Low	Low or medium importance or rarity on a local scale; and/or Not particularly sensitive to change, or has considerable capacity to accommodate a change	**Soil quality** - ALC Grade 4 – poor quality soil; and - ALC Grade 5 – very poor quality soil. **Controlled waters - groundwater** Very poor groundwater quality and/or very low permeability making exploitation of groundwater unfeasible. No known past or existing exploitation of this water body. Changes to groundwater are irrelevant to local ecology. **Controlled waters - surface water** Minor watercourses or water bodies. **Listed sites of geological importance** Geology not listed but possesses key characteristics which could be locally important and/or has a high capacity to accommodate change. **Geological resources** No mineral resources identified.
Negligible	Very low importance or rarity on a very local scale; and/or Not sensitive to change, or has very considerable capacity to accommodate a change.	**Soil quality** - Urban land - No soil present. **Controlled waters - groundwater** Groundwater which for this sensitivity includes: strata not classified as an aquifer under the WFD. **Controlled waters - surface water** Very minor watercourses or water bodies. **Listed sites of geological importance** Geology is non-distinctive and/or is likely to tolerate the proposed change or there are no listed sites. **Geological resources** No mineral resources identified.

9.3.3 Conceptual site model and contamination risk assessment methodology

The risk to receptors from existing contamination is assessed by identifying the main potential contamination source – pathway – receptor linkages. The method for risk evaluation is based on guidance in CIRIA (2001) 'C552: Contaminated Land Risk Assessment - A Guide to Good Practice' but adapted slightly to be more suitable for use in an environmental assessment. This is a qualitative method of interpreting the risks based on magnitudes of impacts and the probability (likelihood) of the risk occurring. The matrices used to estimate risk scores are presented below in Tables 9.3 to 9.5 with the magnitude of the impact defined in Table 9.1 above.

Table 9.3: Estimation of likelihood

Classification	Definition
High Likelihood	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term or there is evidence at the receptor of harm or pollution.
Likely	There is a pollutant linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low Likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period, such an event would take place, and it is even less likely in the shorter term.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long term.

Table 9.4: Estimation of risk (likelihood combined with severity)

Risk matrix		Consequence (severity)			
		Major	Moderate	Minor	Negligible
Probability (likelihood)	High Likelihood	Very High	High	Moderate/Low	Low
	Likely	High	Moderate	Low	Very Low
	Low Likelihood	Moderate	Moderate/Low	Very Low	Very Low
	Unlikely	Moderate/Low	Low	Very Low	Very Low

A description of the risks from Table 9.4 above is given in Table 9.5 below.

Table 9.5: Risk description

Risk	Risk description
Very High	There is a high likelihood of the event occurring with severe consequences. If the risk is realised it is likely to result in a substantial liability.
High	It is likely that an event with medium or even severe consequences could arise. If the risk is realised it could result in a substantial liability.
Moderate	It is possible that an event could occur and it is either unlikely and consequences could be severe or if it were to occur it is likely that consequences would be relatively mild. Further investigation would normally be required to clarify the risk and determine the potential liability.
Low Risk	It is possible that an event could occur but it is likely that the consequences would be at worst mild.
Very Low	It is unlikely that an event could occur, and if it happened the consequences would be likely to be at worst mild.

9.4 Baseline Environment

9.4.1 Baseline sources

Sources of baseline data are provided in this section. This topic is defined by four main receptor groups. Table 9.6 summarises these groupings and how the baseline conditions are characterised.

Table 9.6: Topic baseline characterisation

Receptor	Data sources
Soil Quality – Soil type and ALC grading	Baseline conditions for soil quality have been assessed through review of commercially available data from: • Cranfield Soilscapes website (http://www.landis.org.uk/soilscapes) accessed January 2016; and • Ministry of Agriculture, Fisheries and Food (MAFF) (1988), ALC of England and Wales, revised guidelines and criteria for grading the quality of agricultural land.
Geology, Hydrogeology and Hydrology	Baseline conditions for geology, hydrogeology and hydrology have been assessed through review of published information and GI data from: • British Geological Survey (BGS) website http://www.bgs.ac.uk/ [Accessed January 2016]; • Landmark Envirocheck reports: M11 Junction 7A, 48621199_1_1 dated 22/08/13 and Gilden Way, 73748199_1_1 dated 15/10/15; • Explosive Ordnance risk was assessed by review of Dynasafe Bactec Ltd., Explosive Ordnance Threat Assessment Desk Study, Document No. 6025TA, Rev 0, May 2015 and updated Dynasafe Bactec Ltd., Explosive Ordnance Threat Assessment Desk Study, Document No. 6025TA, Rev 1, October 2015; and • Jacobs GI Report, 2016 and Soils Ltd., Factual GI Report, Reference 15096/GIR, April 2016.
Sensitive Sites – Including Mineral Safeguarded Sites and Geological Sites	Baseline conditions for sensitive sites have been assessed with reference to: • Essex County Council (ECC) Website (https://www.essex.gov.uk/Environment%20Planning/Planning/Minerals-Waste-Planning-Team/Planning-Policy/minerals-development-document/Pages/Default.aspx); and • The GeoEssex website (http://www.geoessex.org.uk/), both assessed May 2016.
Land Quality – information on sources and receptors to potential contamination including: human health, controlled waters and soils	Baseline conditions for land contamination were identified through review of the following sources: • Historical land use - Landmark Envirocheck reports: M11 Junction 7A, 48621199_1_1 dated 22/08/13 and Gilden Way, 73748199_1_1 dated 15/10/15; • The EA website (http://maps.environment-agency.gov.uk/wiyby) - assessed in January 2016; • Jacobs GI Report, 2016 and Soils Ltd., Factual GI Report, Reference 15096/GIR, April 2016; • Consultation Response: Harlow Council, ECC and Epping Forest Direct Council and the EA (Appendix 9.1); and • Site reconnaissance - undertaken in July 2016.

As outlined in Table 9.6 the information in this chapter has been obtained from a combination of published data, consultation responses and from the Jacobs GI. The GI fieldwork was carried out between October 2015 and February 2016 and included: groundwater monitoring and analysis, geo-environmental laboratory testing and post GI gas monitoring (completed between January and March 2016). The borehole locations and the geology of the study area are indicated on Figure 9-1. The chemical quality data obtained from the GI is summarised in the land quality section of this chapter.

9.4.2 Baseline conditions

9.4.2.1 Soil quality

Soil type

The soils underlying the western section of the Proposed Scheme including Gilden Way and Sheering Road are classed as “freely draining slightly acid but base rich soils”. In terms of groundwater vulnerability for the majority of this section, soils are classed as “Soils of Intermediate Leaching Potential (I1)”; these soils can possibly transmit a range of pollutants. In a small area close to Old Harlow the soils are classed as “Soils of High Leaching Potential (U)”.

The soils underlying the eastern section of the Proposed Scheme including the existing M11 are classed as “lime rich loamy and clayey soils with impeded drainage”. The impeded drainage could potentially cause overland flow where soils are compacted. The soils in this area are not classed in terms of groundwater vulnerability as this area is underlain by unproductive strata. In one small area around The Campions, the soils are classed as “Soils of Intermediate Leaching Potential (I1)” (Cranfield University, 2016).

Agricultural land classification

The Agricultural Land Classification (ALC) system set out within Agricultural Land Classification of England and Wales: Revised Guidelines and Criteria for Grading the Quality of Agricultural Land (MAFF, 1988) defines six grades of soils: Grade 1 (excellent quality), Grade 2 (very good quality), Subgrade 3a (good quality), Subgrade 3b (moderate quality), Grade 4 (poor quality) and Grade 5 (very poor quality). Grades 1 to Subgrade 3a are determined as BMV agricultural land. This is the most flexible land in terms of the range of crops that can be grown, the level and consistency of yield and the cost of obtaining it, and offers the best prospect for both food and non-food crop production. Land in sub-grade 3b is of moderate quality with lower yields, and/or a more restricted cropping range.

For the Proposed Scheme area, only provisional ALC data were available, obtained from the post 1988 survey published by NE. Based on these data, the majority of the eastern scheme area would be classified as ALC Grades 2 and 3, with urban land to the west (see Figure 9-5). Following the above guidance, ALC Grade 2 land is classified as BMV, which is considered a high sensitivity receptor. Agricultural land Classification Grade 3 land is classified as moderate/good quality and could potentially be BMV. Without a more detailed assessment it has been assumed that the Grade 3 land is Grade 3a. This would therefore also be considered a high sensitivity receptor. Based on the current Proposed Scheme design, approximately 26.3ha (53%of Proposed Scheme area) is classified as Grade 2, approximately 16.5ha (33% of Proposed Scheme area) as Grade 3 and approximately 6.8ha (14% of Proposed Scheme area) as urban land. These areas include temporary land use during construction as soil in these areas could potentially be impacted by the Proposed Scheme. Chapter 12 – People and Communities, discusses the potential permanent land take impacts to agricultural land.

9.4.2.2 Geology, hydrogeology and hydrology

Published geological mapping has been used to inform this baseline subsection together with information from the Envirocheck reports. The GI information provides site-specific geological and hydrological information.

Geology

Published geology

The majority of the Proposed Scheme is underlain by superficial deposits of the Lowestoft Formation (Diamicton), with head deposits in a narrow band running parallel west to east across the study area towards the existing M11 and extending south through the central section of the Gilden Way. A band of alluvium to the north of the head deposits extends in a parallel band across the area, following the approximate path of the Pincey Brook. In addition, there is a band of glaciofluvial deposits in the western section of Gilden Way. The area in the vicinity of the M11, to the east of Gilden Way, is underlain by the London Clay Formation, which thins towards the west. In the centre of the proposed Gilden Way, London Clay is absent (where it has been eroded away). Where the London Clay is absent the underlying older Thanet Sand Formation and Lambeth Group (undifferentiated clay silt and sands) are revealed and then the older still Lewes Nodular Chalk Formation and Seaford Chalk Formation (undifferentiated), which are shown to subcrop beneath the superficial deposits. Table 9.7 summarises the published geology for the study area.

The British Geological Society (BGS) artificial and reworked ground data are shown on Figure 9-1. The BGS artificial ground map shows an area of made ground directly south east of the Churchgate Roundabout. This area is now marked as a recreation ground. There is another area marked immediately north of the Pincey Brook extending to the west and slightly across Sheering Road. In addition, the general area is known to have been extracted for sand, gravel and clay and as a consequence, there are a number of potentially infilled pits within the scheme area. It should be noted that the precise locations of all of these areas cannot be confirmed. The Envirocheck historical land use information indicates the location of some potentially infilled areas noted as resulting from brick and clay manufacture. These are located to the west and east of Marsh Lane, and to the west and east of Sheering Road. A number of these areas match areas of known pits (Figure 9-2). Additionally, made ground is expected in areas of existing roads, with some areas of reworked ground, infilled pits and demolished buildings also expected.

Table 9.7: Summary of published geology

Geological unit	
Superficial	Alluvium Deposits
	Head Deposits
	Lowestoft Formation
	Glaciofluvial Deposits
Bedrock	London Clay
	Lambeth Group and Thanet Sand Formation (undifferentiated)
	Lewes Nodular Chalk Formation and Seaford Chalk Formation

Geology encountered during the ground investigation

The GI broadly confirmed the published geology in the scheme area. Figure 9-1 shows the investigation locations. The majority of the ground encountered during the investigation was assessed as natural. Made ground was only identified at BH1 and BH2 (on the M11 embankment), and WS1, 2, 10, 11 and 12 (along Gilden Way). Minor amounts of anthropogenic materials were observed in the made ground which largely comprised brick and concrete fragments with lesser amounts of metal, glass and tarmac. No significant visual or olfactory indications of contamination were encountered during the investigations.

Ground conditions

Ground stability

The data reports procured from Envirocheck were reviewed to provide information on the potential ground conditions for the Proposed Scheme in relation to the potential for ground instability from dissolution, landslides, running sand and potential for shrinking clays. The review presented here is a summary of ground stability issues across the Proposed Scheme and detailed geotechnical assessment is being undertaken as part of the engineering design process.

The Proposed Scheme would encounter a range of geological conditions and therefore the potential risks identified would be variable throughout the scheme area. Risk from the potential collapse from ground stability hazards ranges from 'no hazard' to 'very low'. The risk from potential compressible ground stability hazards for most of the scheme is given as 'no hazard' or 'very low' with some areas assessed as 'moderate risk' including the following area of the M11 to the Gilden Way north (up to Marsh Lane): Grid Ref: 548805, 212522, and Grid Ref: 548671, 212085. In the Gilden Way area, areas assessed as 'moderate risk' are: Grid Ref: 548580, 212082. There was 'no hazard' identified for potential for ground dissolution stability hazards. The potential for landslides and running sand is identified as 'very low' to 'low' with the potential risk from shrinking clays identified as 'very low' or 'low' for most areas with one location in the M11 to the Gilden Way north area (Grid Ref: 548789, 212443) identified as 'moderate risk'. To provide locational context, the four areas identified as 'moderate risk' for ground instability are indicated on Figure 9-2.

Unexploded Ordnance

The risk of Unexploded Ordnance (UXO) in the study area was initially assessed by Dynasafe Bactec Ltd. in May 2015 as 'Low' to 'Medium'. Details of the assessment and recommended risk mitigation measures are provided in the Dynasafe Bactec Ltd., Explosive Ordnance Threat Assessment Desk Study, Document No. 6025TA, Rev 0, May 2015 (superseded by Rev 1).

Anecdotal evidence of World War II UXOs between the M11 motorway and Gilden Way/Mayfield Farm area was subsequently provided by the landowner before the recent GI commenced. The anecdotal evidence includes details of the following findings:

- 1970 - three or four German 1kg incendiary bombs were discovered within a farmer's field following agricultural ploughing to depths of approximately 200-350mm; and
- 1991 to 1993 - similar to the previous incident, three or four German 1kg incendiary bombs found during ploughing and were subsequently destroyed.

In light of the new information, the risk of UXOs was amended by Dynasafe Bactec Ltd. to Medium. Further details are provided in the updated Dynasafe Bactec Ltd., Explosive Ordnance Threat Assessment Desk Study, Document No. 6025TA, Rev 1, October 2015. Dynasafe Bactec Ltd.'s recommendation for a non-intrusive magnetometer survey and targeted investigation was adopted during the recent GI undertaken at the scheme. First Line Defence Ltd. carried out the non-intrusive magnetometer survey during which 4,213 magnetic anomalies were identified. First Line Defence Ltd. has also recommended that a targeted investigation is carried out prior to construction works commencing. Further details are provided in the 1st Line Defence Ltd., Report on UXO, Non-Intrusive Magnetometer Survey, Report Reference OPN2825NIS, 27 November 2015 (see Soils Ltd., Factual Ground Investigation Report, Reference 15096/GIR, April 2016 for full report).

Hydrogeology

Published hydrogeology

The aquifer classification status for each of the geological units is presented within "Chapter 13 - Road Drainage and the Water Environment" to which reference should be made. A summary of the aquifer classifications is presented in Table 9.8 and discussed briefly in the text below.

Table 9.8: Summary of the published hydrogeology

Geology type	Formation name	Aquifer classification
Superficial	Alluvium Deposits	Secondary A Aquifer
	Head Deposits	Secondary (undifferentiated)
	Lowestoft Formation	Unproductive Strata*
	Glaciofluvial Deposits	Secondary A Aquifer
Bedrock	London Clay	Unproductive Strata
	Lambeth Group and Thanet Sand Formation (undifferentiated)	Secondary A
	Lewes Nodular Chalk Formation and Seaford Chalk Formation	Principal

***Note the EA website groups the Head deposits and Lowestoft together as Secondary (undifferentiated) Aquifers. However, this is at a large scale (1:75,000). The Envirocheck reports class the Lowestoft Formation as 'Unproductive Strata'. Although the Lowestoft Formation contains pockets of more permeable sand and gravel (Glaciofluvial Deposits – Secondary A Aquifer), the formation is mostly comprised of clay, with a low permeability and would therefore not be considered as a significant water resource.**

The EA's bedrock aquifer map and groundwater vulnerability map shows the majority of the study area to be within a non-aquifer zone (London Clay), classified as unproductive strata. The eastern and western area of Gilden Way is classified as a Secondary A Aquifer of intermediate vulnerability (Thanet Sand Formation and Lambeth Group) with the centre (extending north and south) classified as a Principal Aquifer of high vulnerability (Lewes Nodular Chalk Formation and Seaford Chalk Formation).

The EA classifies the superficial deposits of head as Secondary Undifferentiated Aquifers with the glaciofluvial deposits and alluvium deposits classified as Secondary A Aquifers. The head, alluvium and glaciofluvial deposits have a high-intermediate groundwater vulnerability classification. The Lowestoft Formation is classified as unproductive strata (see Table 9.8 above) and has negligible significance for water supply or river base flow.

The study area for this chapter does not fall within a Source Protection Zone (SPZ).

Hydrogeology encountered during the ground investigation

Groundwater level data were collected between December 2015 and January 2016 from 22 boreholes located in the east of the study area between Mayfield Farm and the M11 carriageway. Groundwater levels were found to vary between 0.5m below ground level (bgl) in BH29 next to Ealing Bridge and 16.1m bgl in BH19 north east of the M11 Junction 7A Dumbell Roundabout (Westbound). The groundwater level data available show variable groundwater levels across the Proposed Scheme (see Figure 9-1 for borehole locations).

Hydrology

Published hydrology

Hydrology is covered in "Chapter 13 - Road Drainage and the Water Environment" including information on flood risk.

There are two brooks within the study area: Pincey Brook, which crosses under the existing M11 and the proposed route and Harlowbury Brook which crosses the centre of the Gilden Way section of the scheme. The Harlowbury Brook also has smaller associated water courses branching off from it within the study area. Both Pincey Brook and Harlowbury Brook are tributaries of the River Stort which is approximately 1.5km to the north of the study area.

In addition, there are several ditches and ponds located in the vicinity of the Proposed Scheme. A ditch crosses the proposed route running north of two ponds near to Morgan Farm. A number of ponds are also indicated on the mapping in the area of The Campions.

Discharge consents, groundwater abstractions and other boreholes

Discharge consents

With reference to data within the Envirocheck reports, there are a number of discharge consents within the study area, the majority of which are for sewage discharges, with one listed for other matter and one of unknown type. The discharge consents are located in the housing area close to Moor Hall Road (~95m and ~195m from scheme), just south of Matchings Road (~145m and ~210m from scheme), at Mayfield Farm (~30m from scheme) and at Sheering Hall Farm (~300m from scheme). Figure 9-2 indicates the locations of these consents. *Groundwater abstractions*

Based on review of Envirocheck data and information provided by the EA, there are two groundwater abstraction consents within the study area. The abstractions are both shown as being less than 10m from the scheme (located near the proposed Sheering Road Roundabout). The abstractions are recorded as spray irrigation related to agricultural practices. Figure 9-2 presents the location of these abstractions.

One of the groundwater abstraction consents (No.21 on Figure 9-2) is listed as “revoked”. The co-ordinates given in the Envirocheck Report place this abstraction directly beneath the proposed Sheering Road Roundabout. The “positional accuracy” is given in the Envirocheck Report as “located within 100m”. The EA website does not provide any co-ordinates for this abstraction and combines both boreholes and the surface water abstractions as a single, general location on their plans. In addition, the abstraction and borehole data provided by the EA only records one groundwater abstraction licence and corresponding borehole information within the study area. This licenced abstraction borehole (licence number: 29/38/06/0172) is located at TL4906 1246, and is listed as abstracting from the chalk for spray irrigation. This matches the licence number in the Envirocheck shown as No. 22 on Figure 9-2. One abstraction has been observed during site reconnaissance and is located within a small building at the field edge close to Sheering Road.

The borehole relating to the “revoked” licence was investigated during site reconnaissance and no evidence was seen, nor was it observed during the GI undertaken at the site. It is not clear whether this borehole was decommissioned and removed or whether it may be located outside the scheme footprint, buried or otherwise obscured. It is likely that the two Envirocheck boreholes are the same well with two licences issued since installation. The inaccuracies in the grid references could potentially be mistaken for two separate wells, with the “revoked” licence (No. 21 on Figure 9-2) representing the original licence from when the single abstraction well was installed. However, it has not been possible to confirm whether one or two boreholes exist with the information available at this stage.

Surface water abstractions

The Envirocheck data show one surface water abstraction, consent less than 10m from the scheme, to the north of the proposed Sheering Road Roundabout. No additional surface water abstraction information was provided by the EA.

Additional boreholes

During site reconnaissance to investigate the groundwater abstractions, a number of existing dual boreholes were noted along the field edge (Figure 9-2). These are suspected to be old monitoring wells; however, the purpose of these wells is unknown.

9.4.2.3 Sensitive sites

Geological sites

Based on a review of the Essex geology website there are no geological SSSIs or Local Geological Sites (LoGS), formerly called Regionally Important Geological Sites or RIGS within the study area.

Mineral sites

The local mineral planning policy for Essex has been reviewed. Based on this, no mineral safeguarded sites have been identified in the study area.

Other sensitive sites

The Proposed Scheme is within a designated Surface Water Nitrate Vulnerable Zone (NVZ), as established under the EU Nitrates Directive for the purpose of protecting drinking water quality and is within a drinking water Safeguard Zone (SgZ).

9.4.2.4 Land quality receptors

Historic and current land use – potential sources of contamination

Current land use

A description of the study area is provided in Section 4. The proposed motorway junction is located within Green Belt land in open, gently undulating countryside. Land use for the Proposed Scheme area is predominantly arable or residential. The hamlet of The Campions lies to the west of the proposed re-alignment of Gilden Way. Mayfield Farm lies opposite The Campions which has a bakery business, shop and café.

The data reports procured from Landmark Information Group Limited (Landmark) were reviewed to provide information on potentially contaminative uses within the study area. The following were identified and are indicated on Figure 9-2:

- The reports indicate one polythene and plastic sheeting supplier (active), a sausage manufacturer (active), a furniture manufacturer (inactive), meat wholesaler (inactive) and cheese supplier (inactive) at the eastern end of Gilden Way;
- On Oxleys Road which connects to the middle section of Gilden Way there is an active road haulage services listed;
- On Mulberry Green which connects to the middle section of Gilden Way there is an inactive slate products company listed; and
- There are no fuel station entries listed within the study area.

Historical land use

A number of ordnance survey historical maps and environmental data reports procured from Landmark were reviewed to inform historical development of the land surrounding the scheme and to inform the presence of historic (and current) potentially contaminative sites.

On-site land use:

The proposed new road length has comprised primarily agricultural/undeveloped land since at least 1881 (first available historic mapping). Between 1898 and 1923, Mayfield Farm was developed to the south east of Sheering Road. For the Gilden Way, there has been no significant change until it was built (present on maps from 1965). The location of the proposed site compound to the south of the Gilden Way is shown as a plant nursery from the 2006 map. In the vicinity of the M11 no significant changes are recorded until 1960 -1982 when the M11 was built.

Off-site land use:

The land surrounding the Proposed Scheme has been predominantly agricultural/undeveloped land since at least 1881 (first available historic mapping). Between 1881 and 1887 gravel and clay pits and a brickfield are shown to the north and south of the eastern section of Gilden Way - the closest being approximately 40m south of Gilden Way. These are no longer shown by 1982 and appear to have been infilled. Between 1887 and 1889, there is increased residential development, a number of gravel pits present on the maps and a fire station house to the north of the Gilden Way. On the 1923 map there is some additional development, with Mayfield Farm and some allotments (parallel to the Gilden Way, near to Harlow) present. Between 1947 and 1982 housing developments appear to have expanded and redeveloped to the north and south of the M11 Westbound Link. In the area of the proposed Gilden Way scheme there is no significant change depicted until 1960, when there is some increased development in Harlow, with an electrical substation shown (1965-1986 map). In 1982, Harlow (now labelled as 'Old Harlow') and the Churchgate area to the north of the Gilden Way appeared to have further developed, with the fire station house now labelled as F House and ambulance station and the gravel pits no longer present (the latter potentially infilled). From 1982 the land within the study area appeared to remain largely unchanged with the exception of the addition of Morgan Farm (to the south of the M11 Westbound Link) and another farm in 2013 (next to Sheering Hall).

Landfills, waste management sites, and mineral extraction sites

Landfills

The nearest recorded historical landfill is the Moor Hall Road landfill, located at the southern edge of the study area (approximately 240m from the Proposed Scheme). This is recorded as having accepted inert waste between 1974 and 1976. As the Moor Hall Road landfill site is at the edge of the study area and would not be impacted by the Proposed Scheme, it has been discounted from further assessment. The location of the landfill is shown on Figure 9-2, No.2.

Another former landfill site was identified by information provided by Epping Forest District Council, located at NOSGR: 548903, 212547 (No.3 on Figure 9-2). The waste type accepted is unknown. This former landfill is located approximately 85m from the Proposed Scheme and is not mentioned in EA information or on the EA website. However, due to the distance from the Proposed Scheme, and the fact that no elevated gas levels or groundwater contamination has been detected in the area, this landfill has been discounted from further assessment.

Waste management sites

In addition, there is one licensed waste management facility within the study area of the Proposed Scheme (middle section of Gilden Way, south of Mulberry Gardens (No.1 Figure 9-2). This facility is for the management of composting waste (only accepting organic materials suitable for composting). The licence status for this site is currently dormant.

Mineral extractions sites

There are a number of abandoned mineral extractions sites. These are all located close to the eastern end of Gilden Way and were all for the extraction of sand and gravel. The closest was approximately 20m north of the Gilden Way north (No.8 Figure 9-2). The extraction would have been open cast so the resulting pits at these locations would likely have been infilled since the extraction ceased. One of the sites close to the proposed works is identified in correspondence from Harlow Council (see below).

Within the Proposed Scheme area there are a number of small-scale, sand, gravel and clay pits as well as several brickfields marked on historical maps. It should be noted that not all of the extraction locations are marked on historical plans and that the precise location of these areas cannot be confirmed.

The above potential sources of contamination are shown on Figure 9-2.

9.4.2.5 Local Authority and regulatory correspondence

Responses were received from the three councils initially contacted with information regarding the Gilden Way, with additional information received following subsequent contact with the three councils and the EA to request any additional information held for the Proposed Scheme study area. All information received, with a summary cover note is presented in Appendix 9.1. A brief summary of the key information relevant to land quality issues is detailed in Table 9.9.

Table 9.9: Summary of consultation

Consultee	Summary of information
Harlow Council	• There is former gravel pit, approximately 90m north of Gilden Way - this may have been infilled "presumably with domestic refuse". Harlow Council note that ground gas monitoring has been undertaken here although results have not been available for review. • The correspondence from Harlow Council also states that the current land use is predominantly agricultural and that there are no known contaminated land issues, designations, pollution incidents or potable water abstractions within the study area (Note: the Gilden Way section only, is within Harlow Council area). • Harlow Council stated that the length of the Proposed Scheme between the M11 and Sheering Road is not within their district. This area falls within Epping Forest District Council.
Epping Forest District Council	• Epping Forest District Council identified two additional potential sources of contamination within the Proposed Scheme study area: o A former landfilled site located immediately north of the Pincey Brook (Figure 9-2 feature No. 3). The precise nature of this landfill is unknown. o The area to the south of the Sheering Road Roundabout has been subject to widespread extraction of clay used for the manufacture of bricks; the precise location of these areas cannot be confirmed. Historic information suggests that these areas have been backfilled/infilled with materials of unknown origin. Ground stability could be affected by these activities as a consequence and there could be a potential for the production of gas. Historic paper-based records compiled by ECC shows a single extraction area marked 'gravel pit' sited approximately 145m West of Mayfield Farm (Figure 9-2 feature No. 8), although Epping Forest District Council are aware that other similar sites could exist in the vicinity. • Epping Forest District Council also stated that they have no records of any significant pollution incidents and there are no relevant public health issues or environmentally sensitive sites in close proximity to the Proposed Scheme. • Epping Forest District Council has no record of water abstractions in addition to those provided by the EA and no information at this time with respect to ground gas generation or aggressive ground conditions.
Essex County Council (ECC)	• ECC provided information on environmental areas in regard to ecological habitat and listed buildings. No information relating to land quality was provided. • Additional information was also requested from the ECC minerals and waste team, with no response received to date.

Consultee	Summary of information
Environment Agency (EA)	• The EA provided information on a number of land quality issues within the study area including a site map showing information requested (Appendix 9.1). The EA states that there is little within the study area itself, with a lot of the data provided outside the scope of this assessment. • The EA abstractions data identifies one abstraction within the study area (Licence 29/38/06/0172) for spray irrigation, which abstracts from the chalk. The abstraction is located at TL4906 1246. This matches the licence number in the Envirocheck shown as No. 22 on Figure 9-2 and the EA borehole data for this location. The revoked abstraction licence (No.21 on Figure 9-2) is not mentioned in the EA information. • Another borehole is identified within the study area, approximately 200m to the south of the Gilden Way. There is no associated licence listed in the EA data. This well is unlikely to be impacted by the Proposed Scheme, so is not considered further. • The EA data also identifies the location of their surface water sampling sites, one of which is within the study area located at Ealing Bridge. This is presented on the site plan provided (Appendix 9.1).

9.4.2.6 Site reconnaissance

An initial site reconnaissance was undertaken in advance of the GI in publically accessible areas. This was used to inform the GI design and sampling locations. A second reconnaissance was undertaken in advance of the Gilden Way GI. No significant additional findings were made above those already identified by the desk study.

An additional site reconnaissance was conducted within the footprint of the Proposed Scheme in July 2016. The aim of the visit was to attempt to locate two groundwater abstraction boreholes very close to and potentially within the area of the proposed Sheering Road Roundabout. The expected locations of these boreholes were based on grid references from the Landmark Envirocheck Reports. During the walkover an inaccessible building was identified at the edge of the field next to the area of the proposed Sheering Road Roundabout. This building is expected to contain the borehole (No.20 on Figure 9-2). The field itself contained high crops preventing it being fully observed. The other borehole (No.21 Figure 9-2) if present, was not observed and therefore its presence or absence from the area beneath the proposed Sheering Road Roundabout cannot be confirmed.

In addition, a number of existing dual boreholes were noted along the field edge (Figure 9-2). These are suspected to be old monitoring wells; however, this is not confirmed. The Gilden Way area was also accessed by a public footpath to view an area of landfilling which could potentially impact the scheme. This potentially infilled pit area was observed as (currently) a field overgrown with vegetation. One old, backfilled groundwater or gas monitoring well was noted at the field edge.

9.4.2.7 Ground investigation - land quality findings and assessment

The GI fieldwork was carried out between October 2015 and February 2016 and included groundwater monitoring and analysis, geo-environmental laboratory testing and post GI gas monitoring. The borehole locations and the geology of the study area are indicated on Figure 9-1.

The key aim of the GI was to assess the ground conditions for the Proposed Scheme for geotechnical and land quality purposes. As part of the GI, soil and groundwater samples were collected and scheduled for chemical analysis. This chemical data provided general information concerning the soil and groundwater quality likely to be encountered during the works, together with the potential risks that any contamination could pose to workers and the environment. The following sections summarise the GI results and site specific assessment for soils, groundwater and gas.

Soil assessment

Soil assessment criteria

As part of the GI, 91 soil samples were scheduled for chemical analysis. The results of the samples tested are discussed in detail in the Jacobs GI Report, 2016 together with information regarding the screening criteria used to assess the significance of the results. The findings are summarised below.

Soil assessment summary (Jacobs GI Report, 2016):

- There are no exceedances of the guideline values for commercial/industrial or residential land uses. There is one exceedance of the allotment end use criteria for lead in WS7 (0.25m) at 95mg/kg compared to the guideline value of 80mg/kg. This is significantly below both the residential and commercial guideline values. Asbestos was not detected in any samples.
- The provisional waste assessment undertaken indicates that all of the samples tested could be classified as “non-hazardous” with respect to waste disposal.
- Based on WAC results and the WM3 assessment, 28 samples indicate that material from which they were taken would be suitable for disposal within an inert landfill, with 63 samples indicating material potentially suitable for inert landfill disposal if further testing were undertaken to confirm the preliminary assessment as only hazardous WAC analysis was undertaken. One sample (BH2 at 2.0m) indicates material suitable for disposal in a non-hazardous landfill due to the inert WAC value for antimony (Sb) being exceeded.

Groundwater assessment

As part of the GI, 22 boreholes were monitored to assess groundwater conditions on site. Samples were collected and tested from all 22 boreholes in January 2016.

To aid assessment of the risk to human health and the water environment from potentially contaminated groundwater at the Proposed Scheme, the results of the groundwater chemical data available have been assessed against either EQS for freshwater outlined within the ‘The WFD, 2015’ or UK DWS where there are no EQS assessment criteria available.

Groundwater assessment summary (Jacobs GI Report, 2016):

- Metals - There were no exceedances of the DWS; however, some samples exceeded the EQS for chromium, copper, nickel and zinc (for chromium five samples exceeded the EQS: BH23, BH27, BH28, BH33 and BH34. For copper, one sample exceeded the EQS, BH19. For zinc, seven samples exceeded the EQS: BH3, BH8, BH9A, BH9B, BH11A, BH11B and BH17. Nickel was found to be below the laboratory detection limit in all samples other than BH19 which exceeded the EQS. However, as the laboratory detection limit for nickel is 5µg/l which is slightly higher than the EQS of 4µg/l, it cannot be conclusively determined whether or not there may be any further exceedances.
- All other determinants were either at or below the available guideline criteria.

Ground gas assessment

Seven rounds of ground gas monitoring were completed during the recent GI. The first round was undertaken on 1st December 2015 with subsequent rounds completed at weekly intervals between 13th January 2016 and 17th February 2016. Measurements of flow, differential pressure, methane equivalent, carbon dioxide, oxygen, hydrogen sulphide, carbon monoxide, Volatile Organic Compounds (VOCs) and groundwater levels were taken during each round.

Atmospheric pressure recorded during the monitoring rounds ranged from 978mbar to 1036mbar. Hydrogen sulphide concentrations were all 0.0 parts per million (ppm). Carbon monoxide concentrations were predominantly 0.0ppm, with a maximum concentration of 6.4ppm. Concentrations of VOCs were largely 0.0ppm, with a maximum concentration of 0.4ppm. A summary of the bulk gas, flow rate and groundwater level data are given in the Jacobs GI Report, 2016, with the full data set presented within the Soils Ltd., Factual GI Report, Reference 15096/GIR, April 2016.

A gas risk assessment has been undertaken to evaluate the risk posed to potential receptors at the Proposed Scheme. Given the context of the works, receptors of ground gas, (i.e. confined spaces where hazardous gases may accumulate and create a risk of either explosion or asphyxiation) are considered likely to be limited to trenches and services and drainage infrastructure.

The CIRIA C665, 2007b has been used to inform the gas risk assessment. This uses a method which allows the potential risk at the site to be evaluated into one of six 'Characteristic Situations' with Characteristic Situation 1 being the least onerous in terms of mitigation measures required (if any) and Characteristic Situation 6 representing a high risk site where extensive protection measures and potential remediation could be required to mitigate the risks.

One borehole (BH20) was assessed as Characteristic Situation 3, and one borehole (BH30) was assessed as Characteristic Situation 2. All remaining boreholes were assessed as Characteristic Situation 1.

Monitoring at both BH20 and BH30 detected air flows in the boreholes. It is unclear why flows were detected in these boreholes as there was little corresponding presence of gas detected. It is possible that pressure changes are occurring in the boreholes due to groundwater fluctuations or gradients between ground and air temperatures leading to air flows. Further details are available in Jacobs GI Report, 2016.

No gas monitoring was possible along the Gilden Way south (from Marsh Lane to the London Road Roundabout). Site access constraints along the verge of the existing road meant that only window sample boreholes were possible along this part of the route and these were backfilled on completion due to safety concerns. This means that it was not possible to fully assess whether any ground gas could be impacting on the Proposed Scheme in this area from the infilling of the old gravel pit to the north of Gilden Way. The closest borehole to the former pit, BH34 (approximately 100 to 140m from the estimated boundary of the pit) did not detect elevated gas levels.

There are three known old BGS gravel extraction pits located to the south of Sheering Road (No.5, 6 and 7 on Figure 9-2). In addition, information provided by consultation with Epping Forest District Council identified a former landfill immediately north of the Pincey Brook to the west of Sheering road and a former gravel pit located approximately 145m to the west of Mayfield Farm (No.3 and No.8 on Figure 9-2, respectively). The four gravel pits mentioned are potentially infilled and are considered potential sources of ground gas. The former landfill is also considered a potential source of ground gas. Ground gas monitoring from boreholes closest to these locations (BH29 close to former landfill and BH33 and BH34 close to the potentially infilled pits) detected little or no gas and these boreholes were assessed as Characteristic Situation 1 in the gas risk assessment. Further details of the gas assessment are included in the Jacobs GI Report, 2016

Ground investigation summary

- The GI soil chemical data demonstrate no exceedances of the commercial/industrial screening criteria. Total Petroleum Hydrocarbon (TPH) and Semi-Volatile Organic Compounds (SVOC) concentrations were below or marginally over the limits of detection, and pesticide and herbicide concentrations were below the limits of detection.
- Total Petroleum Hydrocarbon, Polyaromatic Hydrocarbons (PAHs), SVOC, herbicides and pesticides were all below the limits of detection in the groundwater samples collected. Exceedances of the EQS are considered to be a function of the conservative thresholds used. Ground gas risk assessment indicates predominantly low risks. Slightly elevated ground gas risk categories have been assigned to two boreholes due to elevated flow rates detected in boreholes not elevated gas concentrations. The reasons for the flows detected are not clear.
- It should be noted that some areas of the Proposed Scheme (new off slip extension of M11 northern realignment and the proposed site compound to the south of Gilden Way) were not investigated during the GI as these areas were included within the Proposed Scheme area as a result of design changes following GI completion. Further GI will be undertaken in these areas prior to construction to confirm the anticipated ground conditions.

9.4.2.8 Conceptual site model

Potential sources, receptors and pathways of contamination have been identified by reviewing the data sources outlined above and developed into a CSM. The CSM outlines the potential pollutant linkages for which a qualitative risk assessment has been undertaken in accordance with guidance outlined in Model Procedures for the Management of Land Contamination, Contaminated Land Report 11 (EA, 2004).

The CSM and risk assessment is presented in full within Table 9.10. A summary of the potential sources and receptors of contamination is provided below.

Potential contamination sources

Potential contamination sources at the Proposed Scheme are identified below:

- made ground identified during the GI – Identified in the banking adjacent to the M11 and at a number of locations along Gilden Way;
- potential contamination from agricultural land use;
- potential contamination from former clay and gravel pits; and
- potential contamination at the proposed site compound to the south of the Gilden Way - site previously used as a plant nursery.

Potential contamination receptors

Potential receptors to contamination sources at the scheme are identified below:

Humans, flora, fauna

- construction workers during the works;
- future maintenance workers;
- public/pedestrians during construction works; and
- flora, fauna.

Controlled waters

- surface water (Pincey Brook and Harlowbury Brook); and
- groundwater (Superficial geology (Head - Secondary Undifferentiated Aquifers and Glaciofluvial and Alluvium - Secondary A Aquifers); Bedrock (Thanet Sand Formation and Lambeth Group - Secondary A Aquifers and Lewes Nodular Chalk Formation and Seaford Chalk Formation - Principal Aquifer).

Soils

- Agricultural land Classification Grade 2 and 3 land (BMV) – potential contamination could impact soil re-use.

Potential contamination pathways

Potential human health and flora and fauna exposure pathways from existing contamination sources are:

- exposure of construction workers and future maintenance workers via pathways such as direct dermal contact, ingestion and inhalation of dust;
- exposure of the public on or close to the site during the development works to wind-blown dust via inhalation;
- exposure of flora and fauna to contamination via pathways such as direct dermal contact, ingestion and inhalation of dust; and
- ground gas migration.

Potential controlled waters pathways to existing contamination sources are:

- leaching of contaminants from the made ground into groundwater within the superficial and bedrock geology; and
- base flow from groundwater within the superficial geology to the Pincey Brook; and Surface runoff of soil into Pincey Brook.

Table 9.10: Environmental risk assessment summary

Source	Pathway	Receptor	Plausible pollutant linkage	Risk level
Ground investigation summary: Soil chemical data demonstrate that there were no exceedances of the commercial/industrial screening criteria. Total petroleum hydrocarbon (TPH) and SVOC concentrations were below or marginally over the limits of detection, and pesticide and herbicide concentrations were below the limits of detection. Total petroleum hydrocarbon, PAHs, SVOC, herbicides and pesticides were all below the limits of detection in the groundwater samples collected. Exceedances of the EQS are considered to be a function of the conservative thresholds used. Ground gas risk assessment indicates predominantly low risks. Higher risk categories have been assigned to two boreholes due to elevated flow rates not elevated gas concentrations. Note: some areas of the scheme (new off slip extension of M11 and proposed site compound south of Gilden Way) were not investigated during the GI and therefore the risk for these areas cannot be fully assessed.				
Farms and agricultural land uses – oils, solvents, pesticides, fertilisers	Dermal contact Inhalation Ingestion Surface water run off Infiltration, gas migration	Construction and/or future maintenance workers	It is unlikely that contamination may impact on construction and/or maintenance workers given that no widespread contamination was identified during the GI. The consequences of exposure may be medium.	Low Risk
		Future site users	It is unlikely that existing contamination may impact on future site users, given that no widespread contamination was	Low Risk

Source	Pathway	Receptor	Plausible pollutant linkage	Risk level
			identified during the GI. The consequences of exposure may be medium.	
		Groundwater	It is unlikely that existing contamination may impact on groundwater given that no widespread contamination in the soil was identified during the GI. Groundwater chemical data was largely below detection limits. Low permeability Lowestoft Formation and Head Deposits directly underlie the majority of the study area and would therefore limit vertical migration. The consequences of exposure may be medium.	Low Risk
		Surface water	It is unlikely that existing contamination may impact on surface water given that no widespread contamination in the soil was identified during the GI. Made ground was limited to the M11 banking and to some locations along Gilden way, which are not in proximity to water courses. Groundwater chemical data was largely below detection limits. Low permeability Lowestoft Formation and Head Deposits directly underlie the majority of the study area and would therefore limit vertical migration and subsequent baseflow. The consequences of exposure may be medium.	Low Risk
		Flora, fauna	It is unlikely that contamination may impact on flora and fauna given that no widespread contamination was identified during the GI. The consequences of exposure may be medium.	Low Risk
		Offsite users	It is unlikely that offsite users would be impacted by existing contamination, given that no widespread contamination was identified during the GI. The consequences of exposure may be medium.	Low Risk
		Soil quality	The GI results indicate that there is a low likelihood that contamination would have impacted high grade soils or have rendered the material unsuitable for re-use during the Proposed Scheme (with necessary environmental permitting or similar regulations adopted, i.e. CL:AIRE Definition of Waste: Development Industry Code of Practice).	Moderate

Source	Pathway	Receptor	Plausible pollutant linkage	Risk level
			The consequences of soils being impacted or unsuitable for re-use due to contamination are considered severe given that the soils on site are classed as BMV a high value resource; however, the impact is likely to be localised.	
Gravel and clay pits - metals, oils, asbestos, organic and inorganic contaminants, gas	Dermal contact Inhalation Ingestion Surface water run off Infiltration, gas migration	Current site users	It is unlikely that existing contamination would impact on current site users given that no widespread contamination was identified. The consequences of exposure may be medium.	Low Risk
		Construction and/or maintenance workers	It is unlikely that existing contamination would impact on construction and/or maintenance workers given that the Proposed Scheme does not encroach on the gravel pit location and that no widespread contamination was identified. The consequences of exposure may be medium.	Low Risk
		Future site users (without mitigation)	It is unlikely that existing contamination would impact on future site users given that no widespread contamination was identified. The consequences of exposure may be medium.	Low Risk
		Ground water	It is unlikely that existing contamination would impact on groundwater given that no widespread contamination in the soil was identified during the GI. Groundwater chemical data were largely below detection limits. Low permeability Lowestoft Formation and Head Deposits directly underlie the majority of the study area and would therefore limit vertical migration. The consequences of exposure may be medium.	Low Risk
		Surface water	It is unlikely that existing contamination would impact on surface water given that no widespread contamination in the soil was identified during the GI. Groundwater chemical data were largely below detection limits. Low permeability Lowestoft Formation and Head Deposits directly underlie the majority of the study area and would therefore limit vertical migration and subsequent base flow. The consequences of exposure may be medium.	Low Risk
		Flora, fauna	It is unlikely that contamination would impact on flora and fauna given that no widespread contamination was identified	Low Risk

Source	Pathway	Receptor	Plausible pollutant linkage	Risk level
			during the GI. The consequences of exposure may be medium.	
		Offsite users	It is unlikely that offsite users would be impacted by existing contamination given that no widespread contamination was identified. The consequences of exposure may be medium.	Low Risk
		Soils	The GI results indicate that there is a low likelihood that contamination would have impacted high grade soils or have rendered the material unsuitable for re-use during the scheme (with necessary environmental permitting or similar regulations adopted, i.e. CL:AIRE Definition of Waste: Development Industry Code of Practice). The consequences of soils being impacted or unsuitable for re-use due to contamination are considered severe given that the soils on site are classed as BMV a high value resource; however, the impact is likely to be localised.	Moderate
Made Ground - metals, oils, asbestos, organic and inorganic contaminants, gas	Dermal contact Inhalation Ingestion Surface water run off Infiltration	Current site users	It is unlikely that existing contamination would impact on current site users, as made ground is limited to farms and roads and no widespread contamination was identified during the GI. The consequences of exposure may be medium.	Low Risk
		Construction and/or maintenance workers	It is unlikely that existing contamination would impact on construction and/or maintenance workers given that no widespread contamination was identified during the GI. The consequences of exposure may be medium.	Low Risk
		Future site users (without mitigation)	It is unlikely that existing contamination would impact on future site users given that no widespread contamination was identified during the GI. The consequences of exposure may be medium.	Low Risk
		Ground and surface waters	It is unlikely that existing contamination would impact on ground and surface waters, given that no widespread contamination was identified during the GI. The consequences of exposure may be medium.	Low Risk

Source	Pathway	Receptor	Plausible pollutant linkage	Risk level
		Flora, fauna	It is unlikely that contamination would impact on flora and fauna given that no widespread contamination was identified during the GI. The consequences of exposure may be medium.	Low Risk
		Offsite users	It is unlikely that offsite users would be impacted by existing contamination given that no widespread contamination was identified during the GI. The consequences of exposure may be medium.	Low Risk
		Soils	The GI results indicate that there is a low likelihood that contamination would have impacted high grade soils or have rendered the material unsuitable for re-use during the scheme (with necessary environmental permitting or similar regulations adopted, i.e. CL:AIRE Definition of Waste: Development Industry Code of Practice). The consequences of soils being impacted or unsuitable for re-use due to contamination are considered severe given that the soils on site are classed as BMV a high value resource; however, the impact is likely to be localised.	Moderate
Proposed site compound off Gilden Way (previously used as a plant nursery – potential made ground, demolished buildings, oil storage)	Dermal contact Inhalation Ingestion Surface water run off Infiltration	Current site users	It is unlikely that contamination (if present) would impact on current site users, as contamination is likely to be localised and pathways would be limited by areas of hardstanding; however, no GI data are available to confirm ground conditions. The consequences of exposure may be medium	Low Risk
		Construction and/or maintenance workers	It is likely that existing contamination (if present) may impact on construction and/or maintenance workers during shallow ground works; however, no GI data are available to confirm ground conditions. The consequences of exposure may be medium.	Moderate Risk
		Future site users (without mitigation)	It is unlikely that contamination (if present) would impact on future site users as contamination is likely to be localised and pathways will be limited by areas of hardstanding; however, no GI data are available to confirm ground conditions. The consequences of exposure may be medium.	Low Risk

Source	Pathway	Receptor	Plausible pollutant linkage	Risk level
		Ground and surface waters	It is unlikely that contamination (if present) would impact on ground and surface waters; however, no GI data is available to confirm ground conditions. The consequences of exposure may be severe given the sensitivity of the underlying aquifers.	High Risk
		Flora, fauna	It is unlikely that contamination (if present) would impact on flora and fauna as contamination is likely to be localised; however, no GI data are available to confirm ground conditions. The consequences of exposure may be medium.	Low Risk
		Offsite users	It is unlikely that offsite users would be impacted by existing contamination (if present) as contamination is likely to be localised and pathways will be limited by areas of hardstanding; however, no GI data are available to confirm ground conditions. The consequences of exposure may be medium.	Low Risk
		Soils	There are no GI data for this location; however, the classification of this land is urban, therefore it is considered unlikely that high grade soil would be impacted. The consequences would be considered minor.	Very Low
New M11 off slip extension	Dermal contact Inhalation Ingestion Surface water run off Infiltration	Current site users	It is unlikely that existing contamination (if present) would impact on current site users as contamination is likely to be localised and pathways will be limited by areas of hardstanding; however, no GI data are available to confirm ground conditions. The consequences of exposure may be medium.	Low Risk
		Construction and/or maintenance workers	It is likely that existing contamination (if present) may impact on construction and/or maintenance workers during shallow ground works; however, no GI data are available to confirm ground conditions. The consequences of exposure may be medium.	Moderate Risk
		Future site users (without mitigation)	It is unlikely that existing contamination (if present) would impact on future site users as contamination is likely to be localised and pathways will be limited by areas of hardstanding; however, no GI data are available to confirm ground conditions. The consequences of	Low Risk

Source	Pathway	Receptor	Plausible pollutant linkage	Risk level
			exposure may be medium.	
		Ground and surface waters	It is unlikely that existing contamination (if present) would impact on ground and surface waters; however, no GI data are available to confirm ground conditions. The consequences of exposure may be severe given the sensitivity of the underlying aquifers.	High Risk
		Flora, fauna	It is unlikely that contamination (if present) would impact on flora and fauna as contamination is likely to be localised, however no GI data are available to confirm ground conditions. The consequences of exposure may be medium.	Low Risk
		Offsite users	It is unlikely that offsite users would be impacted by existing contamination (if present) as contamination is likely to be localised and pathways will be limited by areas of hardstanding; however, no GI data are available to confirm ground conditions. The consequences of exposure may be medium.	Low Risk
		Soils	There is no GI data for this location; however, the nearest GI boreholes indicate that there is a low likelihood that contamination would render the material unsuitable for re-use during the scheme. The consequences of the soils being adversely impacted by contamination and being unsuitable for re-use are considered severe given that the soils on site are classed as BMV a high value resource, however the impact is likely to be localised.	Moderate

9.4.3 Value of receptors

From the baseline information presented in this chapter a number of key receptors to potential impacts from the Proposed Scheme have been identified and are presented in Table 9.11 below. The value/sensitivity of these receptors has been assessed using Table 9.1 and Table 9.2.

Table 9.11: Key receptor sensitivities at the Proposed Scheme

Receptor	Description	Sensitivity/importance
Human receptors		
Construction workers	Construction workers/below ground workers during the works	Very High
Current and future site users	Current and future site users and nearby site users.	Very High
Controlled waters - groundwater		
Glaciofluvial deposits and alluvium	Secondary A superficial aquifer	High
Lowestoft Formation and Head deposits	Head (Secondary Undifferentiated) superficial aquifer and Lowestoft (Unproductive – with pockets of more permeable sand) and gravel (Glaciofluvial Deposits, classified as a Secondary A Aquifer)	Medium
Thanet Sand Formation and Lambeth Group	Secondary A aquifer	High
Lewes Nodular Chalk Formation	Principal Aquifer	Very High
Controlled Waters – Surface waters (as defined in “Chapter 13 - Road Drainage and the Water Environment”)		
Pincey Brook	A main river with sections of a morphological diversity. Classified as Good status under the WFD with Good chemical status.	Medium
Harlowbury Brook	A main river with sections of morphological diversity. The watercourse is modified in a number of sections. Falls within a WFD water body catchment with Moderate status and a failing chemical status.	Medium
Other watercourses, ponds and lakes	Small man-made channels, ponds and a lake	Low
Other Receptors		
Soils	Soils and high grade agricultural land in the scheme area including Agricultural Land Classification (ALC) Grade 2 – very good quality (BMV) soil; and ALC Subgrade 3a (assumed) – good quality	High

Receptor	Description	Sensitivity/importance
	(BMV) soil.	
Flora, fauna	The majority of the land is agricultural or developed or comprises existing highway.	Medium (see Chapter 8 – Nature Conservation for further details)
Infrastructure	Current and future highways and associated infrastructure.	Medium

9.5 Significant Effects

The following sections describe the potential effects of the Proposed Scheme on geology and soils.

9.5.1 Construction effects

This section sets out the key elements of the proposed design from which the assessment of effects is based. Where work on the design is currently ongoing or options remain, a realistic worst case has been identified as the basis of this assessment, where possible. The construction design is anticipated to include the following main activities:

9.5.1.1 Earthworks – cuttings

Cuttings are proposed in a number of locations as part of the proposed design. In the area of the Gilden Way north, the Sheering Road Roundabout and the Pincey Brook Roundabout, these are anticipated to be in the order of 4m depth. The M11 cuttings are proposed to be in the order of 6m depth.

The works along the existing Gilden Way are anticipated to be minor, with minimal earthworks (1-2m) and the creation of a new highway pavement.

9.5.1.2 Embankments

A number of areas of embankment are proposed within the current design. The embankments along the link road are expected to be in the order of 10m high, with the M11 embankments in the order of 6m high. All of the embankments are proposed to be vegetated. For the M11 Dumbell Roundabouts a combination of cutting and embankments is proposed, for this the cutting is expected to be in the order of 6m depth, with an embankment in the order of 2m high.

9.5.1.3 Placement of fill materials

Given the requirement for a number of embankments within the scheme design, some deposition of suitable fill materials would be required - preliminary calculations indicate that there is a deficit of fill so materials may need to be imported. See Section 10 - Materials for further information.

9.5.1.4 Structures – sheet pile walls, foundation piling, culverts

Earthworks structures integral to the proposed design include:

- sheet pile walls - these are proposed in two areas: Mayfield Farm and M11 south bound off slip extension. At Mayfield Farm the sheet pile wall is expected to be to be 10m in length and for the M11 south bound off slip extension the sheet pile wall is anticipated to range from about 10m to 15m in length;
- the M11 Dumbell Roundabouts - these are anticipated to be founded on piles installed to a depth of approximately 20m; and
- culverts - large culverts in the Link Area are likely to be founded on spread footings.

Table 9.12 presents the potential construction impacts resulting from these activities in relation to geology and soils receptors.

Table 9.12: Geology and soils construction effects

Activity or source	Potential Impact	Type and Sensitivity of Receptors impacted	Key locations of potential impact	Magnitude of unmitigated impact (Major, Moderate, Minor)	Significance of unmitigated effect
Vegetation clearance and excavation works	This could increase/modify the contaminated groundwater and ground gas regime in the study area, particularly if contamination were to be introduced during construction.	Superficial Aquifers (medium to high), Bedrock Aquifers (high to very high) and surface water (medium).	The highest potential risks are likely to be in areas of cutting such as the Eastbound Link, the Pincey Brook Roundabout, Sheering Road Roundabout, Dumbbell Roundabouts, widening of Gilden Way and the south bound off slip (close to Pincey Brook). These areas could create pathways from the superficial aquifers to the underlying bedrock aquifers.	Moderate – given the GI identified some contaminants within groundwater, albeit at low concentrations. No elevated ground gas recorded; however, some high flow was detected in two locations. It should be noted that some areas were not assessed by the GI; ground conditions have not been confirmed in these locations.	Large or Very Large - given the sensitivity of the underlying aquifers.
Piling	Piling could introduce migration pathways for contaminants to deeper strata particularly if contamination were to be introduced during the works.	Superficial Aquifers (medium to high), Bedrock Aquifers (high to very high).	Possible piling for bridge (M11 Junction 7A Dumbell Roundabouts) and related structures, site compounds (if piling is required) and any other areas of piling required.	Moderate – the GI identified no significant concentrations of soil contamination, some contaminants within groundwater, albeit at low concentrations and no elevated ground gas recorded, although some high flow was detected in two locations. The piling works would likely be within an area of geology comprising the Lowestoft Formation underlain by London Clay. The Lowestoft Formation could be impacted by potential contamination particularly within the pockets of Glaciofluvial Deposits, which could be a potential receptor. However, due to the low permeability of the Lowestoft Formation, it should protect deeper strata from contamination. The London Clay is beneath this and is classed	Large or Very Large - given the sensitivity of the underlying aquifers.

Activity or source	Potential Impact	Type and Sensitivity of Receptors impacted	Key locations of potential impact	Magnitude of unmitigated impact (Major, Moderate, Minor)	Significance of unmitigated effect
				as 'Unproductive Strata and would therefore prevent the migration of contamination to deeper strata. The area of the proposed site compound to the south of the Gilden Way is underlain by the Lowestoft Formation, with underlying Chalk bedrock (Principal Aquifer). If any piling were to be required for this site compound then the potential unmitigated impact would be Major. The other proposed site compound locations are within areas of Lowestoft underlain by London Clay reducing the risk of contamination to the deeper strata.	
Installation of service trenches	Service trenches can act as preferential pathways for migration of ground gas, soil and water-derived vapours and contaminants in groundwater, particularly if contamination were to be introduced during construction.	Superficial Aquifers (medium to high), Bedrock Aquifers (high to very high).	Areas or service trenches.	Moderate – given that the GI identified no significant concentrations of soil contamination, some contaminants within groundwater, albeit at low concentrations, and no elevated ground gas recorded, although some high flow was detected in two locations. It should be noted that some areas were not assessed by the GI; ground conditions have not been confirmed in these locations.	Large or Very Large - given the sensitivity of the underlying aquifers.
Dewatering	Where the groundwater level is shallow, dewatering could be required	Surface Water (Pincey Brook and Harlowbury	Highest risk in areas of excavation close to the surface water receptors such as the Sheering Road Roundabout, the Pincey Brook	Moderate to Major– if contaminated groundwater is released to receptors by construction activities.	Large - given the sensitivity of the surface water receptors.

Activity or source	Potential Impact	Type and Sensitivity of Receptors impacted	Key locations of potential impact	Magnitude of unmitigated impact (Major, Moderate, Minor)	Significance of unmitigated effect
	during the construction phase. If this water is contaminated or became contaminated during construction and were to be discharged locally, i.e. to land or into surface waters, it could have a detrimental impact.	Brook - medium).	Roundabout, the M11 south bound off slip (close to Pincey Brook) and the widening of Gilden Way close to the Harlowbury Brook.		
Accidental spills and leaks	During the construction phase there is a risk of accidental spills and leaks from construction plant, site compounds, fuel storage areas, materials storage and stockpiling areas. This could impact surface waters or migrate vertically into the groundwater or groundwater abstraction boreholes.	Superficial Aquifers (medium to high), Bedrock Aquifers (high to very high) and surface water (medium).	Particularly in areas close to surface water receptors (as above) and in areas where superficial aquifers are exposed at the surface (Sheering Road Roundabout, the Pincey Brook Roundabout, the south bound off slip (close to Pincey Brook) and the central section of the Gilden Way).	Moderate to Major - if accidental spills release contamination to receptors. The impact to the Principal aquifer (Chalk) would be considered unlikely, given that it is protected in the majority of the study area by superficial deposits and the London Clay Formation. The Secondary A aquifers in the head deposits and alluvium are close to the surface so could be impacted by contamination. The Lowestoft Formation is close to the surface and could be impacted by potential contamination particularly within the pockets of Glaciofluvial Deposits, which could be a potential receptor. However, due to its low permeability it should protect deeper strata from contamination.	Large or Very Large - given the sensitivity of the underlying aquifers.

Activity or source	Potential Impact	Type and Sensitivity of Receptors impacted	Key locations of potential impact	Magnitude of unmitigated impact (Major, Moderate, Minor)	Significance of unmitigated effect
Concrete and cement products	Concrete and cement products are often highly alkaline and their release into the environment could have adverse short-term effects on flora and fauna and on general water quality. On-site concrete mixing and washing down of mixing areas during construction could results in contaminated wastewater entering the ground or surface waters.	Superficial Aquifers (medium to high), Bedrock Aquifers (high to very high). Surface Water (Pincey Brook and Harlowbury Brook - medium).	Particularly in areas close to surface water receptors (as above) and in areas where superficial aquifers are exposed at the surface (Sheering Road Roundabout, the Pincey Brook Roundabout, the south bound off slip (close to Pincey Brook)and the central section of Gilden Way).	Moderate to Major – if concrete and cement products are released to receptors by construction activities. Impact to the Principal aquifer (Chalk) would be considered unlikely, given that it is protected in the majority of areas by superficial deposits and the London Clay Formation. The Secondary A aquifers in the head deposits and alluvium are close to the surface so could be impacted by contamination. The Lowestoft Formation is close to the surface and could be impacted by potential contamination particularly within the pockets of Glaciofluvial Deposits, which could be a potential receptor. However, due to the low permeability of the Lowestoft Formation, it should protect deeper strata from contamination.	Large or Very Large - given the sensitivity of the underlying aquifers (Principal aquifer - Gilden Way section and Secondary A aquifers) and - the surface water receptors.
Construction work involving ground disturbance	Construction activities would be likely to disturb the ground, potentially exposing or mobilising contamination. For those construction staff working near potentially	Construction Workers (very high).	In areas of excavation, particularly small localised areas of expected made ground (Gilden Way and M11 embankment).	Minor – areas investigated by the GI identified low levels of contamination in the soils and slight groundwater contamination. Moderate - in the areas not assessed by the GI as ground conditions have not been confirmed.	Moderate or Large – given the sensitivity or the receptor.

Activity or source	Potential Impact	Type and Sensitivity of Receptors impacted	Key locations of potential impact	Magnitude of unmitigated impact (Major, Moderate, Minor)	Significance of unmitigated effect
	contaminated soils, there is some risk of direct contact with or ingesting contaminated soils. Construction workers could also come into contact with shallow groundwater.				
Dust or mud from soils containing elevated concentrations of contaminants impacting on general public	There is the possibility that dust or mud generated during the construction phase could contain elevated concentrations of contaminants, particularly if introduced during the activities. This dust or mud could migrate to off-site residential dwellings in the vicinity of the works and other areas used by the general public.	General Public (very high).	Gilden Way, close to residential land.	Minor - given the GI identified low levels of contamination in the soils.	Moderate or Large – given the sensitivity of the receptor.
Construction works	There would be a loss of high grade agricultural soil within	High grade soil, ALC Grades 2 and	Primarily in Link Road Area.	Moderate to Major– if the soils damaged from construction activities and unable to be re-used.	Large or Very Large - given the sensitivity of

Activity or source	Potential Impact	Type and Sensitivity of Receptors impacted	Key locations of potential impact	Magnitude of unmitigated impact (Major, Moderate, Minor)	Significance of unmitigated effect
	the footprint of the Proposed Scheme. There is also potential for damage to topsoil beyond the footprint of the Proposed Scheme due to vehicle compaction or contamination with foreign matter. In addition, incorrect storage and handling could lead to further impact to soils.	3a (high).			land in terms of its ALC.
Existing contamination impacting highways infrastructure	Existing contamination impacting highways infrastructure.	Highways structures (medium).	Proposed Scheme study area	Minor - given the GI identified low levels of contamination in the soils and slight groundwater contamination, with no significant elevations of gas. However, some high flow was detected in two locations, one along the Westbound Link (BH20) and the other close to the Sheering Road Roundabout (BH30). Moderate - in the areas not assessed by the GI as ground conditions could not be confirmed.	Slight to Moderate
Risk of gas accumulation in voids	Risk of gas accumulating in void spaces and causing an explosion or	Construction workers (very high) and Highways	Westbound Link (BH20) and close to the Sheering Road Roundabout (BH30 – high gas flow.	Moderate – given no significant elevations of gas. However some high flow was detected at two locations, one along the Westbound Link (BH20) and the other close	Large to Very Large

Activity or source	Potential Impact	Type and Sensitivity of Receptors impacted	Key locations of potential impact	Magnitude of unmitigated impact (Major, Moderate, Minor)	Significance of unmitigated effect
	causing asphyxiation to construction workers.	infrastructure (medium).		to Sheering Road Roundabout (BH30). No gas monitoring possible near to infilled pit to west of Gilden Way. Moderate - in the areas not assessed by the GI as ground conditions cannot be confirmed.	
Risk of encountering Unexploded Ordnance (UXO)	UXO encountered during groundworks.	Construction workers	Proposed Scheme area	Moderate to Major	Large to Very Large
Risk of encountering unstable ground conditions	Unstable ground encountered during groundworks impacting the Proposed Scheme or environment	Highways infrastructure, Surface Water (Pincey Brook and Harlowbury Brook - medium).	Proposed Scheme area	Moderate to Major	Large

9.5.2 Operational effects

Table 9.13 presents the potential operational effects resulting from the Proposed Scheme concerning geology and soils.

Table 9.13: Geology and soils operational effects

Activity or source	Potential impact	Type and sensitivity of receptors impacted	Key locations of potential impact	Magnitude of unmitigated impact (Major, Moderate, Minor)	Significance of unmitigated effect
Contamination from road operation	During operation of the road there would be likely to be low loading of petroleum hydrocarbons, metals and suspended solids from the new road surfaces. Furthermore, there would be a potential for spillages of minor volumes of hydrocarbons.	Superficial Aquifers (medium to high), Bedrock Aquifers (high to very high) and surface water (medium).	Particularly in areas close to surface water receptors and in areas where superficial aquifers are close to the surface (Sheering Road Roundabout, the Pincey Brook Roundabout, the south bound off slip (close to Pincey Brook) and the central section of Gilden Way).	Moderate to Major – if contamination from road use released contamination to receptors. The impact to the Principal (Chalk) Aquifer is considered would be unlikely, given that it is protected in the majority of areas by superficial deposits and the London Clay Formation. The Secondary A aquifers (Head deposits and Alluvium) are close to the surface so could be impacted by contamination. The Lowestoft Formation is close to the surface and could be impacted by potential contamination particularly within the pockets of Glaciofluvial Deposits, which could be a potential receptor. However, due to its low permeability it would most likely protect deeper strata from contamination.	Large or Very Large – given the sensitivity of the underlying aquifers (Principal aquifer – Gilden Way section and Secondary A aquifers) and the Pincey Brook.
Exposure of superficial geology	Due to the excavation and removal of soil materials from the Proposed Scheme during construction, there	Superficial aquifer – head deposits (medium) and	Exposure of the superficial deposits would be a risk in the area of the Sheering	Minor – as impact would be localised and most areas of the proposed development would remain largely unaffected and areas	Slight or Moderate – given the sensitivity of the superficial geology at the site has been assessed

Activity or source	Potential impact	Type and sensitivity of receptors impacted	Key locations of potential impact	Magnitude of unmitigated impact (Major, Moderate, Minor)	Significance of unmitigated effect
	would be potential for the superficial geology to be exposed to the surface following construction.	alluvium (high).	Road Roundabout, Pincey Brook Roundabout, the M11 south bound off slip (close to Pincey Brook) the Eastbound Link and any other areas of exposed cuttings.	of cutting would likely be landscaped.	as high (alluvium – Secondary A superficial aquifer) or medium (head - secondary, undifferentiated superficial aquifer) and low in the areas of unproductive strata.
Exposure of human receptors to soil or groundwater contamination	Exposure of human receptors to any remaining contamination on completion of construction.	General public (high).	Mostly near residential areas.	Negligible to Minor – Given that upon completion of the works, it is expected that the presence of asphalt on the road would provide a protective cover for the soil beneath the site and therefore would reduce human receptor exposure to soil contamination that could be encountered or be inadvertently introduced during construction.	Neutral – as hardstanding would reduce risk by eliminating the contamination pathway to human receptors.

9.6 Proposed Mitigation

9.6.1 Construction mitigation

The majority of potential construction impacts from the Proposed Scheme could be controlled and mitigated by implementing a CEMP and Soil Management Plan (SMP), incorporating measures detailed in the outline EMP.

In addition to the measures detailed in the outline EMP, the following mitigation is also recommended:

9.6.1.1 Land Quality mitigation measures:

- The CEMP should include measures to protect the abstraction borehole located near the Sheering Road Roundabout. This should include the physical protection of the borehole housing, electrical supply and pipework, and measures to make sure that potential contaminants did not impact the abstraction. Such measures could include putting barriers in place around the borehole housing. The routes for any utilities and pipework would be established, marked and protected and potential contamination sources kept well away from the protected area.
- The CEMP should include requirements to make sure that any suspect contaminated ground identified during the works is dealt with appropriately. Given that the GI identified low levels of soil contamination, it is considered unlikely that substantial amounts of contaminated ground exist at the site. However, if any significant areas of suspected contamination are identified through visual or olfactory evidence during the construction works or contamination is caused inadvertently during the works, the following would be undertaken: representative samples taken of the suspect material by a suitably qualified person and sent for laboratory analysis to assess the risk to potential receptors. As a worst case, if significant contamination were found where ground works could not be avoided, then the material probably would need to be removed for treatment or disposal and replaced with clean material prior to groundwork re-commencing.
- The CEMP should include measures to ensure that discharges of potentially contaminated water to ground did not occur. Such measures could include using cut-off ditches or installing silt traps around excavation works or exposed ground and stockpiles to prevent the uncontrolled release of sediments or contaminants from accidental spillages to soil or groundwater or treating water prior to discharge.
- The CEMP should include measures to limit potential impacts from concrete preparation. Measures should be put in place to ensure pre-mixing of the required concrete would undertake off-site or in controlled areas of site compounds if feasible. Where this was not feasible the risks could be reduced by limiting the mixing and handling of wet concrete on site to designated areas where the release of runoff could be controlled and contained.
- The CEMP should include measures to prevent the importation of contaminated or unsuitable fill materials to the site. Representative sampling of imported materials and materials excavated for re-use within the scheme could require chemical contamination testing for a range of soil and soil leachate analytical suites and assessment against appropriate limit values for protection of controlled waters and human health.
- Monitoring of any mitigation measures should be undertaken during the construction works to make sure protective measures are adequate and that any need for any corrective action is identified in a timely manner.
- Piling has the potential to introduce migration pathways for contaminants to deeper strata. A piling risk assessment should be undertaken before construction for any areas where piling would potentially impact aquifers.
- The location proposed for a site compound along Gilden Way has previously been used as a plant nursery. As a result of this previous use the site could be a source of potential contamination due to use and storage of fuels, oils and other chemicals. The site walkover undertaken in September 2016 did not identify obvious indications of contamination, but it was not possible to observe ground conditions beneath hardstanding and other surfacing. To mitigate against potential risks from unknown contamination, prior to setting up of the compound a contaminated land risk assessment would be undertaken based on the proposed work to be undertaken. This would assess anticipated ground conditions in areas that would be likely to be impacted. The assessment should include soil sampling if suspect contamination were to be identified and, if piling was required, then a piling risk assessment should be undertaken. During the preparation of the site compound, the CEMP should be followed as a mechanism for dealing with any

suspected contaminated ground. The CEMP and SMP would also outline measures to limit the spread of potential contamination and for the protection of any soil stockpiles at the site compound.

- The boreholes installed during the GI undertaken for the Proposed Scheme should be decommissioned unless they are required for monitoring purposes as they could become potential pathways for surface derived contamination into groundwater if damaged or allowed to deteriorate. Measures should be included in the CEMP for protecting any remaining boreholes such that potential contaminants did not impact the underlying strata. In addition, the boreholes observed during site reconnaissance close to the proposed Sheering Road Roundabout should either be protected during the works or, if no longer required, decommissioned as they could also be a potential pathway for contamination.

9.6.1.2 Gas risk mitigation measures:

- A laboratory gas sample should be collected and analysed from BH20 and BH30 to identify specific gases which could be present in the boreholes to assess if these may be responsible for the flow rates detected. Further risk assessment can be carried out based on the results.
- A gas monitoring well should be installed along Gilden Way to assess for possible gas migration from the nearby infilled gravel pit. It would be prudent to also sample groundwater from this well if groundwater is detected. Further risk assessment could be carried out based on the results.

9.6.1.3 Soil mitigation measures:

- The loss of agricultural land resulting from the construction of the Proposed Scheme cannot be fully mitigated. The retention and management of soils which require excavation for re-use on landscaped areas would make sure that existing good quality topsoil would be retained where practicable.
- The loss of high grade agricultural soils could be reduced further by carefully managing topsoil strip, movement, storage and removal in accordance with a SMP.
- In advance of construction works, a Soil Resource Survey (SRS) should be carried out by a suitably qualified and experienced soil scientist or practitioner. The results of the survey would provide information on the characteristics of each soil resource, suitability of the soil for re-use and recommendations for soil handling and storage. A Materials Management Plan (MMP) should be updated to incorporated the information, identifying the options for re-use, import or export of materials to minimise the amount of waste generated by the Proposed Scheme works.
- The results of the SRS would be presented in a soil resources plan to define areas and types of topsoil and subsoil to be stripped, haul routes, the stripping and handling methods to be used, and the location, type and management of soil stockpiles.
- When handling soil during construction the following measures are also recommended (Defra, 2009):
    - When stripping, stockpiling or placing soil, this would be achieve d in the driest condition possible and would make use of tracked equipment where possible to reduce compaction;
    - Confine traffic movement to designated routes;
    - Keep soil storage periods as short as possible; and
    - Clearly define stockpiles of different soil materials.

9.6.1.4 Other mitigation measures:

- During construction there would be a potential risk of encountering UXO. The most recent site survey classifies the site as medium risk. To mitigate against this risk, it is recommended that a targeted investigation is carried out prior to construction works commencing. This targeted investigation would help to identify and further refine the risks for the Proposed Scheme. Further details are provided in the 1st Line Defence Ltd. Report on UXO, Non-Intrusive Magnetometer Survey Report Reference OPN2825NIS 27th November 2015.
- The Envirocheck report identified some areas of potential ground instability, these would be mitigated as part of the Proposed Scheme design and this issue is therefore not considered further in this chapter.

9.6.2 Operational mitigation

The operational impacts would be mitigated by incorporating standard highway design measures.

On completion of the works, most of the exposed ground surface would be covered with hardstanding or landscaping thereby preventing the exposure of future road users or users of adjacent land to possible contamination which could remain beneath the site.

Following construction and during the road operation, regular monitoring and maintenance should be undertaken, to make sure that any protective measures put in place are adequate and that the need for any corrective action is identified in a timely manner.

In some locations the superficial geology would be exposed in areas of cutting such as the Pincey Brook Roundabout. Potential impacts would be mitigated with the provision of drainage, road surfacing and landscaping to reduce and protect areas exposed at the surface. The likely impact would be localised and most areas of the Proposed Scheme would remain unaffected.

Maintenance works would be carried out periodically along the route during operation and could require occasional excavation beneath the hardstanding or within verges and landscaped areas. If contaminated materials were identified during the construction works and remained beneath the road during operation, details of the locations and types of contaminants present would need to be included in the health and safety file for the Proposed Scheme. This would inform future maintenance workers and make sure that appropriate precautions were implemented during any works likely to disturb the material.

Mitigation measures for protection of surface waters are provided within Chapter 13 - Road Drainage and the Water Environment.

9.6.3 Recommendations for additional investigations

Since the M11 Junction 7A GI, the Proposed Scheme design has evolved with some additional areas now included within the study area. These additional areas were not included in the GI and therefore no soil, groundwater or gas data are available. It is recommended that additional GI should be undertaken in any areas not assessed. It is also recommended that some GI findings are investigated further. The following additional investigations are recommended:

- Additional GI required in the vicinity of the proposed site compound (south of the Gilden Way) if suspected contamination were to be identified during site establishment and also in the area of the new southbound off slip extension of the M11.
- A laboratory gas sample should be collected and analysed from BH20 and BH30 to identify specific gases which could be present in the boreholes to assess if these were responsible for the flow rates detected.
- A gas monitoring well should be installed along Gilden Way to assess for possible gas migration from the nearby infilled gravel pit. It would be prudent to also sample groundwater from this well if groundwater was subsequently encountered.
- A SRS should be carried out and a SMP prepared for the Proposed Scheme prior to construction.

9.7 Residual effects

Given that no significant concentrations of contamination were found in the GI it is not expected that remediation of contaminated soil or groundwater would be required. It is considered that with the above mitigation measures employed during construction and operation of the Proposed Scheme, the significance of residual impacts would be **Neutral** to **Slight Adverse** with respect to geology, contaminated ground or groundwater and residual gas risk. To assess the risk for those areas where no GI has been undertaken and others where potential risk has been identified some addition investigation is recommended as outlined in the above section.

The loss of agricultural soils resulting from the construction of the scheme could not be fully mitigated within the Proposed Scheme. With implementation of the mitigation measures discussed above, to preserve soil removed from beneath the Proposed Scheme to re-use as much of it as possible and to protect surrounding soil, the significance of residual impacts of this loss has been assessed to be **Slight to Moderate Adverse**.

9.8 Summary and Conclusions

The proposed mitigation and significance of impact prior to and after mitigation for geology and soils are summarised in Table 9.14.

Table 9.14: Summary of geology and soils impacts

Description of effect	Significance of effect (prior to mitigation)	Proposed mitigation	Residual effect (after mitigation)
Construction effects			
Vegetation clearance and excavation works - could increase/modify contaminated groundwater and ground gas regime in the scheme area	Large or Very Large Adverse	A CEMP would be prepared and implemented to identify measures to control contamination risk	Neutral
Piling – potential to introduce migration pathways for contaminants to deeper strata	Large or Very Large Adverse	Undertake piling risk assessment for any areas where piling would potentially impact aquifers.	Neutral
Installation of service trenches – these could act as preferential pathways for migration of ground gas, soil and water-derived vapours and contaminants in groundwater	Large or Very Large Adverse	A CEMP would be prepared and implemented to identify measures to control contamination risk	Neutral
Dewatering – if water arising from this process was found to be contaminated and discharged locally it could have a detrimental impact	Large Adverse	A CEMP would be prepared and implemented to identify and control contamination discharges	Neutral
Accidental spills and leaks – could impact surface or groundwater	Large or Very Large Adverse	A CEMP would be prepared and implemented to control contamination discharges	Neutral
Concrete and cement products – uses could impact on water quality, flora and fauna	Large or Very Large Adverse	A CEMP would be prepared and implemented to control the preparation and handling of concrete	Neutral
Construction workers – potential exposure to contamination	Moderate or Large Adverse (due to sensitivity of the receptor)	Control measure such as adopting PPE with appropriate health and safety risk assessments should be implemented	Neutral
Dust or mud from soils containing elevated concentrations of contaminants impacting on general public	Moderate or Large Adverse	A CEMP would be prepared and implemented to control contamination risk to public	Neutral to slight
Loss of soils – There is potential for damaged soils	Moderate to Large Adverse	Manage and try and reduce loss of soil with a SMP (see Section 9.6)	Slight to Moderate

Description of effect	Significance of effect (prior to mitigation)	Proposed mitigation	Residual effect (after mitigation)
and there will be a loss of high grade agricultural land within the scheme footprint		(Not fully mitigatable, loss could only be reduced)	
Existing contamination impacting highways infrastructure	Slight	A CEMP would be prepared and implemented to manage any contamination found during construction not identified in the GI	Negligible
Gas accumulation in voids	Large to Very Large Adverse	Complete additional monitoring and gas sample collection to refine gas risk assessment and design mitigation measures as part of the Proposed Scheme if needed (see Section 9.6)	Slight
Risk of encountering Unexploded Ordnance (UXO)	Large to Very Large Adverse	It is recommended that a targeted investigation is carried out prior to any construction works commencing. This investigation would help to identify and further refine the risk on site (see Section 9.6)	Slight
Risk of encountering unstable ground conditions	Large Adverse	Potential ground instability should be mitigated as part of the Proposed Scheme design (see Section 9.6)	Slight
Operational effects			
Contamination from road operation.	Moderate to Large Adverse	Monitoring following construction to assess adequacy of protective measures and that the need for any corrective action is identified in a timely manner (see Section 9.6)	Neutral to Slight
Exposure of superficial geology	Slight	Mitigated with drainage design, road surfacing and landscaping to reduce and protect areas exposed at the surface. However, the impact would l be localised and most areas of the proposed development would remain largely unaffected	Neutral
Exposure of human receptors to contamination	Neutral	Monitoring following construction to make sure that protective measure are adequate and that the need for any corrective action is identified in a timely manner (see Section 9.6)	Neutral to Slight

10. Materials

10.1 Introduction

This chapter assesses the likely significant effects associated with the use of materials and the generation of waste associated with the construction of the Proposed Scheme. It concentrates on an assessment of potential impacts that could occur through the use of primary, secondary, recycled raw materials and manufactured construction products, including the embodied carbon/energy associated with the manufacture of materials. The assessment follows the guidance within draft DMRB Volume 11, Section 3, Part 6, Materials guidance (HD 212/11) (Highways Agency *et al*., 2011) and IAN 153/11 Guidance on the Environmental Assessment of Material Resources (Highways Agency, 2011b).

The consumption of material resources and generation of wastes could give rise to environmental impacts that would need to be managed and mitigated. Two main areas are assessed:

- provision and use of materials resources; and
- generation and management of wastes.

Whilst the use of materials and the production of waste could potentially affect the full range of environmental media and assessment topics, their effect on the wider environment has been assessed as part of each of the technical chapters in this ES. Examples include the visual impact of material stockpiles in the landscape assessment and noise emissions from material movements and handling during construction in the noise assessment etc.

Material resource use and waste generation during the operational phase, as part of general maintenance of the completed Proposed Scheme, would likely be negligible (by type, duration and volume) and therefore this aspect has been scoped out of this assessment.

Additional information to support this chapter is presented in the following appendices:

- Appendix 10.1: Outline Site Waste Management Plan; and
- Appendix 10.2: Outline Materials Management Plan.

10.1.1 Legislative and planning context

The following legislation and planning guidance has been referenced in the production of this chapter:

- Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (Defra, 2009);
- Council Directive (2008/98/EC) of the European Parliament and of the Council on Waste; the Waste Framework Directive 2008, as amended;
- Environment Act 1995;
- Environmental Protection (Duty of Care) Regulations 1991;
- Environmental Protection Act 1990;
- Essex County Council and Southend-on-Sea Borough Council Replacement Waste Local Plan (2016);
- Harlow Local Development Plan 2011-2031 (Not adopted);
- Hazardous Waste (England and Wales) Regulations 2005;
- Highways Agency Environment Strategy 2010-2015 (Highways Agency, 2010c);
- Highways Agency Procurement Strategy 2009 (Highways Agency, 2009);
- Highways Agency Strategic Plan 2010-2015 (Highways Agency, 2010);
- Highways Agency Sustainable Development Plan 2012-2015 (Highways Agency, 2012);

- National Planning Policy for Waste 2014 (Department for Communities and Local Government, October 2014a);
- Strategy for Sustainable Construction Defra 2008;
- Strategy for Sustainable Construction, Progress Report 2009;
- The Definition of Waste: Development Industry Code of Practice (Contaminated Land; Applications in Real Environments (CL:AIRE), March 2011);
- The East of England Plan (May 2008);
- Waste (England and Wales) Regulations 2011;
- Waste Management Plan for England 2013; and
- WRAP's 'Designing out Waste: a design team guide for Civil Engineering'.

A review has identified key relevant statutory and policy requirements applicable to materials resource use and waste management for the Proposed Scheme. These are presented in Table 10.1.

Table 10.1: Applicable statutory and policy requirements

Legal/policy requirements	Reference
'Take reasonable steps when transferring waste to apply the following waste management hierarchy; *(a) prevention;* *(b) preparing for reuse;* *(c) recycling;* *(d) other recovery; and* *(e) disposal.'*	Waste (England and Wales) Regulations 2011
'Helping to secure the re-use, recovery or disposal of waste without endangering human health and without harming the environment' *'The handling of waste arising from the construction and operation of development, maximises reuse/recovery opportunities, and minimises off-site disposal'.*	National Planning Policy for Waste 2014a (Department for Communities and Local Government, October 2014)
By 2020, the recovery of non-hazardous construction and demolition waste shall be increased to a minimum of 70% by weight.	Council Directive (2008/98/EC) of the European Parliament and of the Council on Waste (EU, 2008) Waste Management Plan for England (2013) Highways Agency Procurement Strategy 2009 (Highways Agency, 2009)
Advocates the 'waste hierarchy' principle. 'Applicants are required to minimise the amount of waste produced and the volume of waste sent for disposal unless it can be demonstrated that an alternative approach results in the best overall environmental outcome. Waste must be managed properly both on and off-site, and must be dealt with appropriately by the waste infrastructure available'.	National Policy Statement for National Networks (Department for Transport, December 2014).

The government removed the statutory requirement for Site Waste Management Plans (SWMP) in October 2013. Site Waste Management Plans were previously required for C&D wastes in England. Their continued use is considered best practice to ensure that demolition and construction wastes are dealt with in an appropriate manner and in accordance with the waste hierarchy; therefore, a SWMP would be developed and implemented for this scheme. This approach is consistent with the guidance in the National Policy Statement for National

Networks (Department for Transport, December 2014) to implement sustainable waste management through the application of the waste hierarchy. An outline SWMP is provided in Appendix 10.1.

10.1.2 Study area

The study area is in two parts:

- All land contained within the Proposed Scheme boundary, within which materials would be contained and wastes generated and managed. The construction site is defined as including the complete footprint of the Proposed Scheme, together with any land that would be used temporarily during construction. Such temporary land could include temporary storage areas for soils and other materials, and haul-roads.
- Essex County Council has been consulted on potential locations of waste management infrastructure. A specific study area for the materials assessment has not been identified as a whole market approach is proposed for procuring materials required for the Proposed Scheme. However, efforts would be made to source materials locally whenever possible.

10.2 Assumptions and Limitations

The following assessment is based on current reference design. The assessment does not consider impacts associated with the off-site extraction of raw materials used for the off-site manufacture of products. These stages of the products' or materials' life-cycles are outside the remit of this assessment due to the range of unknown variables associated with the extraction and manufacturing processes and given that it is likely that environmental effects associated with materials extraction and wastes management have already been dealt with for the relevant facilities' established consents.

Initial quantification of material resources use and waste arising from the Proposed Scheme has been derived from the reference design information and combined with professional judgement. The quantities derived are estimates considered sufficient to inform this assessment.

Material resource use and waste generation during the operational phase, as part of maintenance of the completed Proposed Scheme are likely to be negligible (by type, duration and volume) and unlikely to give rise to significant environmental effects. Materials use and waste generated during the operational phase of the Proposed Scheme have therefore been scoped out of this assessment. The management of any environmental impacts associated with material resource use and waste generated, during any subsequent maintenance or improvement works, would be guided by the contractor's Handover Environmental Management Plan (HEMP).

Furthermore, for the purposes of this assessment, the quantification of materials and wastes has been based on likely worst case scenarios.

The direct energy associated with the operation of the road, such as energy from the use of lighting is not considered in line with the IAN 153/11 (Highways Agency, 2011b).

10.3 Methodology and Assessment Criteria

10.3.1 Methodology

It should be noted that the assessment of materials has not yet been formally incorporated into the current DMRB guidance and that guidance is still evolving. This chapter therefore follows draft/interim guidance on the scope of the 'Materials' topic and the approaches / methodologies to be applied as set out in draft DMRB Volume 11, Section 3, Part 6, Materials guidance (HD 212/11) [March 2011] and DMRB IAN 153/11 Guidance on the Environmental Assessment of Material Resources (Highways Agency, 2011b).

10.3.2 Assessment of sensitivity, magnitude and significance

The significance effect of an impact has been derived through consideration of the sensitivity of a receptor (sometimes referred to as its value or importance) and the magnitude of the impact. The significance of the effect is influenced by both variables.

10.3.2.1 Materials

The assessment of materials use has been undertaken by quantifying the carbon footprint of the materials used during construction. The magnitude of effects associated with material use has been derived from a calculation of embodied carbon associated with those materials known to be required for the construction of the Proposed Scheme using HE's Carbon Tool (August 2015 as amended February 2016). The methodology in the draft guidance (HD 212/11) does not include sensitivity criteria which would need to be accounted for to derive the significance of any effect. Only magnitude is used to describe the effect. Levels of magnitude are defined as follows from o HD 212/11 (Table 4.4), reproduced in Table 10.2 below:

Table 10.2: Materials (carbon) assessment magnitude criteria

Scale of impact magnitude	Total CO_2 equivalent (CO_2e) of materials (tonnes)
No change	<1,000
Negligible	1,000 - 5,000
Minor	5,000 - 20,000
Moderate	20,000 - 40,000
Major	>40,000

In terms of potential effects on resource depletion, sensitivity of materials use has been based on the availability of the resource in question and whether its use could result in its depletion. For example, high sensitivity might pertain to a rare resource, either not available locally or available only in very limited amounts, such that the resource could be significantly depleted by its proposed use. Conversely, a low sensitivity resource could be considered as one that is very common locally or that primarily comprises recovered/recycled materials such that its use would contribute to waste reduction targets and avoidance of primary materials. Moderate sensitivity would apply to materials somewhere between these two extremes.

HD212/11 and IAN153 do not require significance to be assessed for materials depletion or provide guidance on how this should be achieved; nevertheless, significance has been assessed. Professional judgement has been applied to determine the significance of potential impact on a graduated scale as per the DMRB Volume 11, Section 2, Part 5, Assessment and Management of Environmental Effects (HD 205/08) (Highways Agency *et al*., 2008). This has been achieved by comparing the value or sensitivity of the resource with the magnitude of impact (i.e. the requirement for materials capacity created by the Proposed Scheme). The generic impact assessment matrix set out in Chapter 4 'Approach to the Assessment' Table 4.1 has been used to determine the significance of effect.

A potential impact is considered to be significant if it is of moderate significance or greater. The assessment also identifies potential impacts as positive or negative, permanent or temporary and direct or indirect as required by IAN 153 and HD 212/11.

Indicative quantity estimates of materials have been prepared by the project design team, based on the reference design. The assessment of potential impacts has been undertaken with consideration of:

- regulatory and policy drivers;
- availability of natural resources; and
- materials re-use/recycling/recovery.

10.3.2.2 Waste

Determination of the sensitivity of waste management facilities is based on the available local waste management capacity. For example, a high sensitivity waste management operation (or even the entire waste management infrastructure in an area) could be considered to have very limited capacity for the waste type requiring treatment/disposal. This could be particularly true of hazardous wastes where local capacity could be

limited. Low sensitivity operations/local infrastructure could be considered to be large, or numerous waste management sites with plenty of capacity to deal with the wastes arising.

Sensitivity, magnitude and significance criteria have been derived from guidance in draft DMRB Volume 11, Section 3, Part 6, Materials guidance (HD 212/11) [March 2011]. Table 10.3 has been used to assess the value of receptors and Table 10.4 has been used to assess the magnitude of impacts.

Table 10.3: Determining the value of the receptor

Waste sensitivity	Available waste management infrastructure
Very High	There is no available waste management capacity for any forecast waste arising from the project
High	There is limited waste management capacity for all forecast waste arising from the project
Medium	There is adequate waste management capacity for the majority of forecast wastes arising from the project
Low	There is adequate available waste management capacity for all forecast wastes arising from the project

Table 10.4: Waste magnitude criteria

Waste magnitude	
Major	Waste is predominantly disposed of to landfill or to incineration without energy recovery with little or no prior segregation
Moderate	Wastes are predominantly disposed of by incineration with energy recovery
Minor	Wastes are predominantly segregated and sent for composting, recycling or for further segregation and sorting at a materials recovery facility
Negligible	Wastes are predominantly re-used on-site or at an appropriately licensed or registered exempt site elsewhere

The significance of potential impact was determined as a combination of value of the receptor and the magnitude criteria. This was achieved based on professional judgement informed by the matrix illustrated in Section 4.6, Table 4.1.

10.4 Baseline Environment

10.4.1 Baseline sources

Baseline information has been obtained from a number of sources including the Department for Communities and Local Government (DCLG), ECC, and EA.

10.4.2 Baseline conditions

10.4.2.1 Materials

The principal raw materials used in road construction are aggregates, including sand and gravel. Primary aggregate' *"is the term used for aggregate produced from naturally occurring mineral deposits and used for the first time"* (British Geological Society, 2015).

The East of England Aggregates Working Party: Annual Monitoring Report (DCLG, 2014a) identifies primary aggregate and mineral sources in the East of England which includes Essex. The report identifies that sand and gravel sales in Essex in 2012 amounted to 2.3 million tonnes and the aggregate reserves were 35.5 million

tonnes. As of August 2012, there were 23 sand and gravel sites with a further four sand and gravel quarries with permission to extract but currently dormant. This is based on current data.

Table 10.4: Land-won aggregates: reserves and landbanks 2013

Sand & gravel	Reserves (as at 31/12/13)	Annual call on reserves (2005-20)	Landbank (years) (as at 31/12/13)
	(thousand tonnes)		(years)
Essex	32,885	4,450	7.4 years
East of England	146,878	14,750	10 years

Due to EU competition regulations, it is not possible to prescribe materials sources. Based on current data and the information detailed in Table 10.4, it is inferred that there would unlikely be primary aggregates available locally during the lifetime of the Proposed Scheme. Construction of the Proposed Scheme would start in 2018 and take approximately four years to complete. This would mean that the 7.4 years landbank from the end of 2013 in Essex, as set out in Table 10.4 above, would be exhausted before construction was completed. However, as shown in Table 10.4 there is landbank regionally in the East of England until 2023. Nevertheless, it is expected that some aggregates would be available locally. Other materials needed for the Proposed Scheme would have to be transported from areas further afield; for example, steel, plastic and pre-cast concrete elements.

10.4.2.2 Waste

There were 33 Construction and Demolition (C&D) recycling sites within Essex in 2014, either currently operating or under construction, giving an estimated capacity of approximately 1.64 million tonnes per annum. There is an adequate geographical distribution of recycling sites, clustering near urban areas and transport routes with fewer facilities in rural areas except for temporary planning permissions co-located on operating minerals or landfill sites. Table 10.5 provides a summary of the construction, demolition and excavation (CD&E) recycling capacity that is available within Essex. There is additional capacity available through mobile plant and, in 2014, it was estimated that there were approximately 20 mobile recycling plants registered in Essex. These have not been captured in Table 10.5 due to their mobile nature.

Table 10.5: CD&E recycling facility capacity summary

Static CD&E recycling facilities	Number of facilities (2012/13)	Estimated total capacity (tpa) in 2012/13
Operational Facilities	33	1,636,237
All Facilities with Planning Permission	38	1,704,362

Table 10.6 provides a summary of inert landfill capacity within Essex in 2014.

Table 10.6: Inert landfill capacity summary

Inert landfills	Capacity of those facilities solely accepting inert waste (m^3)
Currently Operational Facilities	754,958
All Facilities with Planning Permission	2,554,958

(ECC and Southend on Sea Borough Council, 2015)

In 2012, there were 48 hazardous waste facilities operating in the ECC and Southend on Sea Borough Council Plan Area. Table 10.7 provides a summary of the hazardous waste facilities and primarily includes information on facilities dealing with Waste Electrical and Electronic Equipment (WEEE), asbestos or other metal recycling sites involved with vehicle dismantling. There are a number of hazardous waste transfer facilities, enabling waste to be exported beyond the plan area boundary for further recovery and treatment activities. Within the plan area, there are no facilities for incineration with or without Energy from Waste (EfW) or treatment. There is also no provision for the disposal of hazardous waste to landfill. Therefore, all hazardous waste requiring disposal to landfill would need to be exported out of Essex. Hazardous waste that needs to be disposed of to landfill is exported outside Essex principally to Suffolk, Kent and Northamptonshire, as well as Oxfordshire, Peterborough and Hertfordshire.

Table 10.7: Hazardous waste facilities

Broad facility type	Total number of facilities	2012 amount of waste accepted
Transfer	13	5,407
Recovery	35 (31 metal recycling facilities & 4 treatment facilities)	32,128
Total	48	37,535

In 2012, there were 15 ‘organic treatment’ and ‘organic treatment with energy recovery facilities’ operating in the ECC Plan Area. Table 10.8 provides a summary of the permitted throughput of the organic treatment sites within ECC.

Table 10.8: Organic treatment and organic treatment with energy recovery facilities summary

Organic treatment and organic treatment with energy recovery facilities	Planning permission / EA 4yr average (tonnes)
In Vessel Composting	36,782
Open Windrow Composting	154,079
Anaerobic Digestion	180,000

10.4.3 Value of receptors

Receptor types likely to be at risk of potential impact under this topic heading include:

- resource depletion from quarries, other sources of minerals and other finite raw material resources;
- the capacity of waste management infrastructure, such as landfills, materials recovery facilities, composting sites, and waste transfer stations; and
- national and local policy and targets relevant to materials and wastes (see above).

10.5 Significant Effects

A detailed assessment reporting matrix for materials and waste impacts is provided in Table 10.13.

10.5.1 Construction effects

10.5.1.1 Material resources

Potential impacts on materials resources include those associated with the extraction and use of primary raw materials and the use of products for construction. Many material resources would originate on-site, and would be reused on-site. Other materials and products such as street lamps and fencing would be purchased and used for construction. Potential impacts also include those associated with the generation of waste.

The types of materials likely to be required for construction are common to all road schemes. Indicative estimated quantities of the major materials required based on the current Proposed Scheme design are provided in Table 10.9.

Table 10.9: Summary of estimated main material quantities

Material	Units	Approximate estimated quantity
Pavement	m^3	28,350
Concrete	m^3	3,100
Steel	tonnes	810
Timber	tonnes	110
Other metals	tonnes	4
Plastic	tonnes	10

The depletion of finite natural resources could occur through extraction of primary aggregates (i.e. sands and gravels) from local or other quarries. Structures, drainage and signage products would need to be procured with consideration of the environmental impacts associated with their manufacture, as well as other issues such as structural design, carbon footprint, energy consumption, long-life performance, visual impacts, durability and cost. Both reinforced concrete and steel structures include a measurable recycled content in their manufacture.

Existing soils, infrastructure and demolition materials are considered to be potential material resources, including the following which would be generated during construction of the Proposed Scheme:

- excavated soil and/or rock (and made ground) produced during topsoil stripping and the construction of cuttings and embankments (collectively referred to as ‘earthworks’). These could be re-used on-site for landscaping or, potentially, for construction projects off-site; and
- road planings, which could be incorporated into new pavements on or off-site.

Earthworks

Table 10.10 confirms that the earthworks cut required would produce approximately 135,800m^3 of material. However, the earthworks fill required is approximately 550,400m^3. As such, approximately 414,600m3 of fill material would need to be imported from off-site locations. Currently, it is not known where the additional earthworks materials would be sourced, this would be procured by the contractor. However, when sourcing earthworks material the contractor would take into account the proximity principle and consider options in close proximity to the Proposed Scheme. Topsoil would be stripped and stored on site and used for landscaping purposes.

Table 10.10: Summary of estimated main earthworks material quantities

Earthworks material	Approximate estimated quantity (m^3)
Topsoil stripped	38,800
Fill material	550,400
Cut material	135,800

Aggregates

Imported aggregates would likely be required for earthworks, structures, drainage and road pavement during the construction of the Proposed Scheme. These can be either primary aggregates, such as sand, natural gravels and rock, or secondary aggregates, such as recycled concrete, recycled road planings, Incinerator Bottom Ash (IBA), reclaimed railway ballast and materials from building demolition.

The choice of whether to use primary or secondary aggregates (or a combination of both) would be made considering a combination of factors such as materials source, specification, production and transport. Secondary (recycled) aggregates do not always have the lowest impact on the environment and materials would be selected based on a consideration of all relevant impacts. It is likely that within Essex (with a remaining primary aggregate landbank of approximately 33 million tonnes from end the 2013 and 1.7 million tonne CD&E waste recycling capacity per annum) and/or the surrounding area (with a remaining primary aggregate landbank of approximately 147 million tonnes from the end 2013) there would be capacity to supply both primary and secondary aggregates. However, due to EU competition regulations, it is not possible to prescribe materials sources.

Vehicle movements

The Proposed Scheme is located on the road network capable of accommodating vehicle movements for materials and waste transportation. It is anticipated that transport to the site would be by road rather than rail to avoid the potential for 'double handling' when utilising the rail network. Poor planning of materials use could lead to excessive use of plant and vehicles used to move and handle bulk materials, resulting in inefficient use of energy.

Material carbon footprint

The total embodied carbon has been calculated using the HE Carbon Tool (2015). Table 10.11 provides estimates of the embodied carbon contained within the main materials that would be used for the Proposed Scheme.

Table 10.11: Estimated embodied carbon content of materials to be used on the Proposed Scheme

Carbon sources	CO_2e emissions (tonnes)
Embodied tCO_2e	32,888
Materials Transport tCO_2e	10,642
TOTAL	**43,530**

The total CO_2e emissions was assessed to be >40,000 tCO_2. As set out in Table 10.2, this represents a 'Major' impact on materials use.

10.5.1.2 Waste

Waste would arise as a result of the construction of the Proposed Scheme primarily from materials brought to site not used for their original purpose i.e. damaged items, off-cuts, surplus materials and unusable on-site

materials. Impacts would result from the production, movement, transport, processing and disposal of these wastes.

Most of the waste generated from the Proposed Scheme would be C&D type waste. The Waste and Resources Action Programme (WRAP) defines C&D wastes as waste materials arising from UK commercial C&D sites. It includes, but is not limited to, off-cuts and waste timber, plastics, glass, packaging and inert materials such as soils and rubble. The definition also includes aggregate materials (such as masonry, brick and block, paving, tiles and ceramics and plasterboard in mixed waste).

For wastes and surplus or defective materials, potential impacts are primarily associated with the production, movement, transport and processing (including recycling/recovery) of the wastes on and off-site and, if required, their disposal to appropriately licenced off-site facilities. A waste management concern of high importance would be the risk of using up available capacity at waste management/disposal facilities. This would force locally produced wastes to be transported greater distances for disposal elsewhere.

Surplus organic materials, including vegetation from shrubs and trees could also generate waste material for treatment and/or disposal.

Waste and Resources Action Programme's civil engineering wastage rates set out in The Designing Out Waste Tool for Civil Engineering Projects (WRAP, August 2010) have been applied to the construction materials to estimate the waste arisings generated during the construction stage of the Proposed Scheme.

The anticipated main types and quantities of waste generated during the site preparation, demolition and construction phases are shown in Table 10.12.

Table 10.12: Summary of waste arisings

Waste type	Units	Estimated quantities of waste arisings
Tree Clearance	m^3	800
Pavement	m^3	1,400
Concrete	m^3	77
Steel	tonnes	40
Timber	tonnes	3
Plastic	tonnes	0.2

Other wastes could include:

- hazardous wastes (likely to be of minimal volume);
- municipal solid waste from construction workers (likely to be of minimal volume); and
- surplus materials (likely to be of minimal volume).

With regards to the items listed above, quantities for specific items could not be estimated at this time. This information would become available at the detailed design stage and once further assessment of the proposed site has been undertaken in advance of construction. However, they are discussed briefly below.

Hazardous waste

Hazardous wastes could comprise any contaminated soils that cannot be treated to make them suitable for use, such as any material contaminated with asbestos or VOCs, oils, metals etc. Disturbance or storage of contaminated soils during construction can also lead to the release of chemical pollutants into the air, ground or water (remobilisation of contaminants). The potential for waste materials or land uses to generate contaminated soils is discussed in Chapter 9 (Geology and Soils).

Municipal solid waste

Welfare facilities for construction workers would generate municipal wastes in small volumes. Segregation facilities would be provided to ensure that recovery and recycling of such wastes is maximised.

Surplus materials

Surplus materials would be avoided wherever possible by efficient quantity surveying and procurement. If any arise they would be segregated and returned to the manufacturer.

Table 10.13: Detailed assessment reporting matrix for materials and waste effects

Project activity	Potential impacts associated with material resource use/waste management	Description of the impacts	Brief description of mitigation measures
Site preparation	Production of soils (suitable and unsuitable for use) from site clearance.	Suitable soils would be stored and reused on the Proposed Scheme for engineering fill. Other soils would be reused elsewhere on the Proposed Scheme for landscaping or taken off-site for reuse or recycling. It is unlikely that significant volumes would be exported so is unlikely to involve significant transport effects. Impact = low sensitivity, minor magnitude, negative, permanent and direct Significance = Neutral or Slight Adverse	Site Waste Management Plan (SWMP) including use of targets as Key Performance Indicators (KPIs). Market testing for the potential for wastes proposed to be used off site.
	Site clearance resulting in green waste arisings from vegetation.	Vegetation clearance would be required; some of the green waste could be chipped and used on site for landscaping purposes. It is likely that some of this waste would be taken off-site for composting or use off-site. Impact = low sensitivity, minor magnitude, negative, permanent and direct Significance = Neutral to Slight Adverse	SWMP and KPIs.
	Hazardous waste from clearance of contaminated land	Potential for low volumes of hazardous waste to be generated, facilities for hazardous waste are present in the area. Contamination issues dealt with in Chapter 9. Impact = low sensitivity, negligible magnitude, permanent and direct. Significance = Neutral – Slight Adverse	SWMP. On- or off-site treatment of contaminated soils for any hazardous wastes on-site, as appropriate.
Demolition	On site use of material from the demolition of existing pavement	Demolition works would include the removal of old pavement. Inert waste generated through pavement clearance would either be reused on-	SWMP and KPIs.

Project activity	Potential impacts associated with material resource use/waste management	Description of the impacts	Brief description of mitigation measures
		site or taken off-site for recycling. Impact = low sensitivity, minor magnitude, negative, permanent and direct Significance = Neutral to Slight Adverse	
Site construction	Material use and depletion (i.e. virgin aggregates)	Materials would be predominantly available regionally though where possible material would be sourced locally. The potential impact would involve the use of moderate volumes of primary aggregate resources won off-site depending on what could be won and/or recovered on-site or what suitable recycled materials were available at the time of construction. Volumes imported would contribute to impacts associated with traffic. Impact = medium sensitivity, moderate magnitude, negative, permanent and direct Significance = Slight or Moderate Adverse	CEMP. Procurement policies and KPIs would be used to maximise local sourcing of materials and the inclusion of as much recycled content as practicable, in accordance with the required specifications of the construction material. Maximisation of the use of on-site material would be followed, wherever practicable.
	Use of imported materials (i.e. blacktop, steel, concrete).	Moderate volumes of materials would need to be sourced off-site. The use of imported primary materials would contribute to the depletion of finite natural resources whilst use of recycled products would minimise such effects. There would be potential impacts associated with transporting imported materials. Impact = low sensitivity, moderate magnitude, negative, permanent and direct Significance = Slight Adverse	CEMP. Procurement policies and KPIs would be used to maximise local sourcing of materials and the inclusion of as much recycled content as practicable, in accordance with the required specifications of the construction material. Use of on-site material, would be maximised wherever practicable.
	Carbon footprint of materials transport and use	The impact of the embodied carbon contained within the main material resources to be used on the Proposed Scheme is assessed to be	As above and use of ‘just-in-time’ delivery to minimise double handling. Also sensitive routing to minimise

Project activity	Potential impacts associated with material resource use/waste management	Description of the impacts	Brief description of mitigation measures
		Major Adverse.	amenity effects.
	Wastes from materials use and municipal solid waste production	It is anticipated that the majority of wastes would be recycled (excluding any hazardous or contaminated waste). There is local CD&E recycling capacity such that sensitivity is low. The effect magnitude is considered to be minor. Municipal solid waste production is expected to be minimal. If waste requires landfill disposal/treatment off site, landfill capacity is available. Impact = low sensitivity, minor magnitude, short term, localised and adverse impact. Significance = Neutral to Slight Adverse	SWMP and KPIs, use of segregation facilities for municipal wastes.

10.6 Proposed Mitigation

10.6.1 General mitigation measures

There is significant synergy between materials re-use and the avoidance of the generation of waste and a substantial overlap between the mitigation measures for both.

Structures, drainage, road restraint systems, street lighting, traffic signals and signage products would be procured with consideration of environmental impacts associated with their manufacture, as well as other considerations such as structural design, carbon footprint, energy consumption, long-life performance, visual impacts, durability and cost. Both reinforced concrete and steel structures include a measurable recycled content in their manufacture. Where possible, the availability of responsibly sourced local and recycled materials would be considered in order to minimise potential environmental effects, such as from transport emissions.

The principles of the waste hierarchy would be applied to minimise waste generation and maximise re-use of materials on-site, where possible. Where on-site re-use is not possible, alternative options would be sought off-site, such as reprocessing into aggregate or the use of inert materials for other developments. For all potential waste arisings, the contractor would be required to comply with The Environmental Permitting (England and Wales) Regulations 2015. Consideration would also be given to The Definition of Waste: Development Industry Code of Practice (Contaminated Land; Applications in Real Environments (CL:AIRE), March 2011) and appropriate EA Pollution Prevention Guidelines (PPGs) (note: all PPGs were withdrawn in December 2015 but are still available through the National Archives and are still considered to contain useful ‘good practice guidance’ applicable to the Proposed Scheme). If wastes could not be legitimately re-used on site, they would be removed by licenced carrier to a licensed recycling or disposal facility in line with regulatory requirements. In addition, WRAP’s ‘Designing out Waste: a design team guide for Civil Engineering’ would be utilised by the contractor and referenced in the SWMP.

A summary of mitigation measures is provided in Table 10.14.

10.6.2 Implementation of a Construction Environmental Management Plan

An Outline Environmental Management Plan (EMP) has been developed to support this ES. The outline EMP is a ‘live document’ and it will form the basis for the development of the CEMP as more information becomes available and there is more certainty in terms of the proposed project layout, construction methods, programmes and the likely environmental effects. The CEMP is a principal mitigation measure for the Proposed Scheme and would be developed by the Principal Contractor based on the outline EMP during the detailed design phase (i.e. before the start of construction works) and implemented during construction phase. The CEMP would include the following:

- details of the approach to environmental management throughout the construction phase, with the primary aim of mitigating any adverse impacts from construction activity on identified sensitive receptors;
- procurement and waste management protocols/Key Performance Indicators (KPIs) and targets designed to minimise impacts on the environment and maximise local procurement of materials and waste management options;
- good materials management methods, such as recovery and re-use of temporary works materials, as well as use of ‘just-in-time’ delivery to minimise double handling etc.;
- in order to minimise effects on amenity, materials for import and waste disposal would be transported appropriately along prescribed routes which are likely to include the M11, A414 and B183 Gilden Way. Prescribed routes would be included in the main construction contract documents. The contractor would be required to seek approval from the relevant authority should they wish to use any other routes; and
- risk/impact-specific method statements and strategic details of how relevant environmental impacts would be addressed throughout the Proposed Scheme, embodying the requirements of the relevant PPGs.

10.6.3 CEEQUAL

A CEEQUAL assessment has been undertaken for the design and construction of the Proposed Scheme. The CEEQUAL assessment includes a section for materials and waste, which looks for opportunities throughout the design and construction period to conserve the use of materials through the reduction, reuse and recycling of wastes. CEEQUAL also seeks to influence the supply and use of materials through design, specification, selection, storage and use. CEEQUAL assessment would continue throughout the construction period and would seek to influence waste management and conservation of materials.

10.6.4 Implementation of the Materials Management Plan

A MMP would be developed by the contractor and would detail how all construction phase materials (material resources and waste) would be managed; this plan would be implemented by the Principal Contractor. An Outline MMP is provided in Appendix 10.2 and provides a framework which would be used as the basis on which the Proposed Scheme's MMP would be based. The MMP would set out how the materials associated with the Proposed Scheme would be procured, handled and managed in the most efficient and sustainable manner.

10.6.5 Implementation of a Site Waste Management Plan

Though not currently mandatory in the UK, a SWMP would be developed and would be regularly updated during construction. The plan would identify, prior to the start of construction works, the types and likely quantities of wastes that could be generated. It would set out, in an auditable manner, how waste would be reduced, re-used, managed and disposed of in accordance with the waste hierarchy. The SWMP would be developed by the contractor before commencement of construction and any advanced works contract and would include waste minimisation targets and associated KPIs. An Outline SWMP has been provided in Appendix 10.1.

10.6.6 Hazardous waste

If contaminated soils are encountered during the construction works, further investigation, testing and risk assessment would be undertaken to determine whether the soils could either: stay on-site, require treatment to make them suitable to remain on-site, or would need to be disposed of off-site. Details for dealing with unexpected contaminated soils would be included in the CEMP. For further information refer to Chapter 9 - Geology and Soils.

Table 10.14: Mitigation measures reporting matrix

Project Activity	Potential impacts associated with material resource use/waste management	Description of the mitigation measures	How the measures would be implemented, measured, and monitored
Site preparation	Production of soils (suitable and unsuitable for use) from site clearance Site clearance resulting in green waste arisings Hazardous waste from clearance of contaminated land	SWMP including use of targets as Key Performance Indicators (KPIs). Market testing for the use of wastes off-site via the materials exchange. Pre-demolition audit to identify wastes.	Implementation: Provision of separate appropriately contained/bunded waste storage locations/bins for recyclable materials away from wastes for disposal. Provision of a SWMP incorporating targets for recycling and waste minimisation. CEMP Measured/Monitored: SWMP used to measure and monitor the waste off-site. Appropriate waste and recycling facilities identified. Materials and waste inventories/materials balance. Materials and waste audits.
Demolition	Production of pavement material from the demolition of existing pavement	As above	Implementation: Appropriate segregation and storage on-site and implemented through the SWMP. Construction staff training regarding waste minimisation and recycling. CEMP Measured/Monitored: SWMP used to measure and monitor the waste off-site. Appropriate waste and recycling facilities or reuse opportunities identified.

Project Activity	Potential impacts associated with material resource use/waste management	Description of the mitigation measures	How the measures would be implemented, measured, and monitored
Site construction	Material use and depletion (i.e. virgin aggregates)	Methods to reduce the use and impacts of external primary materials would be considered throughout the development of the Proposed Scheme. This would include reuse of on-site materials and use of secondary/recycled materials locally and responsibly sourced. On-site materials would be reused wherever possible subject to appropriate testing for suitability for the proposed end use.	Implementation: Provision of separate appropriately contained/bunded waste storage locations/bins for recyclable materials away from wastes for disposal. Provision of a SWMP incorporating targets for recycling and waste minimisation. CEMP Construction staff training regarding: waste minimisation and recycling. Design specifications. Use of 'just in time delivery' where materials would be ordered when they are required; thus reducing the need to stockpile materials and also reducing wastage. Where materials do need to be stockpiled this would be in accordance with best practice and managed appropriately to reduce wastage i.e. covering, appropriate stockpile dimensions. Supply and procurement documentation including specifications Measured/Monitored: SWMP. Waste consignment notes/weighbridge records. Waste inventory. Carbon monitoring and management would also enable low carbon design and minimise material use and waste arisings.
	Use of imported materials (i.e. blacktop steel, concrete).	Methods to reduce the use and impacts of external primary materials would be considered throughout the development of	As above

Project Activity	Potential impacts associated with material resource use/waste management	Description of the mitigation measures	How the measures would be implemented, measured, and monitored
		the Proposed Scheme. This would include reuse of on-site materials and use of secondary/recycled materials locally and responsibly sourced. Where importation of materials is required, the methods of this would be explored with the contractor. Transport routes for road haulage shall be identified and discussed with the highways authority.	
	Carbon footprint of materials transport and use	As above	As above
	Wastes from materials use and municipal solid waste production	Maximise the opportunities for reuse and recycling site via dedicated storage areas for specific waste.	Implementation: Provision of separate contained waste storage locations/bins for reusable materials away from wastes for disposal. Provision of a SWMP and Code of Construction Practice (CoCP) incorporating targets for reuse, recycling and waste minimisation. Measured/Monitored: SWMP. Materials and waste inventories/materials balance. Materials and waste audits.

10.7 Residual Impacts

Whilst no unmitigated impacts are predicted to be more than Slight or Moderate Adverse (with the exception of the carbon footprint of material)**,** these impacts can be reduced or eliminated through well planned and well controlled construction site management, planned and expressed through procedures such as the MMP, CEMP and SWMP. The correct application of these management procedures should reduce the significance of all impacts predicted to be more than slight adverse in this chapter to between **Neutral** to **Slight Adverse.**

The impact of the forecast material use is predicted to be Major Adverse. However, through maximisation of the amount of material resources and waste to be reused onsite the overall demand for materials from off-site sources could be reduced however the impact would still remain as **Major Adverse**.

It should be noted that all stages of the project would seek to minimise waste, reuse as much material as possible on site, recycle/recover as much waste as possible that cannot be used on-site and minimise carbon emissions. Thus the scheme proposals accord with relevant legislation, policy and guidance as set out in this chapter.

The magnitude and/or significance of each residual impact are described in Table 10.16

Table 10.16: Residual effects matrix and mitigation measures

Project activity	Description of effect	Significance of effect (prior to mitigation)	Proposed mitigation and residual effect (after mitigation)
Site preparation	On site use of soils (suitable and unsuitable for use) from site clearance	Soils would be generated from site clearance. Impact = low sensitivity, minor magnitude, negative, permanent and direct. **Neutral or Slight Adverse**	Suitable soils would be stored and reused on the Proposed Scheme for engineering fill. Other soils would be reused elsewhere on the Proposed Scheme for landscaping or taken off-site for reuse or recycling. It is unlikely that significant volumes would be exported so unlikely to involve significant transport effects. If the use of on-site soils can be maximised the magnitude of the effect can be reduced to negligible resulting in a significance level of **Neutral**
	Site clearance resulting in green waste arisings	Vegetation clearance is required, it is anticipated that there would be relatively low volumes generated so this is unlikely to be significant. Impact = low sensitivity, minor magnitude, negative, permanent and direct. **Neutral or Slight Adverse**	Volumes of green waste are unlikely to be significant. Some of the green waste could be chipped and used on site for landscaping purposes. It is likely that some of the green waste would be taken off site for chipping and composting. If the re-use and recycling of such wastes can be maximised the magnitude of the effect can be reduced to negligible resulting in a significance level of **Neutral**
	Hazardous waste from clearance of contaminated land	Potential for low volumes of hazardous waste to be generated, facilities for hazardous waste are present in the area. Impact = low sensitivity, negligible magnitude, permanent and direct.	On or off-site treatment of contaminated soils for any hazardous wastes on-site, as appropriate.

Project activity	Description of effect	Significance of effect (prior to mitigation)	Proposed mitigation and residual effect (after mitigation)
		Neutral or Slight Adverse	
Demolition	On-site use of pavement material from the demolition of existing pavement	Demolition works would include the removal of old pavement. Impact = low sensitivity, minor magnitude, negative, permanent and direct. **Neutral or Slight Adverse**	Some of this pavement material could potentially be used for the construction works but some would need to be taken off-site for recycling. If the use of such wastes can be maximised, the magnitude of the effect can be reduced to negligible resulting in a significance level of **Neutral**
Site construction	Material use and depletion (i.e. virgin aggregates)	Materials predominantly available regionally though where possible material would be sourced locally. The impact would involve the use of moderate volumes of primary aggregate resources won off-site depending on what can be recovered on-site or what suitable recycled materials are available at the time of construction. Volumes imported would contribute to impacts associated with traffic. Impact = medium sensitivity, moderate magnitude, negative, permanent and direct **Slight or Moderate Adverse**	If the use of local materials can be maximised and materials can be effectively managed on site the significance would remain as **Slight Adverse**
	Use of imported materials (i.e. blacktop, steel, concrete)	The impact would involve the use of moderate volumes of materials that would need to be sourced off-site. The use of imported primary materials would contribute to the depletion of finite natural resources. Potential impacts associated with transporting imported materials. Impact = low sensitivity, moderate magnitude, negative, permanent and direct **Neutral to Slight Adverse**	If the use of local and / or recycled materials can be maximised the significance would remain as **Neutral to Slight Adverse**
	Carbon footprint of materials transport and use	The impact of the embodied carbon contained within the main material resources to be used on the Proposed Scheme is assessed to be **Major Adverse**	Through maximising the amount of material resources and waste to be re-used on-site the overall demand for materials from off-site sources could be potentially be reduced. Carbon monitoring and management would also enable low carbon design and minimise material use and waste arisings. However, the significance level would remain at **Major Adverse.**

Project activity	Description of effect	Significance of effect (prior to mitigation)	Proposed mitigation and residual effect (after mitigation)
	Wastes from materials use and municipal solid waste production	It is anticipated that the majority of wastes would be recycled (excluding any hazardous waste). There is local recycling CD&E capacity such that sensitivity is low. The magnitude is considered to be minor. Municipal solid waste production is expected to be minimal. If waste requires landfill disposal/treatment off site, landfill capacity is available. Impact = low sensitivity, minor magnitude, short term, localised and adverse impact. **Neutral or Slight Adverse**	If waste from construction materials can be avoided and/or re-use on site can be maximised, the magnitude of the effect can be reduced to negligible resulting in a significance level of **Neutral.**

10.8 Summary and Conclusions

This chapter sets out an assessment of the likely significant effects that would arise through the use of materials and generation of waste associated with the construction of the Proposed Scheme. Mitigation measures would be implemented to reduce the effects of materials use and wastes generated. These mitigation measures have been incorporated into the Proposed Scheme proposals by design and using best industry practice for managing material use and waste generation on construction sites.

The magnitude of the Proposed Scheme's embodied carbon emissions during the construction would remain at Major as set out above in Table 10.11. All waste materials arising from the Proposed Scheme would be managed in a responsible manner with the clear intention of applying the principles of the waste hierarchy, aiming to minimise waste generation and maximise reuse of materials on-site, where possible, to reduce the impacts on waste management facilities.

11. Noise and Vibration

11.1 Introduction

This chapter presents the result of noise and vibration impact assessment undertaken as part of the environmental inputs into the DMRB Stage 3 of the proposed M11 Junction 7A road scheme in relation to the operation of the Proposed Scheme and its associated construction activities.

Noise in its broadest sense can be defined as unwanted or disruptive sound. It relates to the subjective human response to the sound, which is dependent upon not only the level of the sound but also on its duration, its character and the time of day at which it occurs. Noise can be a source of complaint for people in their homes and gardens but also in recreational areas outdoors.

Vibration comprises oscillatory waves that propagate from a source through either the ground or the air to adjacent buildings. There is no evidence that traffic induced airborne vibration could cause even minor damage to buildings. However, it could be a source of annoyance by causing vibrations of doors, windows and, on occasions, floors of properties in close proximity to roads.

Construction activities such as piling or compaction have the potential to cause perceptible levels of ground-borne vibration when undertaken in close proximity to receptors and could therefore, also be a source of annoyance to local residents. In contrast, roads are generally not a source of perceptible ground-borne vibration (unless there are significant irregularities in the carriageway surface).

It should be noted that road traffic induced noise and vibration impacts resulting from operation of the Proposed Scheme would be permanent and would continue to have impacts into the future, whereas any impacts associated with construction would be transient and cease at the end of the construction period.

Additional information to support this chapter is presented in the following appendices:

- Appendix 11.1: Acoustic Terminology;
- Appendix 11.2: Construction Information;
- Appendix 11.3: Predicted Traffic Noise Levels within the Calculation Area; and
- Appendix 11.4: Basic Noise Level (BNL) Links.

To assist the reader with understanding the technical terminology in this chapter, a list of relevant acoustics terminology is included in Appendix 11.1.

11.1.1 Legislative and planning context

The following legislation and planning guidance has been referenced in the production of this chapter:

- Various national and local planning policies as required (detailed in Chapter 11 Section 3.3).
- The NPPF (2012) sets out the government's planning policies for England and how these are expected to be applied. It provides a framework in which the planning system is required to contribute to, and enhance the natural and local environment (through sustainable development). Consequently, the aim is to prevent both new and existing developments from contributing to, or being put at unacceptable risk from, or being adversely affected by, unacceptable levels of noise pollution. The NPPF states that planning policies and decisions should aim to:
    - avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;
    - mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;

- recognise that development will often create some noise and existing businesses wanting to develop …their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established subject to the provisions of the *EPA 1990* and other relevant law; and
- identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

- With regards to 'adverse impacts' and 'significant adverse impacts' the NPPF refers to the Noise Policy Statement for England (NPSE) (Defra, 2010).
- Noise Policy Statement for England (Defra, 2010) - The 'Explanatory Note' within the NPSE provides guidance on defining 'significant adverse effects' and 'adverse effects' using the following concepts:
  - No Observed Effect Level (NOEL) - the level below which no effect can be detected. Below this level no detectable effect on health and quality of life due to noise can be established;
  - Lowest Observable Adverse Effect Level (LOAEL) - the level above which adverse effects on health and quality of life can be detected; and
  - Significant Observed Adverse Effect Level (SOAEL) - the level above which significant adverse effects on health and quality of life occur.
- National Planning Practice Guidance – supporting guidance which sets out how potential noise impacts from new developments can be managed through the planning system. It advises that planning authorities should take account of the acoustic environment and in doing so considers whether:
  - a significant adverse effect is occurring or likely to occur;
  - an adverse effect is occurring or likely to occur; and
  - a good standard of amenity can be achieved.

  The PPG states that these potential effects should be evaluated by comparison with the SOAEL and the LOAEL for the given situation.
- *Control of Pollution Act 1974* - provides the local authorities the powers to impose requirements or restrictions on construction methods, including the type of plant to be used and permitted noise levels during specified hours. Restrictions can be imposed even if the noise levels would be below those causing a 'nuisance'.
- Noise Action Planning, Defra, (2014b) "Noise Action Plan – Roads (Including Major Roads)" - developed under the terms of the *Environmental Noise (England) Regulations 2006*, as amended. In line with the Government's policy on noise, its aim is to promote good health and good quality of life through effective management of noise. It identifies "Important Areas" within in England where the competent authority should look, where feasible, to reduce noise levels.
- *Noise Insulation Regulations 1975* (as amended 1988) - the relevant highways authority has a duty to offer to insulate specific rooms in dwellings affected by new roads and roads that have their line or level altered, if the dwellings satisfy specific criteria.

11.1.2 Study area

The study area for this assessment has been defined, in accordance with DMRB HD 213/11 (Highways Agency, 2011c) as a 1km boundary around the start and end points of the physical works associated with the Proposed Scheme route, and any routes improved or bypassed as part of the Proposed Scheme. Based on the extent of the study area, the Calculation Area has been determined. The Calculation Area has been defined as all residential dwellings and other noise sensitive receptors within 600m of the Proposed Scheme. Any routes improved or bypassed as part of the Proposed Scheme, and roads on the existing road network (within 1km of the Proposed Scheme or improved or bypassed routes) that have been predicted to result in noise changes of 1dB or more in the opening year or 3dB or more in the future assessment year.

Design Manual for Roads and Bridges HD213/11 (Highways Agency, 2011c) requires consideration beyond the Calculation Area boundary mentioned above, to take into account the likely noise impacts on the wider road

network (considered in terms of change in Basic Noise Level (BNL)). This is required for such roads where there is a minimum 1dB increase or decrease in noise level in the baseline year and/or a minimum 3dB increase or decrease in the future assessment year in comparison with the baseline year. Such roads are also included in the study area.

The Calculation Area used in this assessment is illustrated in Figure 11-1.

Within the Calculation Area, a number of receptors have been selected as 'sample receptors' for the purpose of discussion. These are receptors positioned close to the Proposed Scheme route, bypassed road, affected roads, or within 'Important Areas'. Each receptor is deemed representative of a larger group of receptors in their surrounding area, and selected on the basis that it would be likely to experience the greatest impact of properties in that group. The sample receptors locations are illustrated in Figure 11-1.

11.2 Assumptions and Limitations

All noise modelling studies are dependent on computer-modelling of future conditions. The operational noise model has been based on a number of assumptions and dependent on input data from computer modelled traffic data which, in itself, has been based on a number of assumptions, as well as being subject to an inherent degree of uncertainty.

Similarly, the construction noise model has been based on anticipated plant, phasing and programme information. Such information provided for this assessment has been based upon the construction engineers' information (see Appendix 11.2).

For any location, noise levels vary from time to time throughout the day, and from day to day. Elements of prediction (i.e. the specific noise level at an individual receptor) are intended to represent the 'typical' noise level across a whole year, rather than the absolute noise level on a specific day or at a specific time, and should be taken as indicative rather than precise. Caution should therefore be exercised in comparing measured noise levels with predicted noise levels.

Sensitive receptors associated with the Harlowbury housing development north of Gilden Way have been assessed based on the layout provided in the Planning Statement produced in support of the outline planning application for the development (dated January 2011). The development layout used has been considered largely representative and suitable for the purpose of this assessment.

Low noise road surfacing would be included as part of the Proposed Scheme. Design Manual for Roads and Bridges HD213/11 advises that due to the absence of reliable estimates, the noise benefit from low noise road surfacing can only be applied where speeds are 75km/h or higher. As the speeds along Gilden Way would be below the 75km/h cut-off value, the benefit of low noise road surfacing has not been included in this assessment. However, it is likely that low noise road surfacing would provide noise benefits at lower speeds than 75 km/h (as per DMRB HD213/11 para A4.27). The results of this assessment in terms of operational noise are considered conservative.

To mitigate the noise effects arising due to operation of the Proposed Scheme, acoustic barriers have been specified as detailed in Section 11.6. However, it should be noted that the acoustic barrier specifications are indicative at this stage as further development in respect of the exact locations and heights would be undertaken at the detail design stage in consultation with local planners and residents.

These barriers would be included as part of the Proposed Scheme (also see Figure 7.3 'Landscape Mitigation' for barrier locations) and constructed at the beginning of construction programme. The acoustic barriers as specified for the operational phase of the Proposed Scheme have therefore been included in the construction noise and vibration assessment.

Operational night-time noise levels (L_{night}) have been derived from the predicted daytime $L_{A10,18h}$ noise levels using the Method 3 conversion technique within the TRL report 'Converting the UK traffic noise index $L_{A10,18h}$ to EU noise indices for noise mapping' (Abbott, P.G. and Nelson, P.M. 2002). For this conversion method, night-time noise levels are derived from the daytime noise levels, and therefore, directly correlate to daytime traffic

conditions. Given that a purpose of the Proposed Scheme is to relieve congestion, the potential exists that the correlation between the night-time and daytime traffic might not be strictly applicable for some links. That is, relieving congestion during the day might not translate to similar effects at night. As a consequence, the predicted night-time noise level changes within certain areas could vary slightly from those presented in this report.

The construction information used in this chapter has been taken to be the most likely works proposal. However, it is subject to the Principal Contractor's chosen working method, and therefore could change. As such, the assessment of potential noise and vibration impacts from construction should be considered as indicative.

It is considered that all data inputs for this assessment are adequate to support a 'Detailed' level of assessment as defined in DMRB HD213/11.

11.3 Methodology and Assessment Criteria

11.3.1 Methodology

11.3.1.1 Construction

In line with DMRB HD 213/11 advice, BS 5228 has been followed to assess noise and vibration impacts from construction activities.

The assessment of potential construction noise and vibration effects has been undertaken through consideration of the following:

- likely construction plant associated with the various phases of construction including the various site compounds;
- likely rate of progress for each construction phase;
- likely use of each plant item over a typical day;
- distance of receptors to construction works;
- existing noise levels at receptors;
- the presence of intervening objects between source and receptor, i.e. brick walls or fences;
- the nature of the local ground and strata; and
- local topography.

The construction team has identified typical plant and equipment that would be used for construction of the Proposed Scheme together with the anticipated number of plant required per activity. A representative construction programme containing different construction phases, Phase 1 and Phase 2, which themselves contain sub-phases, i.e. earth, formation, inlay and surfacing works, has also been provided. Phase 1 covers all construction works from the London Road Roundabout to approximately 400m west of the proposed Sheering Road Roundabout. Phase 2 covers the remaining works through to the M11.

The majority of construction works would normally take place between 08:00-18:00, Monday to Friday and 08:00 to 13:00 on Saturday (Chapter 2, Section 2.4.4). There would be exceptions to these hours for some night-time works such as resurfacing and junction tie-in works to avoid closure of the road during the works. Should night-time works be necessary, these would occur between 22:00 to 05:00.

In relation to noise, BS 5228: 2009+A1:2014, Part 1 provides two example methodologies for the consideration of significance during typical construction works, based upon noise change and existing measured ambient noise levels. Method 2 is considered more appropriate for the purpose of this assessment due it considering duration of construction, whereas Method 1 does not. In addition, Method 2 makes reference to receptors others than residential dwellings.

Method 2 - The '5dB(A) Change Method' states that noise levels generated by construction activities are deemed to be significant if the total noise (pre-construction ambient noise plus construction noise) exceeds the pre-construction ambient noise by 5dB or more, subject to lower cut-off values of 65dB for the daytime period, 55dB for the evening period and 45dB for the night-time period ($L_{Aeq,period}$) from construction noise alone. This applies to durations of one month or more. The evaluation criteria are generally applicable for residential housing, hotels and hostels, buildings in religious use, schools and health or community facilities.

This assessment has considered the potential noise and vibration impacts at a number of representative receptor locations for the various phases of the construction programme see Figure 11-1 for the receptor locations. These receptors are representative of those located closest to the proposed construction works. Noise and vibration levels are considered where the various 'working teams' are nearest to the receptor plus the contribution from plant along haul routes; therefore, this represents a worst-case approach. The construction plant information for the specified representative receptor for each assessed phase including numbers of plant, percentage on times and BS 5228-1: 2009+A1:2014 references, are detailed in Appendix 11.2. This information has formed the basis of this construction noise and vibration assessment.

The construction information used in this chapter has been taken to be the most likely works proposal. However, it is subject to the Principal Contractor's chosen working method, and could therefore change. As such, the assessment of potential noise and vibration impacts from construction should be considered as indicative.

11.3.1.2 Operation

The assessment of noise and vibration at sensitive receptors has followed the "Detailed Assessment" methodology from DMRB HD 213/11 to determine the Proposed Scheme's potential impact when in operation. Potential operational impacts have been determined for the short-term (opening year) and long-term (15 years after opening) scenarios.

Noise

Operational noise levels have been predicted using Calculation of Road Traffic Noise (CRTN) methodology along with DMRB HD 213/11 updated guidance on the use of CRTN. The calculation methodologies for predicting road traffic noise have also been implemented using CadnaA noise modelling software. The noise level predictions have taken account of the following variables:

- typical weekday volumes of traffic during the 18-hour period from 6am to midnight (18-hour Annual Average Weekday Traffic (AAWT) flows) – daytime assessment;
- typical weekday volumes of traffic during the eight-hour period from 11pm to 7am – night-time assessment;
- percentage of Heavy Vehicles (vehicles of unladen weight >3.5 tonnes);
- traffic speeds;
- road gradient;
- local topography;
- nature of the ground cover between the road and the receptor;
- shielding effects of any intervening structures, including allowances for limited angles of view from the road and any reflection effects from relevant surfaces; and
- road surfacing type.

Night-time noise levels have been derived in accordance with DMRB HD 213/11. Therefore, consideration has been given to those receptors predicted to experience a noise level change in the long term and that would be exposed to an $L_{night,outside}$ noise level of 55dB or greater in any scenario. The Method 3 conversion technique within the TRL report 'Converting the UK traffic noise index $L_{A10,18h}$ to EU noise indices for noise mapping' has been used to determine the night-time noise levels.

Traffic data are fundamental to predicting operational noise levels, thus facilitating the noise and vibration assessment of a scheme. Traffic flow (numbers of vehicles), composition (percentage of heavy vehicles) and speed data (which follows the guidance contained in IAN 185/15) all contribute to calculating road traffic noise levels. Traffic data have been provided for the year of opening (2021) and future assessment year (2036) for the DM and DS scenarios.

The noise action planning Important Areas within the Calculation Area have been identified using the Extrium England Noise Map Viewer.

Noise nuisance

Design Manual for Roads and Bridges HD 213/11 defines the level of noise 'nuisance' by reference to the percentage of people in the affected population likely to be 'bothered very much or quite a lot' by traffic noise. Gradual increases in noise are expected to produce a gradual and proportionate increase in the nuisance level (i.e. the percentage of the population bothered). However, sudden increases in the noise level are expected to result in an initial large increase in the nuisance level. This new level of nuisance appears to persist for several years at least but, in the longer term, nuisance levels tend back towards those expected for a gradual increase in noise.

In this assessment, noise nuisance predictions have been based on the highest nuisance levels expected during the first 15 years after opening for the DM and DS scenarios and compared to the nuisance levels of the DM baseline year (2021). In accordance with the predictive technique presented DMRB HD 213/11, an assessment of noise nuisance for all properties situated within the Calculation Area has been undertaken.

Vibration nuisance

Where residential properties are within 40m of a carriageway, DMRB HD 213/11 states that, for a given level of noise exposure, the percentage of those 'bothered' by airborne vibration is 10% lower than the corresponding figure for noise nuisance (derived using DMRB HD 213/11 methodology). Where noise levels are below 58dB LA10 18h, it should be assumed that residents would not be 'bothered' by airborne vibration. In line with the above, consideration has been given to changes in airborne vibration nuisance at all dwellings within 40m of roads in the Calculation Area. It should be noted that, as described in DMRB HD 213/11, for receptors located beyond 40m of a road or screened, vibration nuisance levels have not been predicted with accuracy using the recommended prediction method.

11.3.2 Assessment of magnitude and significance

11.3.2.1 Construction

Considering the above, this assessment has considered that a potentially significant noise effect would occur under the following circumstances:

- the daytime noise level at a receptor, $L_{Aeq,10h}$ (Monday to Friday) or $L_{Aeq,5h}$ (Saturdays), exceeds 65dB;
- the night-time noise level at a receptor, $L_{Aeq,8h}$, exceeds 45dB; and
- the above noise levels occur for at least one month at a given receptor.

BS 5228: 2009+A1:2014, Part 2 provides guidance on the human response to vibration. The Standard provides guidance for predicting human response to vibration in buildings. For construction works, the guidance contained in Table 11.1 is provided:

Table 11.1: Guidance on the human response to vibration levels

Vibration level, PPV (mm/s)	Effect
0.14	Vibration might just be perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies people are less sensitive to vibration
0.30	Vibration might just be perceptible in residential environments
1.00	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents
10.00	Vibration is likely to be intolerable for any more than very brief exposure to this level in most building environments

As shown in Table 11.1, the Standard advises that at a vibration level of 1.0mm/s Peak Particle Velocity (PPV) "*It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents*". This is considered to be the threshold when construction vibration is significant.

For building structure response, BS 5228: 2009+A1:2014, Part 2 reproduces the advice given in BS 7385-2, which gives guidance on vibration levels which could potentially result in building damage. The response of a building to ground-borne vibration is affected by the type of foundation, underlying ground conditions, the building construction and the state of repair of the building. Table 11.2 reproduces the guidance detailed in BS 5228: 2009+A1:2014, Part 2 on building classification and guide values for cosmetic building damage.

Table 11.2: Guidance on the effects of vibration levels on building structures

Type of building	PPV in frequency range of predominant pulse	
	4Hz to 15Hz	15Hz and above
Reinforced or framed structures	50mm/s	50mm/s
Industrial and heavy commercial buildings		
Un-reinforced or light framed structures	15mm/s at 4Hz increasing to 20mm/s at 15Hz	20mm/s at 15Hz increasing to 50mm/s at 40Hz and above
Residential or light commercial buildings		

Minor damage is possible at vibration magnitudes greater than twice those given in Table 11.2, with major damage at values greater than four times the values in the table. BS 7385-2 also notes that the probability of cosmetic damage tends towards zero at 12.5mm/s peak component particle velocity.

Datakustik CadnaA noise modelling software (Version 2017) with the BS 5228 option has been used in this assessment to create a three-dimensional noise model and to calculate noise levels from the construction activities associated with each construction phase.

11.3.2.2 Operation

Noise

Section 3 of DMRB HD 213/11 provides guidance on the magnitude of traffic noise impacts on human receptors. Magnitudes of impact are considered for both the short term and long term. A change in road traffic noise of 1dB in the short term, for example when a project is opened, is the smallest that is considered

perceptible. In the long term, a 3dB change is considered perceptible. The classification of the short and long term noise impacts, provided by DMRB HD 213/11, are detailed in Table 11.3 and 11.4 respectively.

Table 11.3: Classification of magnitude of noise impacts in the short term

Noise change $L_{A10,18h}$ (dB)	Magnitude of impact
0	No Change Negligible
0.1 - 0.9	Negligible
1.0 - 2.9	Minor
3.0 - 4.9	Moderate
5+	Major

Table 11.4: Classification of magnitude of noise impacts in the long term

Noise change $L_{A10,18h}$ (dB)	Magnitude of impact
0	No Change Negligible
0.1-2.9	Negligible
3.2 - 4.9	Minor
5.0 - 9.9	Moderate
10+	Major

For the assessment of night-time noise impacts, DMRB HD 213/11 advises that, until further research is available, only impacts in the long term scenario shall be considered. Therefore, only the classification in Table 11.4 is used for determining night-time noise impacts. In addition, DMRB HD 213/11 advises only those sensitive receptors predicted to be subject to a noise level exceeding 55dB $L_{night,\ outside}$ should be considered.

In terms of the significance of effects for the operational noise assessment, the noise levels detailed in Table 11.5 are to be considered as the LOAEL and SOAEL in this assessment. These have been defined based on the guidance provided in the NPSE and PPG.

Table 11.5: Lowest Observable Adverse Effect Level (LOAEL) and Significant Observed Adverse Effect Level (SOAEL) noise levels

Observed effect level	Value for daytime	Value for night-time
LOAEL	55dB $L_{A10,18h}$ (façade) 50dB $L_{Aeq,16h}$ (free-field)	40dB $L_{night,outside}$ (free-field)
SOAEL	68dB $L_{A10,18h}$ (façade) 63dB $L_{Aeq,16h}$ (free-field)	55dB $L_{night,outside}$ (free-field)

A predicted noise level which exceeds the SOAEL does not in itself result in a significant effect for any given sensitive receptor. The noise level change when compared with the DM 2021 noise level also requires consideration.

Where the predicted noise level is above the SOAEL, it is considered that any perceptible noise increase in the short or long term has the potential to cause a significant adverse effect. Conversely, a perceptible noise decrease, where the absolute noise level is above the SOAEL, is considered to be a potentially significant benefit.

It is considered that a potentially significant adverse effect has occurred where:

- the predicted DS noise level is more than or equal to the SOAEL; and
- there is an increase in noise level (compared to the DM 2021 scenario) of 1dB or more in either the short term or long term.

Conversely, it is considered that a potentially significant beneficial effect has occurred where:

- the DM 2021 noise level is above or equal to the SOAEL; and
- there is a perceptible decrease in noise level of either 1dB or more the short term or 3dB or more in the long term.

It is worth noting that DMRB HD 213/11 advises that changes in noise levels of less than 3dB are not considered perceptible in the long term.

For predicted noise levels less than the SOAEL, it is considered that a potentially significant adverse effect has occurred where:

- the predicted DS noise level is above or equal to the LOAEL; and
- There is an increase in noise level (compared to the DM 2021 scenario) of at least 3dB in the short term or 5dB in the long term.

Conversely, it is considered that a potentially significant beneficial effect has occurred where:

- The DM 2021 noise level is above or equal to the LOAEL; and
- There is a decrease in noise level of either 3dB or more the short term or 5dB or more in the long term.

The above aligns with unpublished advice provided by HE in determining potentially significant adverse effects.

In addition to the above, consideration has been given to the 'Important Areas' within the study area. As the highway authority should look to reduce noise levels in these 'Important Areas' (where feasible), any predicted increase in noise within these areas of greater than 1dB has been highlighted as significant.

Vibration

The DMRB HD 213/11 advises that adverse impacts from traffic induced vibration (at receptors) can be identified as:

- any predicted increase in the level of vibration to 0.3mm/s (PPV) or more; and
- any further increase in vibration where the existing level is already above 0.3mm/s (PPV).

The DMRB HD 213/11 advises that, whilst irregularities in a road surface could cause significant ground-borne vibrations, this is unlikely to be important in considering disturbance from new roads. This is supported by measurements summarised in TRRL Report No RR53 – Ground Vibration Caused by Civil Engineering Works, Figure 3, which show that the vibration level expected at 8m from the road with a heavy lorry running on a poor surface would be around 0.1mm/s.

The shortest horizontal distance between a sensitive receptor and the running surface of the Proposed Scheme would be around 7m. Although this is slightly less than the 8m mentioned above, it is considered that the resulting traffic induced ground-borne vibration would be similar (i.e. around 0.1mm/s) should the road surface deteriorate to a 'poor' condition and less when in good condition. Ground-borne vibration due to operation of the Proposed Scheme has not therefore been considered to be a significant issue and has not been considered as part of this assessment.

11.4 Baseline Environment

11.4.1 Baseline sources

Traffic flow (numbers of vehicles), composition (percentage of heavy vehicles) and speed data, following the guidance contained in IAN 185/15, for the Proposed Scheme's opening year have been provided. These were used to determine the baseline conditions for the noise and vibration assessment. In accordance with DMRB HD 213/11, the baseline noise year is defined as the DM year of opening, which is 2021 for this assessment.

Furthermore, baseline noise monitoring has been undertaken at four representative residential properties in close proximity to the Proposed Scheme. Where applicable, the baseline monitoring data have been used for determining baseline conditions for the construction noise assessment.

11.4.2 Baseline conditions

The existing noise environment in the immediate area of the Proposed Scheme is dominated by road traffic noise, particularly from the M11 motorway, Gilden Way and A414. The contribution of these road traffic noise sources to a receptor's noise environment depends on the proximity to respective sources.

Long-term noise monitoring has been completed during the period 11th to 18th September 2014 at four residential locations in vicinity of the route of the Proposed Scheme. A summary of the results are presented in Table 11.8 below showing the noise monitoring results as average values measured over the survey period for weekdays and the 08:00 - 13:00 Saturday periods. The monitoring positions are shown in Figure 11-1.

Table 11.6: Baseline noise level measurements summary

Location number	Location	Average measured noise level (dB) - weekdays				Saturdays
		LAeq,12h	LAeq,8h	LA90,18h	LA10,18h	LAeq,08:00 - 13:00
26	3, Millhurst Mews	56.6	48.9	48.4	58.2	56.5
4	119, Sheering Road	61.3	53.5	46.4	63.9	61.2
27	129, Sheering Road	59.2	51.5	45.7	61.7	58.2
28	Campions Oak, Sheering Road	51.3	46.6	47.4	51.1	50.0

11.5 Impact Assessment and Significant Effects

11.5.1 Construction effects

As the Proposed Scheme passes through an urban built-up area, a number of receptors, in particular those along Gilden Way/Sheering Road would be located in close proximity to the construction works associated with the Proposed Scheme. As a number of construction activities required for completing the Proposed Scheme would be inherently noisy or produce high levels of vibration, there would be potential to cause adverse impacts at nearby receptors.

11.5.1.1 Daytime noise effects

Noise levels would be elevated in the immediate vicinity of the Proposed Scheme due to various construction activities taking place. Receptors in these areas have the potential to be adversely affected by construction noise. Using the indicative construction activities and plant contained in Appendix 11.2, worst-case construction noise levels have been predicted at representative receptors located in close proximity to the works. The results

are shown in Table 11.7 and 11.8 for the Phase 1 and Phase 2 daytime works respectively. For each phase, worst-case noise levels for each 'activity', i.e. cut and fill, formation, etc. are presented.

The baseline noise levels (L_{Aeq}) contained in Table 11.6 have been obtained mostly from the noise modelling exercise. The $L_{Aeq,12h}$ noise level has been derived by applying the $L_{A10,18h}$ conversion formulae provided within the TRL report (Abbott and Nelson, 2002) to the predicted noise level for the DM 2021 scenario.All noise levels in Table 11.7 and 11.8 are façade noise levels. Where applicable a correction of +3dB has been applied to any free-field measured noise levels used.

Table 11.7: Construction noise impact - worst case weekday daytime - Phase 1 works

Receptor name	Sheering Hall Barns, Sheering Road	163, Ealing Bridge Cottage, Sheering Road	135, Sheering Road	122, Sheering Road	Harlowbury Development - Location 1 - ground floor	Harlowbury Development - Location 1 - 2nd floor	7, Mayfield Close	Churchgate RAB Playing Field	4, Millhurst Mews	Mulberry Gardens, Mulberry Green	81, Chippingfield
Receptor No.	1	2	3	4	5	6	7	8	9	10	11
Baseline Noise Level, $L_{Aeq,12h}$ (dB)	58	72	68	60	68	70	58	59	60[12]	70	60
Predicted maximum construction noise level, L_{Aeq} (dB)											
Cut and fill	55	64	73	87	85	86	64	68	78	86	72
Formation	54	64	83	91	81	88	72	69	80	83	75
Inlay	50	59	69	87	78	82	62	62	73	79	64
Overlay	53	61	71	83	81	83	63	64	75	83	65
Site compounds	37	46	47	53	51	53	41	42	46	64	48
Total noise level, L_{Aeq} (dB)											
Cut and fill	60	73	74	87	85	86	65	68	78	86	72
Formation	60	73	83	91	81	88	73	69	80	83	75
Inlay	59	72	72	87	78	82	64	64	73	79	65
Overlay	59	72	73	83	81	83	64	66	75	84	66
Site compounds	58	72	68	60	68	70	59	59	60	71	61
Noise increase, L_{Aeq} (dB)[13]											
Cut and fill	2	1	6	27	17	16	7	9	18	16	12
Formation	1	1	15	31	14	19	14	10	20	13	15
Inlay	1	0	3	28	10	13	5	5	13	9	5
Overlay	1	0	4	23	14	14	6	6	15	13	6
Site compounds	0	0	0	1	0	0	0	0	0	1	0

[12] Measured baseline noise level

[13] Noise increase calculations undertaken to the decimal place with the results rounded to whole numbers. The resulting increase in noise presented may therefore be slightly different when comparing the total and baseline noise level presented in the table.

The predicted noise level increases shown in Table 11.7 indicate that worst-case Phase 1 construction noise levels during the day would, in accordance with the criteria contained within BS 5228, result in significant increases for the majority of the representative sample receptors. This includes all sample receptors located in the vicinity of Gilden Way/Sheering Road (sample receptors 4 to 11). The noisiest works would be the cut and fill and formation works. However, due to the linear construction method, i.e. the construction works would gradually move from one end of the Proposed Scheme to the other, the noise impacts would be transient, i.e. the worst-case noise would last for a relatively short period and construction noise levels would reduce considerably as the works move past a receptor. Given the transient nature of the works, it has been considered likely that noise levels would not exceed the BS 5228 criteria for more than a month; therefore, in accordance with Section 11.3.2.1, the resultant effects would not be considered significant.

Table 11.8: Construction noise impact - worst case weekday daytime - Phase 2 works

Receptor Name	Sheering Hall Barns, Sheering Road	163, Ealing Bridge Cottage, Sheering Road	135, Sheering Road	122, Sheering Road
Receptor no.	1	2	3	4
Baseline noise level, $L_{Aeq,12h}$ (dB)	58	72	68	60
Predicted maximum construction noise level, L_{Aeq} (dB)				
Cut and fill	45	55	56	53
Bridge works	49	55	57	53
Formation works	61	86	74	57
Overlay works	52	87	63	53
Pond excavation	49	64	57	53
Road surfacing	58	84	67	56
Site compounds	47	55	57	53
Total noise level, L_{Aeq} (dB)				
Cut and fill	59	72	69	60
Bridge works	59	72	69	60
Formation works	63	87	75	61
Overlay works	59	87	70	61
Pond excavation	59	73	69	61
Road surfacing	61	85	71	61
Site compounds	59	72	69	61
Noise level increase, L_{Aeq} (dB)[#]				
Cut and fill	0	0	0	1
Bridge works	1	0	0	1
Formation works	4	15	6	2
Overlay works	1	15	1	1

Receptor Name	Sheering Hall Barns, Sheering Road	163, Ealing Bridge Cottage, Sheering Road	135, Sheering Road	122, Sheering Road
Pond excavation	0	1	0	1
Road surfacing	3	13	2	2
Site compounds	0	0	0	1
Note#: noise increase calculations undertaken to the decimal place with the results rounded to whole numbers. The resulting increase in noise presented may therefore be slightly different when comparing the total and baseline noise level presented in the table.				

Table 11.8 shows that the predicted worst-case noise level increases due to the Phase 2 construction works (at the nearest receptors) would be less when compared to the Phase 1 works. There would be fewer receptors exposed and generally at greater distance from the works. Nevertheless, relatively large increases in noise have been predicted for some of the sub-phases, most notably at sample Receptor 2 (163 Ealing Bridge Cottage). This is due to this receptor being located directly adjacent to the Proposed Scheme and therefore very close to the works. However, similar to the Phase 1 works, the works would be of a transient nature. Also, this receptor is located towards the western end of the Phase 2 works. Subsequently, the exposure period to the worst-case noise levels would be likely to be relatively short. Due to the relatively short exposure to high levels of construction noise, i.e. less than one month, the effects of construction noise for receptors in close proximity to Phase 2 would not be significant.

The baseline noise level measurements undertaken show that noise levels during Saturday morning period are similar to the weekday daytime noise level ($L_{Aeq, 10h}$). As such, the above results for the daytime weekday period are considered representative of the Saturday morning period.

11.5.1.2 Night-time noise effects

A number of construction activities would be undertaken at night to minimise disruption to traffic. These would include the Phase 1 road surfacing works and some Phase 2 junction tie-in works. As the Phase 2 works would be primarily undertaken ‘offline’, i.e. the new carriageway being fully constructed whilst the existing road remained operational, the only night-time work that might be required for this phase would be connection of the new carriageway to the existing ‘online’ section of the Proposed Scheme. These Phase 2 night-time works would therefore be of short duration, and thus not considered as significant when compared to the nearby Phase 1 works.

Noise level predictions for the worst-case night-time Phase 1 construction works are shown in Table 11.9.

Table 11.9: Construction noise impact – worst case weekday night-time – Phase 1 Works

Receptor No.	Receptor name	Baseline noise level, $L_{Aeq,8h}$ (dB)	Maximum construction noise, L_{Aeq} (dB)	Total noise level, L_{Aeq} (dB)	Noise level increase, L_{Aeq} (dB)
1	Sheering Hall Barns, Sheering Road	50	50	53	3
2	163, Ealing Bridge Cottage, Sheering Road	63	63	66	3
3	135, Sheering Road	60	67	68	8
4	122, Sheering Road	51	84	84	33
5	Harlowbury Development - Location 1 - ground floor	59	77	77	18
6	Harlowbury Development - Location 1 - 2nd floor	61	81	81	20
7	7, Mayfield Close	50	63	63	13
9	4, Millhurst Mews	51*	72	72	21
10	Mulberry Gardens, Mulberry Green	61	79	79	18
11	81, Chippingfield	52	64	65	13
Note*: measured baseline noise level					

Table 11.9 indicates that adverse noise impacts could occur at the majority of the sample receptors for the night-time resurfacing works. Such works would be very transient in nature and the noise levels presented in Table 11.9 expected to last for only a short period, i.e. a number of hours. Nevertheless, as there is a risk of sleep disturbance at night, a more detailed assessment would be necessary at the construction stage to demonstrate the potential noise impact. This could include the need to implement a mitigation strategy to minimise noise impacts.

11.5.1.3 Vibration effects

The scheme-wide vibratory compacting works would have the potential to give rise to largest levels of vibration at receptors. In terms of the compaction works, a Twin Drum Vibratory Roller for Asphalt Works - Bomag BWA51 AD-5 (or similar) has been identified as a suitable plant item that could be used.

Annex E to BS 5228: Part 2: Vibration provides guidance and equations on the prediction of ground-borne vibration from soil compaction. Predictions are made through considering a number of plant specific variables. The equations also contain scaling factors which dictate the probability of the predicted vibration level being exceeded, ranging from 5% to 50%.

Predicted vibration levels from the Bomag BWA51 AD-5 compactor are presented in Table 11.10. Predictions have been provided for sensitive receptors nearest to the working areas.

Table 11.10: Predicted ground-borne vibration from vibratory compaction plant

Receptor No.	Receptor	Nearest distance to vibratory soil compaction (m)	Predicted ground-borne vibration level, PPV (mm/s)	
			5% exceedance probability	50% exceedance probability
2	163, Ealing Bridge Cottage, Sheering Road	8	4.9	1.3
3	135, Sheering Road	25	1.0	0.3
4	122, Sheering Road	8	4.9	1.3
5	Harlowbury Development - Location 1 - ground floor	10	3.7	1.0
6	Harlowbury Development - Location 1 - 2nd floor	10	3.7	1.0
7	7, Mayfield Close	55	0.3	0.1
9	4, Millhurst Mews	23	1.2	0.3
10	Mulberry Gardens, Mulberry Green	7	5.9	1.6
11	81, Chippingfield	42	0.5	0.1

Based upon the prediction methodology contained within BS 5228: Part 2: Vibration, the ground-borne vibration level at the closest residential properties to the construction works would be 5.9mm/s ppv. In accordance with the Standard, the probability of vibration exceeding this level would be 5%, and it is therefore likely that levels would fall below this. For comparison it should be noted that a worse case vibration level of 1.6mm/s ppv is predicted when using a scaling factor representing a 50% probability of exceedance.

As vibration passes through the foundations of a building the level would alter as an effect of the transfer function. Such transfer functions would differ between properties; however, a general reduction in vibration from free-field to foundations of 60% is often applied. However, for the purpose of this assessment no reduction has been assumed and the approach is therefore a conservative assessment.

With the 5% exceedance probability, vibration levels would be likely to be perceptible to residents and in accordance with the guidance within BS 5228 could lead to complaint, i.e. exceeding 1mm/s ppv, at the majority of the sample receptors. However, BS 5228 also advises that such vibration levels could be tolerated if prior warning and explanation was given to residents. Although there is a risk for short term nuisance, the predicted vibration levels fall well below those vibration levels defined in BS 7385-2 which could give rise to cosmetic damage to buildings.

The compacting works would be transient in nature; therefore, the worst-case vibration levels shown in Table 11.10 would be experienced for short durations and only likely to be perceptible for a matter of hours, whilst the vibratory rollers would be immediately adjacent to the receptors. In view of the transient nature of these works, ground-borne vibration would not be likely to result in significant effects.

11.5.2 Operational effects

The introduction of the Proposed Scheme could potentially result in adverse noise and vibration effects within the study area due to the following:

- the Proposed Scheme would attract additional traffic onto Gilden Way/Sheering Road (B183) between the A414 and the proposed Sheering Road Roundabout, resulting in an increase in traffic induced noise and vibration along this section of carriageway;
- the Proposed Scheme would impact on traffic movements on the wider road network leading to perceptible changes in noise;
- realignment of the existing carriageway between Churchgate Roundabout and the proposed Sheering Road Roundabout;
- amendments to the Churchgate Roundabout to include for a 'hamburger' layout, increasing traffic speeds in the area; and
- the proposed link between Sheering Road and the new M11 Junction 7A would be a new noise source in the area.

An initial appraisal highlighted that adverse noise effects would be likely to occur at a large number of receptors located in the vicinity of Gilden Way and/or Sheering Road during operation of the Proposed Scheme. To illustrate this, noise change contours for the comparison of the DS opening year against the DM opening year scenarios are provided in Figure 11-2.

Based on the outcome of the initial appraisal, noise mitigation measures in the form of acoustic barriers have been specified to eliminate or reduce, as far as practicable, the adverse impacts. In conjunction with the other project disciplines, the acoustic barriers have been specified and included within the scheme design. The mitigation measures included within the scheme design are described in Section 11.6.2

The post-mitigation assessment of the operational impacts of the Proposed Scheme is presented in Section 11.7.2

11.6 Proposed Mitigation

11.6.1 Construction mitigation

This chapter demonstrates that adverse noise and vibration impacts would be likely to occur for a number of receptors throughout the construction period. Therefore, where feasible, the contractor should look to implement a mitigation strategy to minimise impacts. Such measures would be particularly relevant for the following:

- works in close proximity to residential premises, employing high noise emitting plant operating over a number of days. For example: cut and fill, formation, inlay, etc.; and
- night-time operations.

BS 5228 (Part 1 and 2) provides guidance on best practice to minimise noise and vibration impacts during construction. It also advises on proactive measures that can be taken in terms of liaising with residents.

The following mitigation measures would be employed on the site to ensure that noise and vibration levels became attenuated as far as possible:

- the use of 'best practicable means' during all construction activities, as contained in BS 5228;
- switching off plant and equipment when it is not in use for longer periods of time;
- establishing agreement with the local authority on appropriate controls for undertaking significantly noisy works or vibration-causing operations close to receptors;

- programming works such that the requirement for working outside normal working hours would be minimised (taking into account the highway authority's statutory duties under the *Traffic Management Act 2004*);
- use of low noise and vibration emission plant where possible;
- use of temporary noise screens around particularly noisy activities; and,
- regular plant maintenance.

It is anticipated that a scheme of noise and vibration monitoring would be agreed with the Environmental Health Department of Harlow Council and Epping Forest District Council and noise and vibration limits contained within any agreed CEMP.

11.6.2 Operational mitigation

Mitigation measures for reduction of noise and vibration effects of the Proposed Scheme have been included in the design. This would primarily involve inclusion of acoustic fencing along the Gilden Way corridor but some landscaping features would also contribute to noise reduction in places. Low noise road surfacing would also be included as part of the Proposed Scheme; however, its benefit has not been included in the quantitative results of this assessment due to the limitations imposed by DMRB HD 213/11 (also refer to Section 11.2) with regard to application of noise reduction at low speeds.

The details of the proposed acoustic fencing included in the Proposed Scheme design are presented in Tables 11.11 and 11.12 below. Also refer to Chapter 7 - Landscape and Vibration, Figure 7.3 'Landscaping Mitigation' Sheets 1-7 for the fencing locations. The acoustic barriers have been specified to mitigate the greatest amount of noise; however, they are indicative at this stage. Further refinement of the exact locations and heights would be undertaken at detailed design stage in consultation with local planners and residents.

Table 11.11: Proposed acoustic barriers on the northern side of Gilden Way/Sheering Road

Description	Location and chainages	Type	Properties
Approximately 185 m long acoustic fence from London Road Roundabout eastwards.	North of Gilden Way Chainage: 20 to 206	Acoustic fence	2m high, reflective
Approximately 190 m long acoustic fence situated on the allotment garden boundary.	North of Gilden Way Chainage: 206 to 380	Acoustic fence	3m high, reflective
Approximately 30 m long acoustic fence.	North of Gilden Way Chainage: 570 to 600	Acoustic fence	2m high, reflective
Approximately 50 m long acoustic fence.	North of Gilden Way Chainage: 605 to 655	Acoustic fence	2.5m high, reflective
Approximately 140 m long acoustic fence to existing bricked wall.	North of Gilden Way Chainage: 655 to 790	Acoustic fence	2m high, reflective
Approximately 75 m long existing bricked wall to be increased in height.	North of Gilden Way Chainage: 790 to 865	Bricked wall	2.5m high
Approximately 50 m long brick wall on property boundary of 49 Mulberry Green.	North of Gilden Way Chainage: 880 to 910	Bricked wall	2m high
Approximately 215 m long acoustic fence from the Mulberry Green / Gilden Way junction eastwards.	North of Gilden Way Chainage: 910 to 1135	Acoustic fence	2m high, absorptive
Approximately 150 m long acoustic	North of Gilden Way	Acoustic	2.5m high,

Description	Location and chainages	Type	Properties
fence up to the Churchgate Roundabout.	Chainage: 1135 to 1250	fence	absorptive
Approximately 300 m long acoustic fence from the Churchgate Roundabout eastwards to the secondary Harlowbury entrance.	North of Sheering Road Chainage: 1280 to 1580	Acoustic fence	2.5m high, absorptive
Approximately 135 m long acoustic fence from the secondary Harlowbury entrance to the eastern boundary of the development.	North of Sheering Road Chainage: 1600 to 1735	Acoustic fence	2.5m high, absorptive
Approximately 270 m long acoustic fence.	North of Sheering Road Chainage: 1770 to 2040	Acoustic fence	2.5 m high, reflective
Approximately 30 m long acoustic fence sloping down into the earth mound.	North of Sheering Road Chainage: 2040 to 2070	Acoustic fence	2m-1.2m high, reflective

Table 11.12: Proposed acoustic barriers on the southern side of Gilden Way/Sheering Road

Description	Location and chainages	Type	Properties
Approximately 60 m long acoustic fence from the attenuation pond to the access road to the east of the pond	South of Gilden Way Chainage: 710 to 770	Acoustic fence	2m high, reflective
Existing fence to be replaced with an approximately 34 m long absorptive acoustic fence	South of Gilden Way Chainage: 780 to 814	Acoustic fence	2.5m high, absorptive
Existing fence to be replaced with an approximately 90 m long absorptive acoustic fence	South of Gilden Way Chainage: 830 to 940	Acoustic fence	2.5m high, absorptive
Approximately 30 m long acoustic fence.	South of Gilden Way Chainage: 940 to 1030	Acoustic fence	2.5m high, absorptive
Approximately 130 m long acoustic fence.	South of Gilden Way Chainage: 1030 to 1160	Acoustic fence	2m high, absorptive
Approximately 105 m long acoustic fence to the Churchgate Roundabout.	South of Gilden Way Chainage: 1160 to 1250	Acoustic fence	2.5m high, absorptive
Approximately 90 m long acoustic fence from the Churchgate Roundabout eastwards	South of Sheering Road Chainage: 1280 to 1360	Acoustic fence	2.5m high, absorptive
Approximately 380 m long acoustic fence.	South of Sheering Road Chainage: 1360 to 1740	Acoustic fence	2m high, absorptive
Approximately 50 m long acoustic fence, partly on property boundary of 120 and 122 Sheering Road.	South of Sheering Road Chainage: 1755 to 1810	Acoustic fence	2.5m high, reflective
Approximately 53 m long acoustic fence.	South of Sheering Road Chainage: 1877 to 1930	Acoustic fence	2m high, reflective

11.7 Residual Effects

As described above, mitigation has been included as part of the Proposed Scheme design. This section provides the impact assessment with the inclusion of the mitigation measures detailed in Section 11.6.

11.7.1 Construction

This section identifies that a number of receptors would be likely to be subject to adverse noise and vibration impacts associated with the proposed construction works. Mitigation measures have been recommended to minimise impacts as far as is reasonably practicable. However, the fact remains that construction activities inherently give rise to high levels of noise and vibration and therefore impacts on nearby receptors would be adverse.

Given that much of the construction work is transient in nature, the duration of impacts for the majority of receptors would be restricted to periods where the works were situated nearby. During such times, occupants would be likely to experience adverse effects; however, through a proactive approach by the contractor to community liaison, the implementation of an appropriate mitigation strategy and through use of a best practice approach to the works, the impact would be minimised and considered unlikely to result in significant effects.

11.7.2 Operational

11.7.2.1 Noise at sample receptors

Table 11.13 presents the DM in 2021 against the DS scenario in 2021 (short term impact), whilst Table 11.4 compares the predicted noise levels at each sample receptor location in the DM in 2021 against the DS scenario in 2036 (long term impact) for the day and night-time periods respectively. The Tables show the magnitude of noise change taking into account the proposed mitigation measures discussed previously. Consideration has also been given as to whether the predicted changes in noise level constitute a 'significant' effect, as described in Section 11.3.2.2.

As previously described in Section 11.2, the beneficial effects of low noise road surfacing have not been taken into account in this assessment. The predicted operational noise levels have been considered to be conservative, especially in the short term when the effect of low noise road surfacing is greatest. It is possible that a number of the predicted adverse effects would in practice not occur, plus where benefits have been predicted the improvements would in reality be more pronounced.

Table 11.13: Comparison of predicted short-term daytime noise levels at sample receptors

Receptor No.	Receptor name	Do-minimum 2021, $L_{A10,18h}$ (dB)	Do-something 2021, $L_{A10,18h}$ (dB)	Noise level change (dB)	Magnitude of change	Significant effect?
1	The Willows, The Street (B183)	65.7	63.8	-1.9	Minor Beneficial	No
2	Campdell, Sheering Road	71.9	70.9	-1.0	Minor Beneficial	Beneficial
3	The Red House, Sheering Road	62.5	60.8	-1.7	Minor Beneficial	No
4	119, Sheering Road	67.0	62.9	-4.1	Moderate Beneficial	Beneficial
5	122, Sheering Road	73.1	73.3	0.2	Negligible Adverse	No
6	10, Mayfield Close	60.9	59.2	-1.7	Minor Beneficial	No

Receptor No.	Receptor name	Do-minimum 2021, $L_{A10,18h}$ (dB)	Do-something 2021, $L_{A10,18h}$ (dB)	Noise level change (dB)	Magnitude of change	Significant effect?
7	Harlowbury Development - Location 1 - ground floor	68.7	67.3	-1.4	Minor Beneficial	Beneficial
8	Harlowbury Development - Location 1 - 2nd floor	70.0	72.5	2.5	Minor Adverse	Adverse
9	Harlowbury Development - Location 2 - ground floor	66.8	68.6	1.8	Minor Adverse	Adverse
10	Harlowbury Development - Location 2 - 2nd floor	67.9	71.1	3.2	Moderate Adverse	Adverse
11	Chamberlains, Chalk Lane	62.1	62.6	0.5	Negligible Adverse	No
12	35, Old Road	57.9	57.1	-0.8	Negligible Beneficial	No
13	33, Mulberry Green	60.1	61.6	1.5	Minor Adverse	No
14	49, Mulberry Green	69.0	70.0	1.0	Minor Adverse	Adverse
15	Mulberry Gardens, Mulberry Green	73.7	73.6	-0.1	Negligible Beneficial	No
16	81, Chippingfield	64.0	62.6	-1.4	Minor Beneficial	No
17	42, Park Hill	64.6	65.2	0.6	Negligible Adverse	No
18	10, Fesants Croft	66.7	67.8	1.1	Minor Adverse	No
19	247, Felmongers	60.8	60.9	0.1	Negligible Adverse	No
20	51, Spencers Croft	59.0	58.5	-0.5	Negligible Beneficial	No
21	Allways, London Road	67.6	66.7	-0.9	Negligible Beneficial	No
22	Rundells, London Road	64.2	64.3	0.1	Negligible Beneficial	No
23	Orchard View, Hastingwood Road	65.7	62.6	-3.1	Moderate Beneficial	Beneficial
24	80, Ridgeways	70.0	69.8	-0.2	Negligible	No

Receptor No.	Receptor name	Do-minimum 2021, $L_{A10,18h}$ (dB)	Do-something 2021, $L_{A10,18h}$ (dB)	Noise level change (dB)	Magnitude of change	Significant effect?
					Beneficial	
25	Highlands, Hobbs Cross Road	66.4	66.2	-0.2	Negligible Beneficial	No

The introduction of the Proposed Scheme would be expected to result in decreases of traffic flow along the B183 (Sheering Road, The Street). This would be north of the Proposed Scheme with the consequence of noise levels decreasing in the area in the short term. This would be reflected through improvements in the noise environment of sample Receptors 1 and 2, as shown in Table 11.13, where perceptible (i.e. a change in noise level of 1dB or more) 'Minor' benefits have been predicted.

Traffic flow increases have been predicted along Gilden Way/Sheering Road (B183) due to introduction of the Proposed Scheme with subsequent increased noise levels. However, where the Sheering Road would connect to the proposed link to the M11 through Sheering Road Roundabout, the new carriageway location would be situated further away from the nearby sensitive receptors (i.e. sample Receptor 3) when compared to the existing one. This change in road layout, in conjunction with acoustic barriers (see Section11.6) and landscaping features embedded within the Proposed Scheme, would result in Minor to Moderate improvements in the noise environment in the area represented by sample Receptors 3 and 4.

In addition to the predicted increase in traffic flow along Gilden Way, the proposed 'hamburger' junction layout at the Churchgate Roundabout would result in increases in traffic speed along this length of the Proposed Scheme when compared to the existing scenario. Both the increase in traffic flow and speed would result in increases in noise emissions from the carriageway. The potential increase in noise along this length of the Proposed Scheme would be partly negated through introduction of acoustic barriers. However, these barriers would only be effective for ground and first floor receptors. At higher floor levels (i.e. 2nd and 3rd floor), as would be the case for some buildings within the new Harlowbury housing development, the acoustic barriers would not be fully effective due to the height and proximity of these properties to Gilden Way. Minor to Moderate Adverse noise impacts have been predicted at such receptors (sample Receptors 8 and 10) and the effect would be likely to be 'significant' as the resulting noise levels would be in exceedance of the SOAEL.

Residential properties located in Mulberry Green have been predicted to experience Minor Adverse impacts as a result of the introduction of the Proposed Scheme (sample Receptors 13 and 14). The cause of the increase in noise levels at these receptors would be twofold. Firstly, due to the direct noise contribution from the Proposed Scheme from an increase in traffic flow on Gilden Way (as mentioned above). Plus an indirect effect of the Proposed Scheme, where an increase in HGV movements along Mulberry Green has been predicted for the DS opening year scenario. The change in noise level at the property of 49 Mulberry Green has been predicted to be Significant despite the introduction of a noise barrier in front of the property; albeit just due to the 1.0dB increase predicted.

At the remaining receptors along the Gilden Way corridor, represented by sample Receptors 15 and 16, Negligible to Minor Beneficial have been predicted with the Proposed Scheme in place in the short term. This would be mainly due to the adverse noise effects due to increases in traffic flow being offset by the inclusion of acoustic fencing along specific lengths of Gilden Way.

Sample Receptors 17 to 25 represent dwellings on the wider road network within the Calculation Area where mostly Negligible short-term noise impacts have been predicted. Notable exceptions to this are sample receptors 18 and 23 where Minor Adverse and Moderate Beneficial impacts have been predicted respectively. The increase in noise at sample Receptor 18, Fesants Croft, would be due to an increase in traffic flow and percentage of HGV movements on First Avenue. At sample Receptor 23, the Moderate improvement would be due to a decrease in traffic flow on Hastingwood Road of about 50%, resulting in a Significant improvement.

The noise changes throughout the entire Calculation Area in the short term are displayed in Figure 11.3 showing noise change contours in terms of the magnitude of impacts. The contours illustrate the areas where changes in daytime noise levels would occur as a consequence of the Proposed Scheme.

Table 11.14 shows that the majority of sample receptors would experience negligible changes in their noise environment in the long term. Such changes in noise level, i.e. 3dB or less, would be imperceptible in the long term.

Table 11.14: Comparison of predicted long-term daytime noise levels at sample receptors

Receptor No.	Receptor name	Do-minimum 2021, $L_{A10,18h}$ (dB)	Do-something 2036, $L_{A10,18h}$ (dB)	Noise level change (dB)	Magnitude of change	Significant change?
1	The Willows, The Street (B183)	65.7	64.8	-0.9	Negligible Beneficial	No
2	Campdell, Sheering Road	71.9	72.0	0.1	Negligible Beneficial	No
3	The Red House, Sheering Road	62.5	61.7	-0.8	Negligible Beneficial	No
4	119, Sheering Road	67.0	63.7	-3.3	Minor Beneficial	No
5	122, Sheering Road	73.1	74.1	1.0	Negligible Adverse	Adverse
6	10, Mayfield Close	60.9	60.1	-0.8	Negligible Beneficial	No
7	Harlowbury Development - Location 1 - ground floor	68.7	68.2	-0.5	Negligible Beneficial	No
8	Harlowbury Development - Location 1 - 2nd floor	70.0	73.4	3.4	Minor Adverse	Adverse
9	Harlowbury Development - Location 2 - ground floor	66.8	69.5	2.7	Negligible Adverse	Adverse
10	Harlowbury Development - Location 2 - 2nd floor	67.9	72.0	4.1	Minor Adverse	Adverse
11	Chamberlains, Chalk Lane	62.1	63.5	1.4	Negligible Adverse	No
12	35, Old Road	57.9	59.3	1.4	Negligible Adverse	No
13	33, Mulberry Green	60.1	62.7	2.6	Negligible Adverse	No
14	49, Mulberry Green	69.0	71.1	2.1	Negligible Adverse	Adverse
15	Mulberry Gardens, Mulberry Green	73.7	74.5	0.8	Negligible Adverse	No

Receptor No.	Receptor name	Do-minimum 2021, $L_{A10,18h}$ (dB)	Do-something 2036, $L_{A10,18h}$ (dB)	Noise level change (dB)	Magnitude of change	Significant change?
16	81, Chippingfield	64.0	63.4	-0.6	Negligible Beneficial	No
17	42, Park Hill	64.6	66.5	1.9	Negligible Adverse	No
18	10, Fesants Croft	66.7	68.4	1.7	Negligible Adverse	No
19	247, Felmongers	60.8	61.6	0.8	Negligible Adverse	No
20	51, Spencers Croft	59.0	59.2	0.2	Negligible Adverse	No
21	Allways, London Road	67.6	67.7	0.1	Negligible Adverse	No
22	Rundells, London Road	64.2	65.1	0.9	Negligible Adverse	No
23	Orchard View, Hastingwood Road	65.7	65.0	-0.7	Negligible Beneficial	No
24	80, Ridgeways	70.0	70.7	0.7	Negligible Adverse	No
25	Highlands, Hobbs Cross Road	66.4	67.1	0.7	Negligible Adverse	No

Predicted changes in noise levels would be imperceptible in the long term at sample Receptors 5 and 14; however, the change in noise level has been assessed to be Significant as the change would be equal or larger than 1dB. The absolute noise level would be in excess of the SOAEL of 68 dB $L_{A10,18h}$.

The noise changes throughout the entire Calculation Area for the long term are displayed in Figure 11.3 showing noise change contours in terms of the magnitude of impacts. The contours illustrate the areas where changes in daytime noise levels would occur as a result of the Proposed Scheme.

Table 11.15 shows that, with the exception of sample Receptor 10, all changes in night-time noise levels in the long term as a result of the scheme have been predicted to be of Negligible magnitude. At sample Receptor 10, representing 2nd floor properties within the Harlowbury housing development, located in close proximity to Gilden Way, a Minor Adverse impact has been predicted also classed as Significant.

Table 11.15: Comparison of predicted long-term night-time noise levels at sample receptors

Receptor No.	Receptor name	Do-minimum 2021, $L_{night,outside}$ (dB)	Do-something 2036, $L_{night,outside}$ (dB)	Noise level change (dB)	Magnitude of change	Significant change?
1	The Willows, The Street (B183)	54.2	53.9	-0.3	Negligible Beneficial	No
2	Campdell, Sheering Road	59.8	60	0.2	Negligible Adverse	No
3	The Red House,	53.2	53.1	-0.1	Negligible	No

Receptor No.	Receptor name	Do-minimum 2021, $L_{night,outside}$ (dB)	Do-something 2036, $L_{night,outside}$ (dB)	Noise level change (dB)	Magnitude of change	Significant change?
	Sheering Road				Beneficial	
4	119, Sheering Road	54.9	52.8	-2.1	Negligible Beneficial	Beneficial
5	122, Sheering Road	59.8	60.7	0.9	Negligible Adverse	No
6	10, Mayfield Close	51	50.8	-0.2	Negligible Beneficial	No
7	Harlowbury Development - Location 1 - ground floor	56.3	55.9	-0.4	Negligible Beneficial	No
8	Harlowbury Development - Location 1 - 2nd floor	57.4	60.2	2.8	Negligible Adverse	Adverse
9	Harlowbury Development - Location 2 - ground floor	54.7	56.8	2.1	Negligible Adverse	Adverse
10	Harlowbury Development - Location 2 - 2nd floor	55.7	58.9	3.2	Minor Adverse	Adverse
11	Chamberlains, Chalk Lane	51	51.9	0.9	Negligible Adverse	No
12	35, Old Road	49.2	50.1	0.9	Negligible Adverse	No
13	33, Mulberry Green	50.3	51.9	1.6	Negligible Adverse	No
14	49, Mulberry Green	56.4	58.1	1.7	Negligible Adverse	Adverse
15	Mulberry Gardens, Mulberry Green	60.4	61	0.6	Negligible Adverse	No
16	81, Chippingfield	52.6	52.4	-0.2	Negligible Beneficial	No
17	42, Park Hill	52.1	53.8	1.7	Negligible Adverse	No
18	10, Fesants Croft	54.2	55.7	1.5	Negligible Adverse	Adverse
19	247, Felmongers	50.5	51.2	0.7	Negligible Adverse	No
20	51, Spencers Croft	49	49.3	0.3	Negligible Adverse	No

Receptor No.	Receptor name	Do-minimum 2021, $L_{night,outside}$ (dB)	Do-something 2036, $L_{night,outside}$ (dB)	Noise level change (dB)	Magnitude of change	Significant change?
21	Allways, London Road	55.2	55.3	0.1	Negligible Beneficial	No
22	Rundells, London Road	53.6	54.3	0.7	Negligible Adverse	No
23	Orchard View, Hastingwood Road	55.5	55.5	0	No Change	No
24	80, Ridgeways	62.6	63.3	0.7	Negligible Adverse	No
25	Highlands, Hobbs Cross Road	59.5	60.1	0.6	Negligible Adverse	No

Similar to the long term daytime predicted noise level changes, a number of significant effects are highlighted in Table 11.15 where the magnitude of changes would be Negligible. However, for these receptors the absolute noise level would be above the night-time SOAEL of 55dB $L_{night, outside}$ noise level and the change equal to or more than 1dB.

Predicted traffic noise levels at all receptors within the Calculation Area are listed in Appendix 11.3.

11.7.2.2 Important areas

As described in Section 11.1.1, the competent authority should look, where feasible, to improve noise levels within ‘Important Areas’. Descriptions of the ‘Important Areas’ within the Calculation Area along with the predicted noise levels and noise level change (in brackets) when compared against the DM opening year scenario are listed in Table 11.16 below.

Table 11.16: Noise action planning 'Important Areas' and predicted changes in noise level with the Proposed Scheme in place and the future Do-minimum scenario

Description of location	IA ID	Asset owner	Predicted noise level (change vs Do-Minimum 2021) $L_{A10,18h}$ (dB)		
			Do-Something 2021	Do-Something 2036	Do-Minimum 2036
Felmongers, adjacent to the A414, approximately 100m south of First Avenue Roundabout.	5682	ECC	65.8 (+0.1)	66.7 (+1.0)	66.8 (+1.1)
Pytt Field, adjacent to the A414, approximately 50m south of Second Avenue Roundabout.	5689	ECC	68.3 (-0.5)	69.0 (+0.2)	69.5 (+0.7)
Nicholls Field, adjacent to the A1025 (Second Avenue), approximately 150m west of Second Avenue Roundabout.	5690	ECC	70.4 (-0.2)	71.4 (+0.8)	71.4 (+0.8)
Great Brays, adjacent to the A1025 (Second Avenue), approximately 500m west of Second Avenue Roundabout.	5691	ECC	70.9 (-0.2)	71.9 (+0.8)	71.8 (+0.7)
Priority Court, adjacent to the A414, approximately 25m south of Southern Way Roundabout.	5688	ECC	73.7 (-0.9)	74.7 (+0.1)	75.0 (+0.4)
Spinning Wheel Mead, adjacent to the A1169, approximately 300m west of Southern Way Roundabout.	5687	ECC	65.4 (-0.2)	66.0 (+0.4)	65.9 (+0.3)
Along Canes Lane (A414), southeast of the M11 J7.	13431	ECC	73.4 (+0.2)	74.5 (+1.3)	74.3 (+1.1)
Crabbs, Mill Street, adjacent to the M11.	4702	HE	71.9 (-0.4)	73.0 (+0.7)	73.1 (+0.8)
Majority of the eastern edge of Church Langley Housing Estate, adjacent to the M11.	4704	HE	69.8 (-0.2)	70.7 (+0.7)	70.7 (+0.7)
Mead Cottage and Hobbs Cross Cottage, Hobbs cross Road, Hobbs Cross – adjacent to the M11.	4705	HE	70.8 (-1.1)	72.3 (+0.4)	73.9 (+2.0)
Chamberlains, St Stephens Cottages, Chalk Lane, adjacent to the M11.	6087	HE	67.6 (-0.5)	68.5 (+0.4)	68.8 (+0.7)
Feltimores Cottages, Chalk Lane, adjacent to the M11.	4706	HE	74.9 (-0.2)	75.7 (+0.6)	75.8 (+0.7)
Woodlands, The Street, adjacent to the M11 east of Longland Bridge.	4708	HE	72.4 (-0.8)	73.4 (+0.2)	74.0 (+0.8)
Crown Close adjacent to the M11.	4707	HE	72.9 (+0.4)	73.8 (+1.3)	73.2 (+0.7)

Table 11.16 shows that for the short term scenario (2021), noise levels would decrease in the majority of the Important Areas with the Proposed Scheme in place. In three areas noise levels have been predicted to increase. However, these increases would be very small and have been classed as 'Negligible'.

For the future year, the predictions show that noise levels would increase in all of the identified Important Areas. In three of the areas (5682, 13431 and 4707) noise levels of 1dB or more have been predicted. However, from

the final column of Table 11.16 it can be seen that in the future DM scenario similar increases in noise have been predicted. It is therefore evident that natural growth in traffic is the main reason for the increased noise levels at these areas and not attributed to the Proposed Scheme.

11.7.2.3 HD 213/11 summary tables

In the previous section of the report, noise level changes have been highlighted at specific locations in the Calculation Area through sample receptors showing localised effects of the Proposed Scheme. In this section, the DMRB HD 213/11 Summary Tables are presented with the purpose of showing an overall picture, in terms of affected receptors the Proposed Scheme would have on the Calculation Area.

Table 11.17 and 11.18 provide the noise level change comparisons in accordance with the reporting requirements for a Detailed Assessment as set out within DMRB HD 213/11.

Table 11.17: Noise summary table, Do-Minimum 2021 against Do-Something 2021 (short term)

Scenario/comparison: Do-Minimum 2021 against Do-Something 2021			
Change in noise level		**Daytime**	
		Number of dwellings	**Number of other sensitive receptors**
Increase in noise level $L_{A10,18h}$	0.1 – 0.9	3791	25
	1.0 – 2.9	361	1
	3.0 – 4.9	5	0
	5+	0	0
No change	0	1096	6
Decrease in noise level $L_{A10,18h}$	0.1 – 0.9	7867	109
	1.0 – 2.9	432	8
	3.0 – 4.9	109	1
	5+	11	0

Table 11.17 shows that 367 receptors would experience perceptible noise level increases of 1dB or more in the short term DS 2021 vs DM scenario. Of these perceptible increases, the majority have been classed as Minor (362) whereas five dwellings have been predicted to experience Moderate Adverse impacts.

In terms of noise level decreases, 561 receptors have been predicted to experience perceptible improvements in their noise environment. Of these, 110 have been classed as Moderate and 11 classed as Major improvements. The remaining 440 receptors would experience Minor improvements.

It can be observed from Table 11.17 that, although there are a number of receptors that would experience Moderate increase in noise in the short-term scenario, these would be far outweighed by the number of receptors experiencing perceptible Moderate and Major improvements. The number of Minor improvements would also exceed the number of Minor deteriorations. Therefore, in the short term, the Proposed Scheme could be considered as Beneficial from a noise perspective.

Table 11.18 shows all but 13 receptors have been predicted to experience Negligible noise changes in the long term should the Proposed Scheme not be introduced. A small number of receptors would experience Minor Adverse impacts, likely due to ‘natural’ growth of traffic in Harlow and the surrounding areas.

Table 11.18: Noise summary table, Do-Minimum 2021 against Do-Minimum 2036 (long term)

Scenario/comparison: Do-Minimum 2021 against Do-Minimum 2036				
Change in noise level		**Daytime**		**Night-time**
		Number of dwellings	**Number of other sensitive receptors**	**Number of dwellings (>55 dB(A))**
Increase in noise level $L_{A10,18h}$	0.1 – 2.9	13548	149	1399
	3.0 – 4.9	13	0	0
	5.0 – 9.9	0	0	0
	10+	0	0	0
No change	0	7	0	0
Decrease in noise level $L_{A10,18h}$	0.1 – 2.9	104	1	0
	3.0 – 4.9	0	0	0
	5.0 – 9.9	0	0	0
	10+	0	0	0

For the night-time period, the noise environments for all receptors in the Calculation Area have been predicted to experience Negligible increases in noise in the future year.

Table 11.19 shows that in the future year the vast majority of receptors would experience Negligible changes in noise levels with the Proposed Scheme in place. 83 receptors have been predicted to experience Minor Adverse impacts, compared to 19 receptors with Minor or Moderate Beneficial impacts.

Table 11.19: Noise summary table, Do-Minimum 2021 against Do- Something 2036 (long term)

Scenario/comparison: Do-Minimum 2021 against Do-Something 2036				
Change in noise level		**Daytime**		**Night-time**
		Number of dwellings	**Number of other sensitive receptors**	**Number of dwellings (>55 dB(A))**
Increase in noise level $L_{A10,18h}$	0.1 – 2.9	13115	145	1243
	3.0 – 4.9	82	1	20
	5.0 – 9.9	0	0	0
	10+	0	0	0
No change	0	77	1	10
Decrease in noise level $L_{A10,18h}$	0.1 – 2.9	379	3	90
	3.0 – 4.9	17	0	4
	5.0 – 9.9	2	0	0
	10+	0	0	0

For the night-time period, 24 receptors would experience Minor changes in their noise environment. Of these, 20 have been classed as adverse and four as Beneficial impacts.

When considering the above, it is considered that in overall terms the Proposed Scheme would have a Neutral to Slight Adverse impact on sensitive receptors within the Calculation Area.

11.7.2.4 Noise nuisance

Calculations of the change in noise nuisance have been undertaken for all dwellings within the DMRB HD 213/11 Calculation Area for the assessment of permanent traffic noise impacts. Table 11.20 provides the results of the noise nuisance assessment.

Table 11.20 shows that with the Proposed Scheme in place, 13,197 dwellings would experience an increase in noise nuisance as compared to 13,561 dwellings in the DM. Although a relatively large number of dwellings have been predicted to experience increases in nuisance levels greater than 10% under the DS scenario, this would be due to short-term changes in noise resulting in a larger percentage increase in nuisance levels. For example, a 0.9dB increase in noise level is equivalent to 20% increase in the noise nuisance level in the short term. In other words, as noted in Annex 6 of DMRB HD 213/11, people are more sensitive to abrupt changes in traffic noise than gradual changes. Therefore, the sensitivity to new schemes is an effect that can last for a number of years, when in fact gradual changes in noise levels can represent higher overall noise level increases but lower nuisance levels.

Table 11.20: Traffic induced noise nuisance

Noise nuisance			
Change in nuisance level		**Number of dwellings**	
		Do-Minimum	**Do-Something**
Increase in nuisance level	< 10%	13561	9040
	10 < 20%	0	3559
	20 < 30%	0	589
	30 < 40%	0	10
	> 40%	0	10
No change	0	7	77
Decrease in nuisance level	< 10%	104	390
	10 < 20%	0	8
	20 < 30%	0	0
	30 < 40%	0	0
	> 40%	0	0

Table 11.20 also shows that 398 dwellings would experience a reduction in noise nuisance with the Proposed Scheme in place compared to 104 in the DM scenario.

Although a smaller number of receptors have been predicted to experience an increase in noise nuisance with the Proposed Scheme in place when compared to the DM scenario, there would be a larger number of dwellings for which the change in noise nuisance was larger than 10%. This seems to indicate that the overall effect of the Proposed Scheme would be adverse in terms of noise nuisance. However, when considering that small changes in noise level could result in a large noise nuisance change, the nuisance assessment has shown that the Proposed Scheme would have a Neutral to Slight Adverse effect upon dwellings in the Calculation Area.

11.7.2.5 Vibration nuisance

Changes in vibration nuisance have been calculated for all dwellings that are within the DMRB HD 213/11 Calculation Area. Table 11.21 provides the results of the vibration nuisance assessment undertaken. It should be noted that for the assessment of traffic induced airborne vibration, DMRB HD 213/11 advises that only receptors within 40m of roads should be considered as the empirical assessment method is not valid outside

the 40m range. As a result, only those properties located within 40m within roads contained within the Calculation Area are contained within Table 11.21.

Table 11.21: Traffic induced airborne vibration nuisance

Vibration nuisance (airborne)			
Change in nuisance level		**Number of dwellings**	
		Do-Minimum	**Do-Something**
Increase in nuisance level	< 10%	2239	1932
	10 < 20%	0	25
	20 < 30%	0	0
	30 < 40%	0	0
	> 40%	0	0
No change	0	542	586
Decrease in nuisance level	< 10%	82	312
	10 < 20%	0	8
	20 < 30%	0	0
	30 < 40%	0	0
	> 40%	0	0

From Table 11.21 it can be observed that 1,957 dwellings have been predicted to experience an increase in airborne vibration nuisance with the Proposed Scheme in place of which 25 would experience an increase of between 10% and 20%. Overall this would be slightly less when compared to the 2,239 dwellings that would experience an increase in airborne vibration nuisance without the Proposed Scheme in place.

Regarding improvements in airborne vibration nuisance, the predictions show that 320 dwellings would experience a decrease with the Proposed Scheme in place. For eight of these dwellings the increase would be between 10% and 20%, and 82 for the DM scenario.

A smaller number of dwellings would see increases in vibration nuisance with the Proposed Scheme in place when compared to the DM. In terms of decreased vibration nuisance, the DS scenario would be more beneficial than the DM scenario. Taking into account the above, it is considered that overall; the Proposed Scheme would be Slight Beneficial in terms of vibration nuisance.

11.7.2.6 Basic noise level changes

A total of 66 BNL links have been identified. A list with these links is provided in Appendix 11.4 together with the number of dwellings within 50m of these links in accordance with the requirements of DMRB HD 213/11.

At the majority of the BNL links reductions in noise have been predicted to occur, in particular along the Gilden Way starting from the Proposed Scheme at Sheering Road Roundabout, all the way to the A120 Stansted Airport junction.

A number of perceptible increases in noise have been predicted. The largest increase (+3.4dB in the short term and +4.9dB in the long term) would occur on Sheering Mill Lane, Lower Sheering. It is predicted that the Proposed Scheme would attract additional traffic to this road, with the consequence of noise increases at nearby receptors. A number of other roads such as Obrey Way, Haydens Road and Bury Lodge Lane would undergo perceptible noise increases in the short term. However, comparison of the future year DS and DM scenarios for Haydens Road and Obrey Way shows that similar increases in noise would occur without the Proposed Scheme in place thereby suggesting that the predicted short term noise increases would not be due

to the Proposed Scheme. Conversely, for Bury Lodge Lane, the future DM scenario shows that a decrease in noise level would occur when compared against the DM opening year. This suggests that the predicted short term noise increase would occur as a consequence of an indirect effect of the Proposed Scheme. Nevertheless, given the relatively low increase in noise (+1.5dB), the relatively low traffic flow on Bury Lodge Lane and the fact that this road would be located adjacent to the M11 (which is considered the dominant noise source in that area), it is considered that the predicted increase in BNL would be unlikely to result in a perceptible change in noise at nearby receptors.

11.8 Summary and Conclusions

The proposed impacts, mitigation and residual effects for noise and vibration are summarised in Table 11.22.

Table 11.22: Summary of noise and vibration impacts

Description of effect	Significance of effect (prior to mitigation)	Proposed mitigation	Residual effect (after mitigation)
Construction effects			
General construction of the Proposed Scheme - daytime noise. A number of inherently noisy operations required. Due to the transient nature of the works, receptors would be exposed to high noise levels. However this would be for a relatively short period only.	Noise levels at receptors in vicinity of the Proposed Scheme would exceed the specified BS 5228 construction noise level thresholds, but not the duration threshold; therefore not predicted to be significant.	Best Practice Means mitigation measures would be applied to minimise impacts wherever possible. The Proposed Scheme's acoustic barriers to be constructed at the start of the construction programme. A CEMP would be prepared and implemented to identify and control noise emissions.	Short term adverse effects; although these would be unlikely to be significant.
General construction of the Proposed Scheme - night-time noise. Night-time operations would be required for some construction activities to minimise disruption to traffic. High noise levels have been predicted at receptors in the vicinity of the Scheme. However these would only be for a short duration due to the transient nature of the works.	Noise levels at receptors in the vicinity of the Proposed Scheme would exceed the specified BS 5228 construction noise level thresholds, but not the duration threshold; therefore not considered to be significant.	Best Practice Means mitigation measures would be applied to minimise impacts wherever possible. Particular mitigation such as temporary hoardings could be required to minimise potential of sleep disturbance. The Proposed Scheme's acoustic barriers would be constructed at the start of the construction programme. A CEMP would be prepared and implemented to identify and control noise emissions.	Short term adverse effects; although these would be unlikely to be significant.
Vibratory compactions - elevated levels of vibration above thresholds where complaints would have the potential to occur. However, the impact would only be of a transient nature, i.e. vibration only perceptible when plant was in close proximity to receptor.	Vibration levels predicted to be at levels where complaints would be possible. However, due to the short exposure time, the effects have not been predicted as	A CEMP would be prepared and implemented to identify and control vibration emissions. Use of low vibration plant where feasible. Proactive measures such as liaising with local residents.	Short term adverse effects; although these would be unlikely to be significant.

Description of effect	Significance of effect (prior to mitigation)	Proposed mitigation	Residual effect (after mitigation)
	significant		
Operational effects			
Operation of the Proposed Scheme – the increase in traffic flow and speeds along Gilden Way / Sheering Road would result in elevated levels of noise emanating from the road.	Magnitude of impact at receptors in vicinity of the Proposed Scheme would range from: Moderate to major in the short term Minor to moderate in the long term The impacts would also be significant at relatively large number of receptors, in particular those closest to the Proposed Scheme.	A substantial suite of mitigation measures including acoustic barriers, landscaping and low noise road surfacing have been incorporated into the design to minimise impacts. However, not all receptors would be mitigated from such noise levels due their proximity to the Proposed Scheme and their heights	Minor to moderate in the short term Negligible to minor in the long term
Operation of the Proposed Scheme – impact upon the wider Calculation Area. Introduction of the Proposed Scheme would result in traffic noise changes on the local traffic network which would potentially affect the noise environment.	Short term: overall adverse Long term: overall adverse	As above	Short term: overall beneficial Long term: overall neutral to slightly adverse

12. People and Communities

12.1 Introduction

This chapter covers the assessment of potential impacts caused by the Proposed Scheme on people and communities. Receptors and impacts relevant to this chapter include the followings.

- Private properties, including land take and impacts on farming businesses.
- Development land, including changes in viability and amenity. This includes how the access to the development site would change and how the site's appropriateness towards its planned use would change.
- Non-Motorised Users, the collective term for pedestrians, cyclists, equestrians, and bus users.
- Community severance, including access to community facilities.
- Public transport users, focussing on bus services.
- Vehicle users, particularly driver stress.

Additional effects on human beings are addressed in other chapters, including:

- Chapter 5 - Air Quality;
- Chapter 7 - Landscape and Visual;
- Chapter 10 - Materials; and
- Chapter 11 - Noise and Vibration.

Additional information to support this chapter is presented in Appendix 12.1 'People and Communities Consultation'.

12.1.1 Legislative and planning context

Relevant policies referring to land use and transport users in highway and development schemes are described below in Table 12.1.

Table 12.1: Legislative and planning context

Planning policy	Relevance
Safeguarding Our Soils: A Strategy for England, (Defra, 2011b)	Sets the current policy context on soils, including specific goals for the management of soils and degradation threats. Where possible, projects are expected to limit the loss of the Best and Most Versatile (BMV) agricultural land (Grades 1, 2 and 3a of the Agricultural Land Classification (ALC)), minimise the impact on agricultural businesses, and assist in the maintenance of viable agricultural holdings.
The Localism Act (2011)	Sets out a series of measures with the potential to achieve a substantial shift in power away from central government and towards local people. This includes the rights and powers for communities and individuals. It also enables ministers to transfer public functions to local authorities to improve local accountability and promote economic growth.
Technical Information Note 049 (TIN049) (NE, 2012)	Describes the ALC system, originally developed by the former Ministry of Agriculture, Fisheries and Food (MAFF, 1998), now Defra, as a means to protect the BMV agricultural land.
The National Planning Policy Framework (NPPF), (DCLG, 2012)	Sets out national planning policy including building a strong and competitive economy, supporting a prosperous rural economy and promoting healthy communities.

Planning policy	Relevance
The National Planning Practice Guidance, (DCLG, 2014b)	Sets out guidance on open space, sports and recreation facilities, Public Rights of Way (PRoWs) and the new Local Green Space designation.
The National Policy Statement for National Networks , (DT, 2014)	Sets out the Government's vision and policy, against which the Secretary of State will make decisions on applications for development consent for nationally significant infrastructure projects on the strategic road and rail networks.
Local Planning Policy (consolidated February 2011)	Emerging Strategy and Options for the Harlow Local Development Plan, 2014, Harlow Council; Epping Forest Combined Local Plan, 1998 and 2006; Epping Forest Transport Strategy (ECC, undated); Essex Road Passenger Transport Strategy, 2005; Essex Transport Strategy: the Local Transport Plan for Essex, 2011; Harlow Local Plan (adopted), 2006.

12.1.2 Study area

Design Manual for Roads and Bridges Volume 11, Section 3, Part 6, Part 8 and Part 9 (Highways Agency, 1993b and 1993c) does not specify a scheme assessment area when considering the effects of a road project on land use, NMUs, vehicle users, or communities. Assessment areas have therefore been selected based on previous professional experience of road development schemes. The 'local study area' has been assigned to the assessment of direct impacts (i.e. landtake, severance and amenity). As illustrated in Figures 12-1 and 12-2, the local study area extends to approximately 500m either side of the proposed route corridor. Where relevant, impacts along the connecting road network have also been considered.

Potential effects of the Proposed Scheme on development land, planning applications and the Harlow Local Development Plan have been assessed within a 1km zone. Planning allocations have been assessed in terms of anticipated direct land take, severance to access and impacts to amenity and viability. In addition, major proposals within the development study area have been assessed for any indirect effects in terms of increased traffic or changes to access.

12.2 Assumptions and Limitations

There is no recognised standard guidance on sensitivity criteria for the topics covered in this chapter; therefore, sensitivity criteria of receptors have been developed based on professional judgement and in accordance with relevant DMRB guidance. Baseline environmental data have been collected using the most up-to-date publicly available third party information.

The assessment of impacts on agricultural land has been carried out using a desk-based study. Soil classification, to determine the grades of soil types in line with the updated 'Agricultural Land Classification of England and Wales' (MAFF, 1998) i.e. 3a or 3b, was outside of the scope of the assessment. It has therefore been assumed that all fields identified as Grade 3 are in fact Grade 3a BMV.

12.3 Methodology and Assessment Criteria

12.3.1 Methodology

The assessment has been undertaken in accordance with DMRB Volume 11 Section 3 Part 6 (Land Use) (Highways Agency, 2001); Part 8 (Pedestrians, Cyclists, Equestrians and Community Effects) (Highways Agency, 1993b) and Part 9 (Vehicles) (Highways Agency, 1993c) and IAN 125/15 (Highways Agency, 2015a), environmental assessment update guidance. Interim Advice Note 125/15 replaced IAN 125/09 and combines the current DMRB Vol 11 Section 3 Part 6 (Land Use), Part 8 (Pedestrians, Cyclists, Equestrians and Community Effects) and Part 9 (Vehicles) into one chapter titled 'People and Communities'.

To appropriately consider the disparate receptors required by the DMRB and the types of impacts that could affect them, all road users and community and private assets were considered within six sub-topics:

- private assets;
- development land;
- Non-Motorised Users;
- community severance;
- public transport users; and
- views from the road and driver stress.

12.3.1.1 Private assets

An assessment of how the Proposed Scheme would impact upon private properties within the study area has been restricted to the residential assets that would be directly affected by the preferred alignment, or for which access routes would be altered.

The method of assessment included a desk-based review of the Proposed Scheme design and aerial imagery to determine where any direct land take from residential properties would occur. Individual land plans produced during the design phase have been consulted and, where relevant, percentage estimations made using GIS mapping, for properties where direct land take would be likely. In the absence of criteria for determining significance of changes in access, a qualitative assessment has been completed.

12.3.1.2 Development land

Development land refers to any area of land allocated for development by local planning authorities. The assessment of the impacts anticipated on development land has included a desk-based assessment of all local planning authorities' land use planning allocations that could potentially be affected by the Proposed Scheme. Designated land use planning allocations have been taken from the 'Adopted Replacement Harlow Local Plan 2006' and Epping Forest Combined Local Plan, 1998 and 2006 maps.

Current planning applications or recently approved applications (i.e. in the last 12 months) located within 1km of the Proposed Scheme have been considered as part of the assessment. Some applications or approved developments have been screened out of the assessment based on professional judgement of their size and location.

Impacts from the Proposed Scheme could affect the amenity and viability of development land. Amenity is the attractiveness of an area to be developed on, with particular focus on access and usage, and viability is the ability for the site to be used as intended. For example, if the construction and operation of a project were to negatively impact the amenity of the development land, this could lead to a change in intended use from homes to offices or retail. If the Proposed Scheme significantly impacted the amenity of the site then the viability of that area as an area for future development could be affected.

12.3.1.3 Non-motorised users

Baseline data have been gathered from desk-based studies and observations made during a site visit, undertaken on 16th September 2015. The aim of the site visit was to confirm the findings of the desktop assessments and to make high-level observations, such as the frequency of use and condition of PRoWs. The site visit was concentrated along Gilden Way, extending from the London Road Roundabout to an area to the west of the proposed Sheering Road Roundabout (Mayfield Farm).

The ECC interactive PRoWs map and data resource have been used to check the locations of the PRoWs network within the study area. Other sources of information referred to include local planning policy documents and cycle maps produced by Cycle Harlow (2015).

The NMUs baseline data have been compiled from the NMU Context Report, (2016).

Cycle survey data for 2014 have been obtained from Essex Highways for the NCN Route 1 at Netteswell Road.

12.3.1.4 Community severance

Community severance is defined by DMRB as "*the separation of residents from facilities and services they use within their community caused by new or improved roads or by changes in traffic flows*" (DMRB, Volume 11 Section 3, Part 8, 1993). The definition also extends to severance caused by the demolition of a community facility or the loss of land used by members of the public.

The assessment of community severance has considered any loss of all or part of a community facility or community, based on the level of direct land take, as well as disruption in access to facilities, during both the construction and operational phases. The study area for assessing impacts to community facilities extends to those facilities within communities in the adjacent area (the development study area), as well as any key community facilities further afield that could experience an impact due to changes to access issues (wider study area). Key community facilities have been identified through a combination of aerial imagery and information from local authority websites.

A desk-based assessment of potential severance to access between communities, and from communities to community facilities, during both the construction and operational phases has been completed, taking into account how the Proposed Scheme would affect residents' ability to move around a community and/or affect the 'community feel' within a settlement.

12.3.1.5 Public transport users

Baseline information on bus routes and services in and around Harlow has been taken from Arriva's website (2016). Additional information has been taken from the NMU Context Report (2016).

The assessment considered how the Proposed Scheme would potentially impact the ability of individuals to physically access bus stops within the local area, throughout both the construction and operational phases. In the absence of any detailed DMRB guidance, a qualitative assessment has been completed.

Bus stops have been assessed in terms of how access would be obstructed during the construction phase, or where they would be permanently relocated as a consequence of the new road alignment. An adverse effect has been assumed where access for bus users would be impeded by the Proposed Scheme, and a beneficial effect has been assumed where access would be made more convenient.

12.3.1.6 Views from the road and driver stress

The assessment of vehicle users has been based on the view from the road. The 'view from the road' is defined in DMRB, Volume 11, Section 3, Part 9: Vehicle Travellers as the '*extent to which travellers, including drivers, are exposed to different types of scenery through which a route passes'*. The quality of views from a road can influence a drivers experience along a route, either positively or adversely.

The aim of the assessment has been to compare the nature and quality of views likely to be experienced by road users using the Proposed Scheme, with those currently experienced from the existing route. The views considered as part of the assessment extend to the visible skyline, whether this is formed, for example, by adjacent landform and woodland.

The assessment of views from the road has included:

- types of scenery or the landscape character as described and assessed for the baseline studies;
- extent to which road users might be able to view the scenery and landscape; and
- quality of the landscape as assessed for the baseline studies.

When assigning a view to the surrounding landscape, the following two categories have been used:

- restricted view - frequent cuttings or structures blocking the view; and
- open view - view extending over many miles, or only restricted by existing landscape features.

Baseline data have been gathered from desk-based studies and observations made during a site visit, undertaken on 16th September 2015. The assessment of views from the Proposed Scheme has taken into account the growth of trees and shrubs throughout the landscape mitigation period.

Driver stress is defined in the DMRB as "*the adverse mental and physiological effects experienced by a driver traversing a road network"*.

The following three components of driver stress have been considered as part of this assessment:

- frustration;
- fear of potential accidents; and
- uncertainty relating to the route being followed.

Traffic modelling has been carried out for the Proposed Scheme and adjoining road network to identify existing and forecast traffic flows (2036 forecast, medium growth scenario).

To assess driver stress, DMRB guidance provides advice on categorising stress as high, moderate or low based upon speeds and flows during peak hour flows over at least 1km of a route. The guidance figures provided within the DMRB were not considered appropriate for this assessment. This is due to the use of the DMRB guidance resulting in inappropriate stress grading for most local links, as many of the modelled links are short in length and designed for low speed traffic. Under the DMRB guidance all links with traffic travelling at less than 60kph (37 mph) are considered High Stress.

Rather than attempt an assessment based on DMRB guidance, a qualitative assessment has been completed.

12.3.2 Assessment of magnitude and significance

The available published guidance does not include methodologies for many of the topics considered, either for determining the magnitude of impacts considered, or for measuring the sensitivity of the receptors to these impacts. No guidance is provided for private properties, development land, NMUs, or community severance. The bespoke sensitivity and magnitude criteria, developed for the purposes of this assessment, are described in the following sections.

12.3.2.1 Private assets

The sensitivity criteria for community and private assets are outlined in Table 12.2.

Table 12.2: Sensitivity criteria for private assets

Sensitivity	Descriptors
High	Private, residential or commercial buildings currently in use. Grade 1, Grade 2, and Grade 3 agricultural land (MAFF,1998).
Medium	Private, residential or commercial land (excluding buildings) i.e. gardens. Undeveloped land subject to a planning approval. Grade 4 agricultural land.
Low	Unoccupied buildings. Undeveloped land subject to a current (but yet to be approved) planning application. Grade 5 agricultural land.

Topic-specific magnitude criteria have been developed and are set out in Table 12.3.

Table 12.3: Magnitude criteria for private assets

Magnitude	Descriptors
Major	Property or business (including agricultural) which is completely demolished/destroyed, all access is blocked, or where the business will no longer be viable as a result of the scheme.
Moderate	Property or business where some direct landtake is required, access is partially blocked, or where that residence or business is directly affected but can continue viably into the future.
Minor	No significant direct land take but there is some loss of amenity and/or where access is somewhat reduced.
Negligible	Very slight change from the baseline conditions, which will have no significant bearing on the property or building.

The sensitivity and magnitude criteria for agricultural land are incorporated into Table 12.4, and are based on the MAFF ALC system. Under this system, land is categorised according to six grades, see Chapter 9 – Geology and Soils, Section 9.4.2.1 for details of the quality of each grade.The significance criteria specifically for agricultural assessment are provided in Table 12.4. Impacts associated with land loss in the context of land holding size, and those associated with the use of farmland, have also been considered.

Table 12.4: Significance criteria for agricultural land assessment

Significance	Descriptors
Major	The Proposed Scheme directly leads to the loss of over 20ha of “Best and Most Versatile (BMV) agricultural land” (Grades 1, 2, and 3a).
Moderate	The Proposed Scheme directly leads to the loss of between 5ha and 20ha of “BMV agricultural land” (Grades 1, 2, and 3a).
Slight	The Proposed Scheme directly leads to the loss of less than 5ha of “BMV agricultural land” (Grades 1, 2, and 3a) or the loss of any quantity of moderate, poor or very poor quality agricultural land (Grades 3b, 4 and 5).
Negligible	No direct impact upon agricultural land.

12.3.2.2 Development land

The assessment of how the Proposed Scheme would impact on development land/planning applications has been carried out using professional judgement, with reference to the criteria in Table 12.5. In this table, viability refers to how the access to the development site would change and amenity refers to how the site's appropriateness towards its planned use would change.

Table 12.5: Summary of effects on development land

Assessment criteria	Viability	Amenity
Beneficial	The land would still be available for the proposed use, and the development of the Proposed Scheme would improve the viability of the site for the planned use category of land use, (generally through improved access).	Impacts on the amenity of the site would not interfere with its proposed land use, or the impact on the amenity would be beneficial, in that the Proposed Scheme would improve the site's appropriateness for its proposed land use.
Adverse	Some or the entire site would no longer be available for the proposed category of land use; therefore, reducing the viability of the development.	There would be a reduction in amenity such as to interfere with the proposed use of the site.
Mixed	Potential impacts include some adverse and some beneficial factors.	Potential impacts include some adverse and some beneficial factors.

12.3.2.3 Non-Motorised Users

Overall significance of the predicted impacts has been determined using a combination of sensitivity and magnitude. The sensitivity criteria for NMUs are summarised in Table 12.6.

Table 12.6: Non-Motorised Users sensitivity criteria

Sensitivity	Descriptors
Very High	Key route used by pedestrians, cyclists and other NMUs for journeys, including commuting. These routes record very high numbers of NMU journeys and connect users with employment and other community facilities. Any interruption to these routes would cause inconvenience to users, and could also cause road users to switch from active modes to the use of private cars. These routes are regularly used by vulnerable road users such as the elderly, school children and people with disabilities.
High	National or regional trails or routes likely to be used for recreation, and recording high use. These routes are judged as highly sensitivity due to the potential number of people affected, and due to effects on recreational and regional use.
Medium	Public right of ways close to communities used mainly used for recreational purposes (i.e. dog walking) but for which alternative routes are available. Users could be more tolerant to disruptions and diversions, but likely to be sensitive to changes to attractiveness and character.
Low	Routes that have fallen into disuse or are scarcely used and do not offer any access for either utility or recreational purposes.

The magnitude of impacts on routes used by NMUs has been assessed according to the criteria provided in Table 12.7. This includes both beneficial and adverse criteria as the scale of change is different between these types of impact.

Table 12.7: Magnitude criteria for Non-Motorised Users

Magnitude	Description
Major Adverse	Loss or severance of route used by pedestrians, cyclists, equestrians or bus road users, resulting in substantial loss of attractiveness and use.
Moderate Adverse	Introduction of new crossing or close proximity of highway, which could result in a minor diversion (<500m) and some loss of attractiveness.
Minor Adverse	No direct impact but some loss of attractiveness.
Negligible	No significant negative or positive change to route used by pedestrians, cyclists, equestrians or bus passengers.
Minor Beneficial	A slight improvement to a route used by NMUs i.e. slight improvement to attractiveness.
Moderate Beneficial	Creation of a new crossing or facility likely to increase journeys made by foot, bicycles or horses.
Major Beneficial	Provision of a new route for NMUs that could be safer, more direct or have a greater attractiveness than routes previously used.

12.3.2.4 Community severance

The sensitivity criteria for community assets are outlined in Table 12.8.

Table 12.8: Sensitivity criteria for community assets

Sensitivity	Descriptors
High	Buildings used by the community i.e. schools and community halls. Land used by the community attracting visitors on a national scale (i.e. national parks, national/well known tourist attractions). Religious sites and cemeteries.
Medium	Land used by the community attracting visitors on a regional scale (i.e. country parks regional tourist attractions).
Low	Locally used community land (i.e. local parks, playing fields, allotment gardens). Local tourist attractions.

Topic-specific magnitude criteria have been developed and are set out in Table 12.9.

Table 12.9: Magnitude criteria for community assets

Magnitude	Descriptors
Major	Community asset is completely demolished, all access blocked, or where the facility would no longer be viable.
Moderate	Community asset where some direct land take is required, access is partially blocked, or where that residence or business is directly affected but can continue viably into the future.
Minor	No significant direct land take but there is some loss of amenity and/or where access is somewhat reduced.
Negligible	Very slight change from the baseline conditions but which would have no significant bearing on the property or building.

12.3.2.5 Public transport users

Where access for bus passengers could be impeded as a result of the Proposed Scheme, this has been assessed as an overall adverse effect. Where access could be made more convenient, this has been assessed as an overall beneficial effect.

12.3.2.6 Views from road and driver stress

Views from the road and driver stress have been assessed as beneficial, neutral, or adverse, reflecting the change expected as a result of the Proposed Scheme.

12.4 Baseline Environment

12.4.1 Baseline sources

The baseline has been primarily established through a desk-based study, including a review of existing information previously produced by the following publicly-available sources:

- CartoGold Essex Public Transport Map [online];
- Sustrans [online];
- DMRB Volume 11, Part 9, Chapter 3, 'Vehicle Travellers' p 3/1 (Highways Agency, Scottish Government, National Assembly Wales and the Department for regional Development Northern Ireland, 1993);
- Harlow Planning Register;
- Agricultural Land Classification of England and Wales' (MAFF, 1998);
- Arriva's network of bus services [online];
- Harlow Cycle Maps [online];
- Harlow Community Map (May 2016);
- Harlow Planning Register (May 2016);
- Adopted Replacement Harlow Local Plan (2006) map;
- British Horse Society, the Cyclists' Touring Club, the Ramblers Association and Sustrans; and
- Essex County Council's interactive Essex Bus and Train map [online].

12.4.2 Baseline conditions

12.4.2.1 Private assets

Key baseline economic features included private properties, local business, and agricultural land. These features are outlined in Table 12.10 and shown in Figure 12-1 'Community and Private Assets'.

Table 12.10: Key private assets

Receptor	Location	Description
Private properties	Local study area	Existing residential dwellings are located on either side of Gilden Way including at Mulberry Green, The Oxleys and at The Campions (to the north of Mayfield Farm).
		Residential dwellings are located on Moor Hall Road/Sheering Road.
		Residential dwellings are located on Churchgate Street.
		Residential dwellings are located on Mulberry Green.
		Residential dwellings are located on Watlington Road.
		Residential dwellings are located in Chippingfield.
Local businesses	Local study area	Mayfield Farm Bakery and Café; located on an access road just off the east of Sheering Road.
		Mutz Kutz; dog grooming service located opposite Mayfield Farm.
		Quintin Associates; located within The Campions residential area on the western side of Sheering Road.
		Gardencare Tree Services; located within Sheering Hall to the north of Pincey Brook.
		IDS consultants; located within Morgans Farm on Moor Hall Road.
		The Green Man; pub and three star hotel located on Mulberry Green.
		Corus Hotel Harlow; three-star hotel located on Elderfield.
		Pages Guest House; bed and breakfast located at Milhurst Mews.
		KT Castings; a baby shop located on Mulberry Green close to the junction with Gilden Way.
		The Queens Head; pub located on Churchgate Street.
		Ye Olde Church Gate Butchery; butchers located on Churchgate Street.
Utilities	Local study area	Thames Water Pumping Station is located on the east of Gilden Way, prior to the entrance to Long Barn Cottage.

There are arable fields within the study area associated with Mayfield Farm (on Sheering Road) and Morgans Farm (on Moor Hall Road).

Effects on agricultural holdings are assessed with respect to the impacts of temporary and permanent land take. Without a more detailed assessment it has been assumed that all the Grade 3 land is Grade 3a. This grade is considered a highly sensitive receptor. Categories of land classification are shown in Figure 9-5 ‘Agricultural Classification Plan’. Agricultural land in the Proposed Scheme study area is comprised of the categories of land classification shown in Figure 9-5. For further details of impacts to agricultural land, please refer to Chapter 9 - Geology and Soils. Without a more detailed assessment it has been assumed that all the grade three land is Grade 3a. This grade is considered a highly sensitive receptor.

Community allotment gardens are located to the north of Gilden Way, providing the community with small plots of land. At the time of writing, the land to the north of Gilden Way is subject to planning permission

HM/PL/00055 but continuing to be used for agriculture. Construction start and completion dates for the Harlowbury development are uncertain at the time of writing.

12.4.2.2 Development land

Current planning applications or recently approved applications (i.e. in the last 12 months) located within 1km of the Proposed Scheme were considered as part of the assessment and are shown in Table 12.11 below.Table 12.1: Planning applications and development land within the study area

Planning application/development land	Location	Description	Status (as of May 2016)	Proximity to the Proposed Scheme
L9/3	Immediately adjacent to the Proposed Scheme at the London Road Roundabout and along the Gilden Way.	Land to the north of Newhall allocated for the provision of sport and recreational facilities.	Reserved matter permission has been granted for 440 homes in Phase I nearing completion. Phase II parcels 1 and 2 secured Reserved Matters approval in 2013 and 12014 respectively amounting to a further 567 homes. Further phases of development are pending.	Directly adjacent to the Proposed Scheme.
H3	Land to the south of the Proposed Scheme, at Newhall.	Land for the further development of the new neighborhood of Newhall.		200m from the Proposed Scheme.
RTCS18, ER2/2, BE21, H2/9, H8/1, L12/3	Land to the south of the Proposed Scheme, at Newhall.	A mixture of housing, recreational and leisure developments for Newhall.		400m from the Proposed Scheme.
HW/PL/15/00388 HW/PL/15/00007 HW/PL/15/00006	Land to the north of Gilden Way, Harlow	Construction of approximately 1,100 dwellings; site for primary school; community buildings; retail/business/live work units; together with associated uses comprising allotments and public open space, plus associated infrastructure and engineering works, with vehicular access from Gilden Way. Application for Approval of Details Reserved by Condition 7 (Survey of Trees, Hedgerows and Other Vegetation), Condition 10 (Biodiversity Strategy), Condition 13 (Refuse Storage), Condition 17 (Car Parking and Cycle Parking), Condition 20 (Estate Roads and Footways), Condition 23 (Landscaping and Implementation Scheme), Condition 25 (Landscape Management Plan), Condition 34 (Noise Protection Scheme), Condition 35 (Sports Pitch	Granted outline planning permission in November 2012. Currently has full planning permission for 911 homes.	Directly to the north of Gilden Way.

Planning application/development land	Location	Description	Status (as of May 2016)	Proximity to the Proposed Scheme
		Details) and Condition 36 (Allotments) of Planning Permission HW/PL/11/00055 and HW/PL/15/00142.		
		Approval of All Reserved Matters for Strategic Infrastructure and Phase 1 (Approximately 716 Dwellings and Associated Community Building, Commercial Units, Open Space and Facilities), In Accordance with Condition 1 of HW/PL/15/00142.		
HW/PL/15/00238	Land To the north Of Gilden Way, Harlow	Application for Approval of Details Reserved by Condition 4 (Detailed Hard and Soft Landscaping Scheme) and Condition 5 (Details of the Existing and Proposed Site Levels) of Planning Permission HW/PL/12/00061 for the Construction of footpath/cycleway in Conjunction With Proposed Development in Respect of Land North of Gilden Way.	Application granted permission on 8th October 2015.	Directly to the north of Gilden Way, the defined study area for the Proposed Scheme.
HW/PL/15/00474	Harlow Campus, London Road, Harlow	Application Under the London Road North LDO to Construct a New Road, Associated Junctions and Highway Works Between the Proposed Junction on the A414 (Located Approximately 486m South of First Avenue Roundabout) and a New Junction on London Road.	Permission granted on 16th December 2015.	Approximately 950m to the south of Gilden Way. Construction under way and due to complete prior to Proposed Scheme completing.

12.4.2.3 Non-Motorised Users

There are no bridleways or Byways Open to All Traffic although there are 11 footpaths adjacent to the Proposed Scheme, all of which are connected to Gilden Way, as shown in Table 12.12 and seen in Figure 12-2.

Table 12.12: Footpaths within the study area

Footpath number	Description
204_26	Runs westwards from Sheering Road adjacent to fields and woodland for approximately 230m before continuing into woodlands and joining Footpath 185_34 from a point approximately 40m north of Ealing Bridge.
204_17	Follows Pincey Brook eastwards from Ealing Bridge on Sheering Road and is bound by agricultural fields and woodland.
204_29	Runs through woodland and pastureland in an easterly direction from Footpath 204_35 to Sheering Road approximately 60m south of Ealing Bridge.
204_30	Runs southwards from Gilden Way across a field and through Mayfield Farm to the New Town boundary. From here it continues as Footpath 198_42 along a farm track to Moor Hall Lane.
204_35	Follows Marsh Lane northwards from the junction with Gilden Way. It links with Footpaths 185_29, 185_15, 185_34 and 204_29.
185_14	Runs from Footpath 185_15 on Marsh Lane just south of the railway line across the fields on which Harlowbury development is to be built and past Footpath 185_29 to join Gilden Way near Churchgate Street. It crosses Gilden Way on the eastern side of the Churchgate Roundabout.
185_22	Runs northwards from Foothpaths 185_20 and 185_21 in a northerly direction to Gilden Way and past Long Barn Cottage, just southeast of its junction with Mulberry Green.
185_20	Runs from the southern side of the Gilden Way, just east of the disused plant nursery, in a southerly then easterly direction to join Foothpath 185_22 west of St Mary's church.
185_136	Runs from Footpath 185_135 in an easterly direction to the north side of Gilden Way opposite Footpath 185_20.
185_26	Runs from the High Street in Old Harlow by the Fire Station in a south-easterly direction to join Footpath 185_111 which crosses Spicer's Field and then 185_135 at the south-eastern corner of the sports ground. From here Footpath 185_135 continues in a south-easterly direction to the north side of Gilden Way opposite Footpath 185_168 and joins Footpath 185_136.
185_168	Runs from the south side of Gilden Way, west of the disused plant nursery, leading generally southwards across Footpath 185_166 and along eastern boundary of Newpond Spring to meet The Chase (the motor access into the Newhall development); this path is being upgraded to a mobility path as part of the committed Newhall development.

Harlow has an extensive network of on-road and off-road cycle routes. These include NCN Route 1 which crosses Gilden Way at the Mulberry Green junction and links Harlow with Chelmsford and a shared footway/cycleway along the south side of First Avenue and the west side of London Road to the south of First Avenue. An off-road cycle route runs along the Gilden Way from the East to the London Road Roundabout.

Essex Highways data (Essex Highways, 2014) show that the 7-day average two way cycle flow of NCN 1 varies between 41 bicycles per day in January and 75 bicycles per day in July with an AADT two-way flow of 58 bicycles. Meanwhile the 5-day (i.e. weekday) two-way average cycle flow varies between 48 bicycles per day in January and 84 bicycles per day in July with an AADT two way cycle flow of 66 bicycles. The all-year use of the route together with the higher weekday average demonstrates that the route is used as part of the transport infrastructure and not just as a leisure facility.

12.4.2.4 Community severance

Key community features are outlined in Table 12.13.

Table 12.13: Key community assets in the study area

Receptor	Location	Description
Community facilities	Local study area	The Gibberd Garden; a Registered Park and Garden that provides public areas housing a sculpture collection, wild garden and an arboretum. The Garden itself falls outside of the study area, but the access point for vehicles and pedestrians is via Marsh Lane, which extends from Gilden Way.
		Harlow Cricket Club; an amateur cricket club located to the north of Gilden Way between London Road and Mulberry Green.
		Old Harlow Fire Station; a small fire station located on High Street, Old Harlow.
		Norman Booth Recreation Centre; recreation centre and gym including council run paddling pool, located to the north of Gilden Way at Elderfield.
		Gilden Way Recreation Ground; playing fields on the south eastern corner of the Churchgate Roundabout.
		Catholic Church of the Assumption and Our Lady of the Assumption RC Church; places of worship located on High Street and Old Road, Harlow.
		Fawbert and Barnard's Primary School; a primary school located on the northern corner of Gilden Way and London Road intersection.
		Mark Hall Specialist Sports College; a specialist sport college located on the southern side of the Gilden Way and London Road intersection.
		Harlowbury Primary School; a primary school located to the north of Gilden Way on Watlington Road.
		Chippingfield Allotments; garden plots available to the community, located to the north of Gilden Way off Chippingfield.
		St Mary and St Hugh Church of England; place of worship located on Churchgate Street.
		Little Fishes Pre-School located on Churchgate Street.

12.4.2.5 Public transport users

Information on bus routes has been cross checked with ECC's interactive Essex Bus and Train map (ECC, 2016). Key local routes are described in Table 12.14.

Table 12.14: Bus routes along the Proposed Scheme

Bus routes	Description
322	Regal Busways Ltd.; bus route from Old Harlow to Saffron Walden along Gilden Way/Sheering Road.
59	Arriva Harlow and First in Essex; bus route from Harlow town centre to Chelmsford town centre along Gilden Way/Sheering Road.
Network Harlow route 7	Network Harlow; bus route from Churchgate Street and Mark Hall to Harlow along Gilden Way.

There is a bus stop on the north side of the Gilden Way/Sheering Road opposite the current entrance to Mayfield Farm. Arriva service provider, SXConnect, runs from Harlow Town Centre (Bus Station) to Chelmsford Town Centre.

There is a bus stop on the south side of the Gilden Way/Sheering Road located opposite the junction with Marsh Lane. SXConnect service Route 59, which runs from Chelmsford Town Centre to Harlow Town Centre (Bus Station).

There are bus stops located on the north and south side of the Gilden Way just northeast of the junction with Mulberry Green. The north-bound SXConnect local service Route 7 linking Harlow, Old Harlow and Churchgate Street village stops here as does SXConnect service Route 59, which runs from Harlow Town Centre (Bus Station) to Chelmsford Town Centre. Regal Busways run the Route 322 school service from Old Harlow to Saffron Walden past this stop daily on weekdays in term time. The south-bound service runs directly opposite to the north-bound.

All of these stops can be seen in Figure 12-2 'Effects on All Travellers'.

12.4.2.6 View from the road and driver stress

The impact on vehicle users is assessed according to the view from the road. The existing views from the road along the Gilden Way are currently predominantly residential, with mature hedgerows and trees along its length and are thus considered to be restricted views for most of the route. Views of open countryside along the stretch of Gilden Way between Mayfield Farm and Churchgate Roundabout (where the Harlowbury housing development is under construction) are replaced by glimpses of houses and business premises towards Harlow town centre. The introduction of signal-controlled pedestrian crossings and street lighting would reflect a change from rural to a more suburban character.

The DMRB defines driver stress as "*the adverse mental and physiological effects experienced by a driver traversing a road network*". The DMRB goes on to state that "*factors influencing the level of stress include road layout and geometry, surface riding characteristics, junction frequency, speed and flow per link. Taken together, these factors could induce in drivers the feelings of discomfort, annoyance, frustration or fear culminating in physical and emotional tension that detracts from the value and safety of a journey*" (DMRB, Volume 11, Part 9, Chapter 3, p 3/1).

Preliminary traffic modelling has been carried out for the Proposed Scheme and adjoining road network. Existing peak traffic flows are shown in Table 12.15.

Table 12.15: Existing traffic flows, (vehicles)

Road/link	Existing traffic AM peak	Existing traffic PM peak
New link road westbound	n/a	n/a
Sheering Road southwest bound, north of Sheering Road Roundabout	756	546
Westbound, Sheering Road Roundabout to Churchgate Roundabout	756	546
Gilden Way westbound Churchgate Roundabout to London Road Roundabout	846	586
Gilden Way eastbound London Road Roundabout to Churchgate Roundabout	596	780
Eastbound Churchgate Roundabout to Sheering Road Roundabout	516	725
Sheering Road north eastbound north of Sheering Road Roundabout	516	725
New link road eastbound	n/a	n/a

During peak hours, traffic is especially heavy at the Churchgate Roundabout westbound and London Road Roundabout eastbound. Traffic is lighter during the remainder of the day.

Based on the data in Table 12.15 it has been concluded that driver stress would be limited to the peak traffic periods and arise as a result of frustration related to slow moving traffic and frequent stop-start movements, as well as fear of accidents due to queuing. The current speed limit on Gilden Way is 60mph, in accordance with the national speed limit for a single carriageway.

12.4.3 Value of receptors

Table 12.16 below sets out the sensitivity the receptors considered. Residential properties are always considered high sensitivity.

Table 12.16: Baseline sensitivity of receptors

Receptor	Sensitivity/importance
Community facilities	
The Gibberd Garden	Medium
Harlow Cricket Club	Low
Old Harlow Fire Station	High
Norman Booth Recreational Centre	Low
Gilden Way Recreation Ground	Low
Catholic Church of the Assumption and Our Lady of the Assumption RC Church	High
Fawbert and Barnard's Primary School	High
Mark Hall Specialist Sports College	High
Harlowbury Primary School	High
Chippingfield Allotments	Low

Receptor	Sensitivity/importance
St Mary and St Hugh Church of England	High
Little Fishes Pre-School	High
Local businesses	
Mayfield Farm Bakery and Café	High
Mutz Kutz	High
Quintin Associates	High
Gardencare Tree Services	High
IDS consultants	High
The Green Man	High
KT Castings	High
The Queens Head	High
Pages Guest House	High
Ye Olde Churchgate Butchery	High
Utilities	
Thames Water Pumping Station	High
Public footpaths	
Footpath 204_17, 204_26, 204_29, 204_35, 204_30, 198_42, 185_10, 185_14, 185_20, 185_22, 185_24, 185_111, 185_26, 185_134, 185_135, 185_136, 185_30, 185_137, 185_162, 185_168	Medium
Cycle routes	
The NCN Route 1 intersects Gilden Way at Mulberry Green	Medium

12.5 Significant Effects

12.5.1 Construction effects

12.5.1.1 Private assets

The land required for the construction of the Proposed Scheme is limited to the agricultural land and farm holdings described, and to a small proportion of a playing field. No additional land take would be required from private properties for construction of the Proposed Scheme as a result of route realignment. One private property and two businesses along Gilden Way westbound would have their driveways and entrances realigned or improved to tie in with the widening of Gilden Way, but no land would be lost. These are the Mayfield Farm, Thames Water Pumping Station and Long Barn Cottage. These alterations would be agreed with the property owners as part of the detailed design phase for the scheme.

It is likely that there would be temporary disruption to access to properties along Gilden Way and Sheering Road including The Campions. Detailed construction methodologies would be provided by the contractor to keep disruption to a minimum wherever possible.

Impacts on agriculture would be most significant due to the total loss of land. This would be lost during the construction phase but continue as a permanent loss during the operation of the Proposed Scheme. Some of

the land taken during the construction phase would be returned to agricultural use. The effects of land loss have therefore been covered in both the construction and operational phases. Land areas are shown in Table 12.17.

Table 12.17: Summary of construction effects on private assets

Receptor	Nature of impacts	Sensitivity of receptor	Magnitude of impact	Significance of effect
Mayfield Farm	Construction works to carry out realignment or improvement of tie in with the Proposed Scheme.	High	Slight	Slight or Moderate Adverse
Thames Water Pumping Station	Construction works to carry out realignment or improvement of tie in with the Proposed Scheme.	High	Slight	Slight or Moderate Adverse
Long Barn Cottage	Construction works to carry out realignment or improvement of tie in with the Proposed Scheme.	High	Slight	Slight or Moderate Adverse
Plot ID: EX738339	Loss of 0.05ha of Grade 3a Best and Most Versatile (BMV) agricultural land in the north west corner of the field to allow for the proposed new link road to be constructed.	High	Slight	Slight or Moderate Adverse
Plot ID: EX738343	Loss of 7.91ha of Grade 3a BMV agricultural land on the northern and western boundary of the field would be required during the construction period to allow for the proposed new link road and Sheering Road Roundabout to be constructed.	High	Moderate	Moderate or Large Adverse
Plot ID: EX764676	Loss of 9.09ha of Grade 2 agricultural land and 0.29ha of Grade 3 agricultural land on the northern and eastern boundary of the field would be required during the construction period to allow for the proposed new junction and slip roads to be constructed.	High	Moderate	Moderate or Large Adverse
Plot ID: EX847418	Loss of 5.18ha of Grade 2 agricultural land would be required during the construction period to allow for the proposed new junction and slip roads to be constructed.	High	Moderate	Moderate or Large Adverse
Plot ID: EX847419	Loss of 8.14ha of Grade 2 agricultural land and 7.38ha of Grade 3 agricultural land on the southern and western boundary of the field would be required during the construction period to allow for the proposed new link road and roundabout to be constructed.	High	Moderate	Moderate or Large Adverse

Temporary land take would occur for construction access and usage. Three site compounds have been proposed as possible locations, with Phase 1 of the construction sited at the Old Plant Nursery site on the south side of Gilden Way. This entire site would be used for the duration of Phase 1. Phase 2A possible site compound would be based south of Sheering Road Roundabout and to the northwest of The Mores Wood, while the Phase 2B compound would be based south of the new Pincey Brook Roundabout within the envelope of the Westbound Link and the Eastbound Link embankments. In addition, an area for general storage would be located east of the M11. Both Phases 2A and 2B sites would require use of agricultural land. The Phase 2A site would be reinstated and returned following completion of the Proposed Scheme. An area of agricultural land to the south of the Westbound Link and bounded by The Mores Wood to the west would be at risk of annexation due to a lack of access to the area. The Phase 2B site sits within the boundary of the land-take required for the Proposed Scheme and is covered by the assessment presented in Table 12.17.

Other impacts on private assets would include noise and dust disruption (including to crops). These topics are covered in Chapter 5 - Air Quality and Chapter 11 – Noise and Vibration.

12.5.1.2 Development land

An assessment of how the Proposed Scheme would affect development land is set out in Table 12.18. In all cases the effects would be adverse as a result of restrictions in access and amenity during the construction of the scheme.

Table 12.18: Summary of construction effects on planning applications and development land

Receptor (application ID)	Impact on development viability	Significance of effect
Planning applications		
HW/PL/15/00388 HW/PL/15/00007 HW/PL/15/00238 HW/PL/15/00006	Reduced access for residents as a consequence of traffic management associated with the Scheme.	Adverse
HW/PL/15/00474	Reduced access for residents as a consequence of traffic management associated with the Scheme.	Adverse
Development plans		
L9/3 H3 RTCS18, ER2/2, BE21, H2/9, H8/1, L12/3	Reduced access for residents as a consequence of traffic management associated with the Scheme.	Adverse

12.5.1.3 Non-Motorised Users

Table 12.19 sets out potential impacts arising from construction of the Proposed Scheme and takes into account embedded mitigation measures.

Table 12.19: Non-Motorised Users construction impacts

Receptor	Description	Sensitivity/ importance	Magnitude of change	Significance of effect
Footpaths	Pedestrians could experience a loss of enjoyment of their journeys due to construction activities and construction compounds. This would be likely to impact the following routes: • The pedestrian footpath along Gilden Way will be out of use during Phase A but potentially for up to 2 years; • Footpaths 185_135, 185_136, 185_26, 185_168, 185_20, 185_106, 185_22, 185_14 and 204_35 where there is an intersect with Gilden Way; • Footpath 204_30 at Mayfield Farm where there are ties with the realigned Sheering Road; and • Footpaths 204_17, 204_26 and 204_29 where there are tie-ins with Sheering Road to the north of the new Sheering Road Roundabout.	Medium	Major Adverse	Moderate or Large Adverse
Cyclists	Cyclists could experience a loss of enjoyment of their journeys due to construction activities and construction compounds.	Medium	Minor Adverse	Slight or Moderate Adverse

12.5.1.4 Community severance

The use of construction compound sites and soil storage areas would require land and movement of material to and from these sites. This would result in the temporary loss (up to 2 years) of the majority of land from the disused plant nursery on the Gilden Way.

As a result of construction works, access to some community facilities would be disrupted temporarily, with diversions and traffic management likely to be put in place. Some disruption to the Chippingfield allotments from dust and noise would be anticipated during construction. This would result from the use of PRoW on Gilden Way to construct the new pavement. However, as the Proposed Scheme would be constructed in phases over a 2-year period, and the required use would be short-term, disruption would be temporary with an overall Minor Adverse effect.

Further information on impacts arising from dust and noise is provided in Chapter 5 - Air Quality and Chapter 11 - Noise and Vibration.

There would be some disruption to access to facilities off Mulberry Green and Sheering Road from Churchgate Roundabout and Gilden Way during construction.

12.5.1.5 Public transport users

Potential impacts upon individuals' access to bus stops during the construction phase are described in Table 12.20. The potential impact on bus stops from the construction phase could include disruption of access, longer routes due to temporary bus stops, and lack of visibility of bus stops due to construction works.

Table 12.20: Assessment of construction impacts to bus travellers

Current bus stops	Description of impacts	Significance of effect
Bus stop on the north side of Gilden Way/Sheering Road opposite the current entrance to Mayfield Farm. SXconnect service Route 59.	Disruption in access for The Campions residents as a result of proposed road widening works, new link road and Sheering Road Roundabout. A bus stop would be retained in the same general vicinity with new bus shelters, laybys and Real Time Passenger Information provided.	Slight Adverse
Bus stop on the south side of the Gilden Way/Sheering Road located opposite the junction with Marsh Lane. SXconnect service Route 59.	Disruption in access for residents living in the housing estate off Sheering Road as a result of the proposed widening works, new access road to Mayfield Farm, the new link road and Sheering Road Roundabout. A bus stop would be retained in the same general vicinity with new bus shelters, laybys and Real Time Passenger Information provided.	Slight Adverse
Bus stop on the north side of Gilden Way just northeast of the junction with Mulberry Green. SXconnect local service Route 7. SXconnect service Route 59. Regal Busways run the Route 322 school service from Old Harlow to Saffron Walden.	Disruption in access as a result of the widening works. Bus stop would not be relocated.	Slight Adverse
Bus stop on the south side of Gilden Way just northeast of the junction with Mulberry Green. SXconnect local service Route 7. SXconnect service Route 59. Regal Busways run the Route 322 school service from Saffron Walden to Old Harlow.	Disruption in access as a result of the widening works. Bus stop would not be relocated.	Slight Adverse

12.5.1.6 Views from the road and driver stress

Table 12.21 below provides an assessment of how vehicle traveller's views from the road would be affected as a result of the Proposed Scheme. Chapter 7 - Landscape and Visual also addresses potential impacts on traveller's views.

Table 12.21: Assessment of views from the road and driver stress resulting from consultation

Receptor	Description of receptor	Significance of effect
Mayfield Farm to Churchgate Roundabout (Views)	Widening of Gilden Way and construction of the Sheering Road Roundabout (and associated tie-in works) would be temporarily visible to motorists using Gilden Way/Sheering Road with construction plant, personnel and compounds likely to be located in close proximity to the road. The Harlowbury development on the area of land opposite Gilden Way recreation ground would have commenced; therefore, vehicle users would be exposed to increased construction traffic due to this development. Best practice mitigation measures during construction would not significantly reduce the magnitude of impact which would remain adverse in the short term.	Adverse
Churchgate Roundabout to London Road Roundabout (Views)	Best practice mitigation measures during construction would not significantly reduce the magnitude of impact which would remain adverse in the short term.	Adverse
M11 north and south (Views)	Drivers on the M11 would be exposed to additional highway infrastructure in the form of the Dumbell Roundabouts and the Dumbell Link. Best practice mitigation measures during construction would not significantly reduce the magnitude of impact which would remain adverse in the short term.	Adverse
Entire scheme (Driver stress)	It is anticipated that construction of the Proposed Scheme would take 40 months, commencing in 2019, with advance work occurring in 2018, and completing in 2022. Apart from the Gilden Way widening, much of the Proposed Scheme would be off-line and a majority of work could be undertaken without the need for significant additional traffic management. Re-surfacing and other activities impacting the existing carriageways would be undertaken at night, requiring some additional traffic management. At these times, driver stress could increase for a relatively small proportion of drivers. However, this would be temporary and for relatively short periods of time. During construction of the Proposed Scheme there would likely to be periods of delay and congestion due to the reduced road capacity caused by traffic management and the need to occupy lanes for construction purposes especially during weekends. The details of the traffic management proposals are not currently known.	Adverse

12.5.2 Operational effects

12.5.2.1 Private assets

Potential operational impacts on private assets are shown below in Table 12.22. In addition to the impacts shown in the table, part of the playing fields at the Churchgate Roundabout would be replaced by an attenuation pond. While this does reduce the overall size of the playing field it should not encroach onto the sports pitches or reduce their size. This has therefore been assessed as a Slight Adverse effect.

Table 12.22: Summary of operational effects on private assets

Receptor	Nature of impacts	Sensitivity of receptor	Magnitude of impact	Significance of effect
Agricultural land				
Plot ID: EX738339	Permanent loss of 0.05ha of Grade 3a Best and Most Versatile (BMV) agricultural land in the north west corner of the field for scheme footprint and landscape mitigation.	High	Slight	Slight or Moderate Adverse
Plot ID: EX738343	Permanent loss of 5.44ha of Grade 3a BMV agricultural land on the northern and western boundary of the field for scheme footprint and landscape mitigation.	High	Moderate	Moderate or Large Adverse
Plot ID: EX764676	Permanent loss of 7.18ha of Grade 2 agricultural land and 0.20ha of Grade 3a agricultural land on the northern and eastern boundary of the field for scheme footprint and landscape mitigation.	High	Moderate	Moderate or Large Adverse
Plot ID: EX847418	Permanent loss of 3.53ha of Grade 2 agricultural land	High	Moderate	Moderate Adverse
Plot ID: EX847419	Permanent loss of 7.06ha of Grade 2 agricultural land and 4.21ha of Grade 3a agricultural land on the southern and western boundary of the field for scheme footprint and landscape mitigation.	High	Moderate	Large Adverse
Local businesses				
Mayfield Farm Bakery and Café	The new link road off Sheering Road would cut across part of the current access road to Mayfield Farm making it dangerous to access with no layby. A new access road off Sheering Road onto Mayfield Farm would be constructed at a more suitable location resulting in improved and safer access for customers. The farm would lose 48.5ha of land.	High	Minor Adverse	Moderate Adverse
Mutz Kutz	New access point off Sheering Road and improvement to Gilden Way.	High	Minor Beneficial	Slight or Moderate

Receptor	Nature of impacts	Sensitivity of receptor	Magnitude of impact	Significance of effect
				Beneficial
Quintin Associates	Proposed improvements to Sheering Road and new link road would reduce traffic and travel times.	High	Negligible	Slight Beneficial
Gardencare Tree Services				
IDS consultants				
Corus Hotel Harlow	Changes to Mulberry Green junction would alter access to the area but not cause positive or negative changes.	Low	Negligible	Neutral
The Green Man Hotel and pub	Changes to Mulberry Green junction off Gilden Way would improve access to the businesses and reduce travel times.	High	Negligible	Slight Beneficial
KT Castings				
The Queens Head Public House	Improvements to Gilden Way and off Churchgate Roundabout onto Gilden Way will improve access and reduce travel times.	High	Negligible	Slight Beneficial
Pages Guest House				
Ye Olde Church Gate Butchery				
Utilities				
Thames Water Pumping Station	New access entry off Gilden Way	High	Negligible	Slight Beneficial

12.5.2.2

12.5.2.3 Development land

An assessment of how the Proposed Scheme would affect development land is set out in Table 12.23. In all cases the effects would be beneficial as a consequence of improvements to access during the operation of the scheme.

Table 12.23: Summary of operational effects on planning applications and development land

Receptor (application ID)	Impact on development viability	Significance of effect
Planning applications		
HW/PL/15/00388 HW/PL/15/00007 HW/PL/15/00238 HW/PL/15/00006	Improved access for residents as a consequence of proposed improvement to Gilden Way, the new link road and the M11 junction.	Beneficial
HW/PL/15/00474	Improved access for residents as a consequence of proposed improvement to Gilden Way, the new link road and the M11 junction.	Beneficial

Receptor (application ID)	Impact on development viability	Significance of effect
Development plans		
L9/3 H3 RTCS18, ER2/2, BE21, H2/9, H8/1, L12/3	Improved access and reduced journey times as a consequence of the proposed Gilden Way improvement Scheme.	Beneficial

12.5.2.4 Non-Motorised Users

Table 12.24 sets out the impacts and effects arising from operation of the Proposed Scheme and takes into account the embedded mitigation measures.

Table 12.24: Non-Motorised Users operational impacts

Receptor	Description	Sensitivity/ importance	Magnitude of change	Significance of effect
Footpaths	Access to all footpaths except Footpath 204_30 would be maintained. Discussions with the Essex PRoW officer are ongoing to divert Footpath 204_30 along the access of Mayfield Farm, terminating where the access meets Sheering Road. Controlled pedestrian crossings are proposed at: • London Road Roundabout (a Toucan crossing is proposed at this location); • between Public Footpaths 185_135 and 185_168; • Mulberry Green footpath 185_22; • near Marsh Lane/Mayfield Farm (a Toucan crossing is proposed at this location); and • an uncontrolled crossing at Sheering Road Roundabout. A 2.5m wide combined use footway/cycleway would be provided along the northern side of Gilden Way except for the length alongside Harlowbury Phase 1 where a suitable facility would be provided by the developer along the southern boundary of that development improving the existing connectivity.	Medium	Moderate beneficial	Slight or Moderate Beneficial
Cyclists	A 2.5m wide combined use footway/cycleway would be provided along the northern side of Gilden Way except for the length alongside Harlowbury Phase 1 where a suitable facility is already being provided by the developer along the southern boundary of that development improving existing connectivity.	Medium	Moderate Beneficial	Slight or Moderate Beneficial

12.5.2.5 Community severance

The Proposed Scheme would maintain and enhance connectivity and access to all the existing footpaths and the NCR which cross Gilden Way, except for Footpath 204_30.

A 2.5m wide combined use footway/cycleway would be provided along the northern side of Gilden Way except for the section alongside Harlowbury Phase 1 where a suitable facility is already being provided by the developer along the southern boundary of that development.

There would be improved access to and from the Mayfield Farm Bakery and Café as a result of a new safer vehicle access point being constructed due to the widening of Gilden Way and the new link road running through part of the farmer's land.

New Toucan crossings would:

- improve pedestrian access to Mayfield Farm and Marsh Lane and associated community facilities;
- provide safer access between Footpaths 185_135 and 185_168 and at Mulberry Green for Footpath 185_22;
- provide safe access along the London Road across Gilden Way to facilities such as schools; and
- improve connectivity of the community between Old Harlow and the Churchgate Street area

The potential operational impacts on community facilities are shown below in Table 12.25

Table 12.25: Summary of operational effects on community facilities

Receptor	Nature of impacts	Sensitivity of receptor	Magnitude of impact	Significance of effect
The Gibberd Garden	The garden itself falls outside the study area, but the access point for vehicles and pedestrians is via Marsh Lane, which extends from Gilden Way. Access from Gilden Way would be improved.	Medium	Minor Beneficial	Slight Beneficial
Harlow Cricket Club	Improvement to Mulberry Green junction would improve access to the cricket club.	Low	Minor Beneficial	Neutral or Slight Beneficial
Old Harlow Fire Station	Improvement to Mulberry Green junction would improve access to the station.	High	Minor Beneficial	Slight or Moderate Beneficial
Norman Booth Recreational Centre	Improvement to Mulberry Green junction would improve access to the area.	Low	Minor Beneficial	Neutral or Slight Beneficial
Catholic Church of the Assumption and Our Lady of the Assumption RC Church	Improvement to Mulberry Green junction would improve access to the churches.	High	Minor Beneficial	Slight or Moderate Beneficial
Fawbert and Barnard's Primary School	Improvement to Gilden Way would reduce queuing at the London Road Roundabout.	High	Minor Beneficial	Slight or Moderate Beneficial

Receptor	Nature of impacts	Sensitivity of receptor	Magnitude of impact	Significance of effect
Mark Hall Specialist Sports College	Whilst there is an increase in traffic, the provision of additional crossing facilities would allow for safer crossing.			
Harlowbury Primary School	Improvement to Mulberry Green junction and to Gilden Way would improve access to the school and allotments and reduce journey times.	High	Minor Beneficial	Slight or Moderate Beneficial
Chippingfield allotments		Low	Negligible	Neutral or Slight Beneficial
St Mary and St Hugh Church of England	Improvement to Gilden Way and Churchgate Roundabout would improve access and reduce journey times.	High	Minor Beneficial	Slight or Moderate Beneficial
Little Fishes Pre-School		High	Minor Beneficial	Slight or Moderate Beneficial

12.5.2.6 Public transport users

Potential operational impacts upon individuals' access to bus stops are described in Table 12.26. Operational impacts could include relocation of bus stops, as a result of carriageway widening. However, overall access would be preserved or improved due to the additional crossing points. There is a risk that the location of noise barriers near to bus stops may contribute to perceived severance in public transport users, through obstructing pathways and sightlines and potentially through discouraging use due to perceived safety concerns. Narrow gaps in the barriers for access through to the road may cause people to feel insecure about who could be hiding behind. Noise barrier locations and types have not been finalised at the time of writing so this would need to be addressed at detail design stage.

Table 12.26: Assessment of operational impacts to bus passengers

Current bus stops	Description of impacts	Significance of effect
Bus stop on the north side of Gilden Way/Sheering Road opposite the current entrance to Mayfield Farm. SXconnect service Route 59.	The effect on bus passengers during operation would be neutral. A bus stop would be retained in the same general vicinity with new bus shelters, laybys and Real Time Passenger Information provided.	Neutral
Bus stop on the south side of Gilden Way/Sheering Road located opposite the junction with Marsh Lane. SXconnect service Route 59.	The effect on bus passengers during operation would be neutral. Bus stop would be retained in the same general vicinity with new bus shelters, laybys and Real Time Passenger Information provided.	Neutral
Bus stop on the north side of Gilden Way just northeast of the junction with Mulberry Green. SXconnect local service Route 7. SXconnect service Route 59. Regal Busways run the Route 322 school service from Old Harlow to Saffron Walden.	The effect on bus passengers during operation would be neutral.	Neutral
Bus stop on the south side Gilden Way just northeast of the junction with Mulberry Green. SXconnect local service Route 7. SXconnect service Route 59. Regal Busways run the Route 322 school service from Saffron Walden to Old Harlow.	The effect on bus passengers during operation would be neutral.	Neutral

12.5.2.7 Views from the road and driver stress

Table 12.27 provides an assessment of how vehicle traveller's views from the road would be affected by the Proposed Scheme. Chapter 7 - Landscape and Visual also addresses the impacts on traveller's views particularly where noise fencing has been specified along the Gilden Way (see Figure 7.3 Sheets 1-7). In some locations, barriers would be intrusive and vulnerable to vandalism. This would need to be addressed at detail design phase.

Table 12.27: Assessment of views from the road and driver stress resulting from operation

Receptor	Description	Residual significance of effect
Mayfield Farm to Churchgate Roundabout (Views)	Views of the Sheering Road Roundabout and associated tie-ins with the existing Sheering Road would be visible to drivers on a 750m stretch of road between Mayfield Farm and Sheering Lower Road. Landscaping of verges, roundabouts and roadsides with native species and trees would have become established, softening views of the infrastructure and integrating the road into the landscape. Overall views form the road would return to being restricted, with a neutral long term effect.	Neutral
Churchgate Roundabout to London Road Roundabout (Views)	Landscaping of verges, roundabouts and roadsides with native species and trees would have become established, softening views of the infrastructure and integrating the road into the landscape. Overall views form the road would return to being restricted, with a neutral long term effect.	Neutral
M11 north and south (Views)	Drivers would be exposed to a similar level of highway infrastructure along the route and it has been assessed that there would not be an additional adverse effect. The resulting magnitude of impact has been assessed as neutral.	Neutral
Entire scheme (Driver stress)	During operation there would be likely to be a beneficial effect upon driver stress, particularly for those drivers who need to use the London Road and Churchgate Roundabouts and access the M11 during peak times. This is because there would be reduced congestion on this part of the network. As the Proposed Scheme would be built to adhere to modern highway standards, the likelihood of fear of accidents and uncertainty of layout would be reduced. The proposed new speed limit would also be reduced from 60mph to 40mph resulting in less stress of the unknown, although some driver frustration would remain.	Beneficial

12.6 Proposed Mitigation

12.6.1 Construction mitigation

The journeys made by NMUs would be maintained during construction through appropriate management, such as temporary diversions or alternative routes.

During the construction phases, a traffic management plan and site traffic management plan would be implemented to reduce any temporary increase in stress caused by roadworks and associated construction traffic. Temporary closure of one lane would be required to allow for safe working areas for construction. This would include temporary signage and traffic signals put in place to reduce uncertainty, fear and frustration. The use of adequate signage would help to direct traffic to businesses and community facilities to avoid any loss of passing trade.

During construction there could be some disruption to bus routes; however, this would be temporary and the services retained during and after construction. Real Time Passenger Information would also help alleviate any disruption.

Throughout the construction of the Proposed Scheme, nuisance due to noise, dust and movement of construction vehicles would be mitigated as best as possible through considerate construction management, including the use of screening and low noise equipment, and temporary traffic management. These issues are covered in more detail in Chapter 5 – Air Quality and Chapter 11 – Noise and Vibration. Appropriate routing of construction haulage would be applied where necessary to maintain access to communities.

The permanent loss of 21.70ha of BMV agricultural land during construction of the proposed Sheering Road Roundabout, new link road and junction cannot be mitigated in this Proposed Scheme. However, surplus topsoil from all areas would be sustainably managed and re-used during construction. This would be in line with the requirements of the SMP to be outlined in the contractor's CEMP and/or SWMP. A more detailed assessment to determine the soil grade (Grade 3a (good quality) or 3b (moderate quality)) would show whether mitigation would be required. The overall significance of impact could be reduced.

12.6.2 Operational mitigation

All new facilities for NMUs would be designed to be accessible for all pedestrians including those with impaired mobility, and those with pushchairs and wheelchairs. An NMU context report has been produced by Jacobs, detailing suggestions for the design team in regards to NMU provision. Throughout the Proposed Scheme design, consideration has been given to the NMU objectives through collaboration between the EIA team and the highway designers, and mitigation has been incorporated as part of the design process. Currently the footpath/cycle way diverts around the back of an area of woodland in the vicinity of the allotment gardens. Due to the perceived safety issues associated with a footpath running between high noise barrier and a wooded area, the footpath/cycleway would be diverted to run directly alongside the Gilden Way. This would also benefit cyclists with a more direct alignment.

To meet the recommended NMU objectives for the Proposed Scheme, the mitigation measures shown in Table 12.28 have been included in the Proposed Scheme.

Table 12.28: Operational mitigation

Objective	Proposed mitigation
Provide a NMU route that follows the route of Gilden Way/Sheering Road between the London Road Roundabout and Footpath 204_17.	A 2.5m wide combined use footway/cycleway would be provided along the northern side of Gilden Way except for the section alongside Harlowbury Phase 1 where a suitable facility is already being provided by the developer along the southern boundary of that development.
Maintain access to all Public Footpaths currently connecting to Sheering Road and Gilden Way, including, if required, a suitable diversion to Footpath 204_30 between Mayfield Farm and Sheering Road.	Access to all footpaths except Footpath 204_30 is being maintained. Discussions with the Essex PRoW officer are ongoing to divert Footpath 204_30 along the access of Mayfield Farm, terminating where the access meets Sheering Road.
Assist pedestrians crossing on Gilden Way at key locations such as near Marsh Lane, at Mulberry Green, near London Road and between Public Footpaths 185_135 and 185_168.	Controlled Toucan pedestrian crossings are proposed at: • London Road roundabout; • between public footpaths 185_126 and 185_168; • Mulberry Green; and Near Marsh Lane/Mayfield Farm.

The upgraded Gilden Way three lane carriageway would also be designed to a higher highway standard than the existing road, helping to reduce uncertainty, fear and driver stress. In addition, it is proposed to reduce the speed limit from 60mph to 40mph, further reducing the risk of accidents.

Access to the area of agricultural land to the south of the Westbound Link and bounded by The Mores Wood to the west would be maintained with an informal access through the southern hedgerow where there is an existing break in the tree line.

A landscape design has been developed incorporating a range of measures and would integrate the Proposed Scheme into the surrounding landscape by maintaining and improving the existing vegetation. Further details on landscape design and mitigation, and views are provided in Chapter 7 – Landscape and Visual.

During operation, the issue of noise nuisance would be mitigated as much as possible by the design of earth embankments and acoustic fences. These measures are described in more detail in Chapter 11 - Noise and Vibration.

12.7 Residual Effects

12.7.1 Construction

12.7.1.1 Private assets

Private properties would be affected in a variety of ways. There would be an Adverse residual effect upon two businesses, Mayfield Farm (Sheering Road) and Morgans Farm (Moor Hall Road), in terms of a loss of 42.84ha of agricultural land during the construction period.

12.7.1.2 Development land

Following the implementation of both embedded and proposed mitigation measures, including the traffic plan, the residual effect has been assessed as Negligible.

12.7.1.3 Non-Motorised Users

During construction, mitigation would be in place to limit the inconvenience to pedestrians, cyclists and equestrians. However, the scale of construction works would have some effects on routes used by NMUs. Potential impacts would be overall short-term and Minor, and would include exposure to noise, dust and visual impacts of construction activities and temporary diversions and route closures. No locations have been identified where this is a major issue.

Where PRoWs are within the scheme footprint, diversions would be put in place throughout the construction phase, and there would be associated attractiveness issues expected for short periods due to the proposed phasing of the works.

12.7.1.4 Community severance

There would be temporary disruption to access to community facilities from some properties, but the effect has been assessed as Negligible.

12.7.1.5 Public transport users

Whilst widening works on Gilden Way would have the potential to temporarily impact bus routes that use this road, all bus routes would be maintained during construction with traffic management implemented and therefore, the residual effect has been assessed as Negligible.

12.7.1.6 View from the road and driver stress

Driver stress due to construction activities, periods of delay and congestion due to the reduced road capacity caused by the need to occupy lanes for construction would be mitigated through the construction programme, phasing, and the traffic management plan and site traffic management plan. These would reduce any temporary increase in stress caused by the roadworks and associated construction traffic. This would include temporary signage and traffic signals which would be put in place to reduce uncertainty, fear and frustration.

12.7.2 Operation

12.7.2.1 Private assets

As a result of design change and route realignment, the effects to private properties within the study area would be largely confined to loss of agricultural land with no residential land take required. Where there would be agricultural land take this would be subject to compensation. This would be the case with Mayfield Farm and the owners of other agricultural land required for construction of the proposed new link road and associated roundabouts and the new junction. Overall the effect on agricultural land has been assessed to be Large to Very Large Adverse with 32.47ha of land required for the Proposed Scheme footprint or associated landscape mitigation.

12.7.2.2 Development land

The Proposed Scheme would have a beneficial effect on development land, with the new road alignment improving access to key communities and to proposed future developments such as the Harlowbury development. Whilst beneficial, this has not been assessed to be a significant impact.

12.7.2.3 Non-motorised users

During the operation of the Proposed Scheme, approximately 2km of new NMU provision would be provided along the northern section of Gilden Way. New diversions, footways, cycle paths would be provided to maintain connectivity throughout the local study area. The new NMU provision would tie in with the existing cycle and footpath network, creating a continuous link.

The Proposed Scheme would be clearly visible from certain PRoWs and the NCN route. Landscaping and vegetation planting would be included to reduce the effects. As there is an existing single carriageway road established, the Proposed Scheme would result in a Minor Adverse effect on the attractiveness of certain footpaths along Gilden Way. This would increase to Moderate Adverse with the new link road, M11 Junction 7A and associated infrastructure becoming clearly visible from footpaths 204_26, 204_29, 204_17, 204_35 and 204_30.

Access to all footpaths would be retained during the operational period. Additional controlled pedestrian crossings would be provided at a number of locations. A 2.5m wide combined use footway/cycleway would be provided along the northern side of Gilden Way.

Overall the effect is considered to be Negligible.

12.7.2.4 Community severance

Community facilities would be affected in a variety of ways. Access to facilities would be either maintained or improved as a result of the M11 Junction 7A. Therefore, overall potential impacts to community facilities on a wider level throughout the study area have been assessed as beneficial, but not significant.

12.7.2.5 Public transport users

Following the completion of the Proposed Scheme the residual effect on public transport users is considered to be Negligible.

12.7.2.6 View from the road and driver stress

Alterations in views are covered in detail in Chapter 7 - Landscape and Visual.

The key objectives of the Proposed Scheme are focused around improved accessibility to and from Harlow, reduced congestion, and ensuring the proposed infrastructure has the appropriate scale for future traffic demands. These objectives are anticipated to contribute to an overall reduction to driver stress on the surrounding road network. The provision of high quality highway infrastructure and widening of Gilden Way would be likely to provide consistent traffic conditions and a reduced fear of accidents, contributing to a beneficial impact for drivers. However this has not been assessed to be significant.

12.8 Summary and Conclusions

The proposed impacts, mitigation and residual effects for the effect on People and Communities are summarised in Table 12.29

Table 12.29: Summary of residual significant effects on people and communities

Description of effect	Significance of effect (prior to mitigation)	Proposed mitigation	Residual effect (after mitigation)
Best and Most Versatile (BMV) Grades 2 and 3a agricultural land would be lost to both Mayfield Farm and the owners of other agricultural land required for construction of the proposed new link road and associated roundabout and the new junction.	Large or Very Large Adverse	None	Large or Very Large Adverse

13. Road Drainage and the Water Environment

13.1 Introduction

The Road Drainage and Water Environment topic covers potential effects of the construction and operation of the Proposed Scheme on flood risk, geomorphology, surface water quality and groundwater receptors. The potential effects on each of the receptors is identified and detailed in this chapter. Mitigation is then listed before describing any residual effects.

Additional information to support this chapter is presented in the following appendices:

- Appendix 13.1: Water Framework Directive Compliance Assessment Report; and
- Appendix 13.2: Flood Risk Assessment.

13.1.1 Legislative and planning context

13.1.1.1 European Union and UK legislation

Department of the Environment, Food and Rural Affairs is responsible for all aspects of water policy in England. Management and enforcement of this water policy is the responsibility of the EA. Some of the key current UK legislation relating to the water environment is given below:

- The Flood Risk (England and Wales) Regulations 2009;
- The Flood and Water Management Act 2010;
- The Sustainable Drainage (Procedure) (England) Regulations 2012;
- The Sustainable Drainage (Approval and Adoption) (England) Order 2012;
- The Sustainable Drainage (Enforcement) (England) Order 2012;
- The Sustainable Drainage (Appeals) (England) Regulations 2012;
- The Water Resources Act 1991;
- The Environment Act 1995;
- The Groundwater (England and Wales) Regulations 2009;
- The Control of Pollution (Applications, Appeals and Registers) Regulations 1996 (SI1996/2971);
- The *EPA 1990*;
- The Land Drainage Act 1991 and 1994;
- The Water Act 2003; and
- The Control of Pollution (Consents for Discharge) (Secretary of State Functions) Regulations 1989.

The Water Framework Directive (WFD) established a framework for management of water resources throughout the EU; the WFD was adopted in England and Wales in 2000. It is a significant piece of legislation with an overarching objective of enabling all water bodies in Europe to attain ‘Good’ or ‘High’ ecological status or ‘Potential’ by 2015. The WFD is implemented in England and Wales by The Water Environment WFD (England and Wales) Regulations 2003 (SI 3242/2003). The EA is the competent authority in England responsible for delivering objectives of the WFD. The WFD foresees in its Articles 16 and 17 two Daughter Directives, on quality of groundwater and on quality of surface waters:

- The Groundwater Daughter Directive 2006/118/EC: adopted in 2006 and updated an existing Groundwater Directive (8068/EEC); and
- The Priority Substances Directive 2008/105/EC.

The Community legislation is also rationalised under the WFD by replacing other "first wave" Directives, including those concerned with freshwater fish and shellfish. The operative provisions of the Directives are taken over in the WFD, allowing them to be repealed (as from December 2013).

13.1.1.2 National policy drivers

The NPPF and accompanying NPPG came into existence in March 2012 and superseded the former topic based PPGs and Planning Policy Statements. The following NPPF paragraphs are relevant to this topic:

- Chapter 10 'Meeting the Challenge of Climate Change, Flooding and Coastal Change' (Paragraphs 94 and 99 to 104); and
- Chapter 11 'Conserving and Enhancing the Natural Environment' (Paragraph 109).

In England, the requirements of the NPPF are set out in the accompanying practice guidance providing additional information on development in flood risk areas. The NPPF sets strict tests to protect people and property from flooding.

Under this strategy, areas of land throughout England are designated according to the potential flood risks from rivers or the sea whilst ignoring any existing flood defences. Any highways and transportation schemes deemed to be 'Essential Infrastructure' (such as the M11 Junction 7A scheme) should pass an 'Exception Test' requiring a development to:

- provide wider sustainability benefits to the community that outweigh flood risk; and
- be safe for its lifetime, taking into account the vulnerability of its users without increasing flood risk elsewhere. Where possible, flood risk should be reduced elsewhere.

The government launched a consultation in December 2014 on its Draft National Networks National Policy Statement. This provides a clear articulation of the overall policy against which the Secretary of State for Transport will make decisions on applications for nationally significant infrastructure projects. This project complies with the requirements set out in the (draft) policy statement.

13.1.2 Study area

The study area for the Road Drainage and Water Environment topic is defined as a 1km buffer from the Proposed Scheme (Figure 13-1, Figure 13-2 and Figure 13-3). However, for the flood risk aspect of the assessment the study area is instead defined by the redline boundary of the scheme and the model extents provided from the modelling of the flood zones.

13.2 Assumptions and Limitations

The assessment provided within this chapter is based on information available to date. For the Harlowbury Brook, low flow information was not readily available and as a result a conservative approach to water quality mitigation provision has been adapted to date. The assessment has been drawn from informed professional judgement. Initial early consultation was undertaken with the regulators and stakeholders; further advice and agreement for the Proposed Scheme are currently being sought as part of the ES process.

Groundwater level data are limited to at least two rounds of monitoring from 22 boreholes in the eastern portion of the Proposed Scheme. There is limited recent investigation information on the ground and groundwater conditions around the Gilden Way section of the Proposed Scheme.

Archive information regarding the existing drainage systems has been obtained from a number of sources and in certain instances, augmented by site surveys. Due to limitations in the coverage of the available archive and survey data, assumptions have been made in respect of residual uncertainties.

Information on private water supplies has been based on records held by the Local Authorities. The potential for further, unrecorded, private abstractions cannot be ruled out.

In the absence of a detailed understanding of the location of existing services and utilities, assumptions have been made regarding the practicalities of co-ordinating all new and existing infrastructure within the land areas available to the Proposed Scheme.

13.3 Methodology and Assessment Criteria

13.3.1 Methodology

An initial assessment of the watercourses has been undertaken along the footprint of the Proposed Scheme comprising:

- A desk study providing information on the catchment area and adjacent land use including historical channel change.
- A walkover assessment (including a geomorphological reconnaissance survey) undertaken in February 2014 and March 2016 to visually inspect surface water features and the site setting. This enabled an understanding of the local topography and hydrological regime and allowed field observations to be completed for the water quality, hydromorphology and Flood Risk Assessments (FRA).
- Gathering of information on water quality elements, including data that subsequently would be used to run the HAWRAT. The Method A (effects of routine runoff on surface waters) assessment was undertaken using the HAWRAT, which adopts a tiered approach as follows:
    - Step 1: Runoff quality - The tool predicts concentrations of pollutants in untreated and undiluted highway runoff prior to any treatment and dilution in a water body;
    - Step 2: In-river effects - The tool predicts concentrations of pollutants after mixing within the receiving water body; and
    - Step 3: In-river effects with mitigation - In Step 3, the tool includes mitigation in the form of Sustainable Urban Drainage Systems (SuDS), taking into account risk reduction associated with any existing measures or any proposed new measures.
- To complete the water quality assessment process, the long-term risks to the ecology of the receiving watercourses (using annual average concentrations) have also been appraised. The HAWRAT method estimates in-river annual average concentrations for soluble pollutants (dissolved copper and dissolved zinc), including a contribution from road runoff. These concentrations are then compared with published EQS values to assess whether there would likely be a long-term impact on ecology, as described in DMRB HD45/09 guidance (Highways Agency, 2009).
- A WFD Compliance Assessment has been completed to determine potential effects of the Proposed Scheme on designated water bodies. This supports the impact assessment and mitigation requirements for the two WFD water bodies that would potentially be directly affected. The WFD Compliance Assessment is provided in Appendix 13.1.
- Consultation with third parties, namely the EA, Thames Water, Affinity Water, ECC, Harlow Council and Epping Forest District Council to obtain flood risk information;
- A desktop study and modelling of flood risk to inform the FRA, including:
    - Environment Agency Flood Zone map for planning, reservoir flood map, surface water flood map and groundwater mapping;
    - British Geological Survey online geology map viewer;
    - Thames Water and Affinity Water Asset Management Plans and Thames Water sewer flood history report;
    - Harlow Council Surface Water Management Plan. There is no Surface Water Management Plan for Epping District Council; and
    - Harlow and Epping Forest Level 1 Strategic Flood Risk Assessment (SFRA) (Harlow Council & Epping Forest District Council, 2011).

13.3.2 Assessment of magnitude and significance

The assessment of the water environment has been carried out in accordance with guidance contained in the DMRB, Volume 11 Section 3: Environmental Assessment Techniques, HD45/09: Road Drainage and the Water Environment (Highways Agency, 2009). Where appropriate, informed professional judgement has been used. This is an important feature of the assessment methodology, primarily in geomorphology, where there is a lack of guidance to date. Flood risk effects have been assessed in accordance with the requirements of the NPPF of 2012 and accompanying online flood risk guidance.

Using DMRB guidance, the significance of a potential impact has been provisionally determined by combining the 'importance' of the attribute and the 'magnitude' of a particular impact. This type of assessment determines the significance of residual effects remaining after mitigation has been applied.

A WFD Compliance Assessment has been completed for the ES to determine potential effects of the Proposed Scheme on the designated water bodies within the study area.

13.3.2.1 Sensitivity

The sensitivity of a receptor relates to the value of the water environment feature and has been initially estimated based on the criteria shown in Table 13.1.

Table 13.1: Assessment criteria for estimating the importance (value/sensitivity) of water environment attributes

Sensitivity of receptor	Typical descriptors
Very High	**Flood risk and drainage:** More than 100 residential properties or critical infrastructure at risk from flooding. **Geomorphology and water quality:** WFD overall status of 'High'. A watercourse that appears to be in natural equilibrium exhibiting a range of natural morphological features (such as pools and riffles). There is a diverse range of fluvial processes present, free from any modification or anthropogenic influence. European Commission (EC) Designated Salmonid/Cyprinid fishery. Site protected/designated under EC or UK habitat legislation (Special Area of Conservation (SAC), Special Protection Area (SPA), Site of Special Scientific Interest (SSSI), Water Protection Zone, Ramsar site, salmonid water) and or species protected by EC legislation. Watercourse widely used for recreation, directly related to watercourse quality (i.e. swimming). **Groundwater:** Principal aquifer providing a valuable resource because of its high quality and yield, or extensive exploitation for public and/or agricultural and/or industrial supply. Source Protection Zone (SPZ) 1 (Inner Protection Zone). Designated sites of nature conservation dependent on groundwater.
High	**Flood risk and drainage:** Between 10 and 100 residential properties or industrial premises or regional main roads at risk from flooding. **Geomorphology and water quality:** WFD overall status of 'Good'. A watercourse that appears to be in natural equilibrium and exhibits a natural range of morphological features (such as pools and riffles). There is a diverse range of fluvial processes present, with only very limited signs of modification or other anthropogenic influences. Major Cyprinid fishery. Species protected under EC or UK legislation. Watercourse used regionally for recreation. **Groundwater:** Secondary A aquifer capable of supporting water supplies at a local scale and forming an important source of base flow to significant surface waters. SPZ2 (Outer Protection Zone). Local areas of nature conservation known to be sensitive to groundwater effects.
Medium	**Flood risk and drainage:** 10 or fewer industrial/residential properties, local roads at risk from flooding. Critical social infrastructure and residential properties not affected.

Sensitivity of receptor	Typical descriptors
	Geomorphology and water quality: WFD overall status of 'Moderate'. A watercourse showing signs of modification, recovering to a natural equilibrium, and exhibiting a limited range of morphological features (such as pools and riffles). The watercourse has a limited range of fluvial processes and is affected by modification or other anthropogenic influences. The watercourse not widely used for recreation or has limited local use, or recreation use not directly related to watercourse quality. **Groundwater:** Secondary B aquifer and/or poor groundwater quality and/or low permeability make exploitation of groundwater unlikely. SPZ3 (Source Catchment Protection Zone). Changes to groundwater not expected to have an impact on local ecology.
Low	**Flood risk and drainage:** Limited constraints and a low probability of flooding of residential and industrial properties. Local minor roads and agricultural land. **Geomorphology and water quality:** WFD overall status of 'Poor' or 'Bad'. A highly modified watercourse that has been changed by channel modification or other anthropogenic pressures. A watercourse that exhibits no morphological diversity and has a uniform channel, showing no evidence of active fluvial processes and likely to be affected by modification and other pressures. Heavily engineered or artificially modified and could dry up during summer months. Fish sporadically present or restricted; no species of conservation concern. Not used for recreation purposes. **Groundwater:** Very poor groundwater quality and/or very low permeability make exploitation of groundwater unfeasible. No known past or existing exploitation of this water body. Changes to groundwater are irrelevant to local ecology.

13.3.2.2 Magnitude

The magnitude of the impact on the water environment relates to the degree of change that the Proposed Scheme would potentially cause 'without' and 'with' mitigation, considering both construction and operational processes and has been provisionally estimated based on the criteria shown in Table 13.2 based on the assessment methodology DMRB, Volume 11, Section 2, Part 1 and 2 (Highways Agency, 2007a and b).

Table 13.2: Assessment criteria for assessing the magnitude of impact on the water environment

Magnitude of impact	Typical criteria descriptors
Major Adverse	**Flood Risk and Drainage:** Results in an increase in peak flood level (1% annual probability) >100 mm. **Geomorphology and water quality:** Causes deterioration in the overall water body status and prevents the water body from achieving an overall status of 'Good'. Failure of hydromorphological elements (morphology, quantity and dynamics of flow) as a result of the works. Loss or extensive damage to habitat due to extensive modification. Replacement of a large extent of the natural bed and/or banks with artificial material. Extensive change to channel planform. Failure of both soluble and sediment-bound pollutants in HAWRAT (Method A, Annex I) and compliance failure with EQS values (Method B). Calculated risk of pollution from a spillage >2% annually (Spillage Risk Assessment, Method D, Annex I). Loss or extensive change to a fishery. Loss or extensive change to a designated nature conservation site. **Groundwater:** Major permanent or long-term change to groundwater quality or available yield. Existing resource use irreparably affected. Changes to quality or water table level would have an impact upon local ecology.
Moderate Adverse	**Flood Risk and Drainage:** Results in an increase in peak flood level (1% annual probability) >50 mm.

Magnitude of impact	Typical criteria descriptors
	Geomorphology and water quality: Prevents a water body from achieving an overall status of 'Good'. Failure of one or more hydromorphological elements (morphology, quantity and dynamics of flow) as a result of the works. Partial loss or damage to habitat due to modifications. Replacement of the natural bed and/or banks with artificial material (total length is more than 3% of water body length). Failure of both soluble and sediment-bound pollutants in HAWRAT (Method A, Annex I) but compliance with EQS values (Method B). Calculated risk of pollution from spillages >1% annually and <2% annually. Partial loss in productivity of a fishery. **Groundwater:** Changes to the local groundwater regime predicted to have a slight impact on resource use. Minor effects on local ecology could result.
Minor Adverse	**Flood Risk and Drainage:** Results in increase in peak flood level (1% annual probability) >10mm. **Geomorphology and water quality:** Potential for failure in one of the hydromorphological elements (morphology, quantity and dynamics of flow) as a result of the works. Slight change/deviation from baseline conditions or partial loss or damage to habitat due to modifications. Failure of either soluble or sediment-bound pollutants in HAWRAT. Calculated risk of pollution from spillages >0.5% annually and <1% annually. **Groundwater:** Changes to groundwater quality, levels or yields not representing a risk to existing resource use or ecology.
Negligible	**Flood Risk and Drainage:** Negligible change in peak flood level (1% annual probability) <+/- 10 mm. **Geomorphology:** No alteration to hydromorphological elements. Very slight change from surface water baseline conditions, approximating to a 'no change' situation. **Water Quality:** No risk identified by HAWRAT (Pass both soluble and sediment-bound pollutants). Risk of pollution from spillages <0.5%. **Groundwater:** Very slight change from groundwater baseline conditions approximating to a 'no change' situation.
Minor Beneficial	**Flood Risk and Drainage:** Results in a reduction in peak flood level (1% annual probability) >10 mm. **Geomorphology and water quality:** Potential for improvements in one of the hydromorphological elements (morphology, quantity and dynamics of flow) as a consequence of the works. Slight change/deviation from baseline conditions or partial improvement or gain in riparian or in-channel habitat. HAWRAT assessment of either soluble or sediment-bound pollutants becomes 'Pass' from an existing site where the baseline was a 'Fail' condition. Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is <1% annually). **Groundwater:** Changes to groundwater quality, levels or yields representing a minor improvement to existing resource use or ecology.
Moderate Beneficial	**Flood Risk and Drainage:** Results in a reduction in peak flood level (1% annual probability) >50 mm. **Geomorphology and water quality:** Provides improvements to the water body that could lead to it achieving an overall status of 'Good'. Improvement in one or more hydromorphological elements (morphology, quantity and dynamics of flow) as a result of the works. Partial creation of both in-channel and riparian habitat. Removal of an existing superfluous structure or artificial channel bed/bank. HAWRAT assessment of both soluble and sediment bound. Pollutants become 'Pass' from an existing site where the baseline was a 'Fail' condition. Calculated reduction in existing spillage by 50% or more (when existing spillage risk >1% annually). **Groundwater:** Changes to the local groundwater regime predicted to result in a moderate improvement to resources or groundwater quality or to local ecology.

Magnitude of impact	Typical criteria descriptors
Major Beneficial	**Flood Risk and Drainage:** Results in a reduction in peak flood level (1% annual probability) >100 mm. **Geomorphology and water quality:** The water body improves in status from the current overall water body status and the improvements could lead to achieving 'Good Status'. Extensive creation of both in-channel and riparian habitat, vastly improving the water body from baseline conditions. Removal of an existing superfluous structure or artificial channel bed/bank. Removal of existing polluting discharge, or removing the likelihood of polluting discharges occurring to a watercourse. **Groundwater:** Major permanent or long-term improvement of groundwater quality or available yield, or to local ecology.

13.3.2.3 Significance

The significance of a potential effect on the water environment is determined by combining the sensitivity of a receptor (Table 13.1) and the magnitude of an effect (Table 13.2). Table 4.1 provides a matrix showing this combination. For the purposes of the EIA, neutral/slight effects are assessed as not being significant.

13.4 Baseline Environment

13.4.1 Baseline sources

The following key sources of information have been used in the assessment:

- Contemporary OS maps;
- Aerial photography;
- Historical maps;
- Soil information (Cranfield Soil and Agrifood Institute, 2015);
- Geological information (British Geological Survey, 2015);
- National River Flow Archive data (Centre of Ecology and Hydrology, 2015);
- WFD information (EA, 2015);
- Online EA mapping (i.e. Flood Zone map for planning, reservoir flood map, etc.);
- Thames Water Asset Management Plan and Sewer Flood History Report;
- Affinity Water Asset Management Plan;
- Harlow Surface Water Management Plan (Capita Symonds, 2013);
- National Planning Policy Framework (DCLG, 2012) and accompanying online guidance; and
- Harlow and Epping Forest Level 1 SFRA (Harlow Council and EPDC, 2011).

13.4.2 Baseline conditions

13.4.2.1 Flood risk

Site conditions

The main land use within the study area is agricultural. However, there are residential properties on both sides of Gilden Way. The residential town of Harlow is located to the south-west of this area.

The Pincey Brook is a tributary of the River Stort, which then flows into the River Lea, a tributary of the River Thames. The Pincey Brook at the M11 crossing point has a catchment area of approximately 52km^2, flowing

from east to west. The Harlowbury Brook is also a tributary of the River Stort and is culverted under Gilden Way. The Harlowbury Brook to the Gilden Way culvert crossing point has a catchment area of approximately 6km^2 and flows south-east to north-west through Old Harlow.

The Proposed Scheme must be subjected to a FRA in accordance with the NPPF (DCLG, 2012) as the development is greater than 1ha in size and some parts of the Proposed Scheme are partially located in areas currently designated as Flood Zones 2 and 3. This FRA is provided in Appendix 13.2. The existing site condition flood risks are described below.

Fluvial flood risk

Figure 13-1 provides an outline of the flood zones and shows flood risk associated with the main river. The map does not present the risk associated with ordinary watercourses such as the unnamed watercourses, or with sources of flooding other than from rivers. The map indicates that most of the Proposed Scheme area is situated within Flood Zone 1, i.e. the zone with an annual probability of fluvial flooding of less than 0.1% (1 in 1000). Between the M11 and Gilden Way, the Pincey Brook flows through rural agricultural land. The only significant fluvial flood receptors partly in areas likely to flood are shown in Figure 13-1.

Pincey Brook and unnamed watercourse 1

Based on historical flood incidents mapping within the Harlow Council and Epping Forest District Council SFRA, it can be seen that areas within the floodplain of the Pincey Brook, including Sheering Road Bridge, experienced flooding in 1947, 1978 and 2000. Exact details of the flooding are unknown. Recent correspondence with ECC and Epping Forest District Council has confirmed that they hold no records of local fluvial flooding.

The EA provided a hydraulic model covering the Pincey Brook, which has been reviewed by Jacobs. The existing hydraulic model targeted the River Stort and includes the downstream reach of the Pincey Brook. This reach does not extend far enough upstream to cover the Proposed Scheme area and the Pincey Brook section of the model was found not to be detailed enough for the FRA requirements. Therefore, a new 1D-2D linked hydraulic model for the Pincey Brook has been built. The hydraulic modelling files for the watercourse modelling carried out for Pincey Brook are available on request. The model includes a 123m reach of unnamed watercourse 1 as required to assess the effects of the Proposed Scheme.

The modelled flood extents are shown in Figure 13-1. The map indicates that generally the flooding on the EA Flood Zone Map appears to be overestimated. Contrary to the EA Flood Zone Map the M11 is not at risk of flooding from the modelled design floods (up to the 0.1% (1 in 1000) AEP event). The modelling shows that the existing Sheering Road Bridge is not flooded by the 1% (1 in 100) AEP flood, but is flooded by the 0.1% (1 in 1000) AEP flood. The localised sparse housing/sheds at the Gardencare Tree Services are outside the floodplain. According to the Jacobs's model, the Gibberd Gardens are hardly affected by the design floods including the 0.1% (1 in 1000) AEP event, showing less flooding than the EA flood zones.

The model shows a risk of flooding to agricultural land either side of the culverted section of the unnamed watercourse 1 to the north of The Mores Wood. This is a combined consequence of surcharge of the culvert as water backs up the watercourse during high flow events and insufficient capacity of the culvert. There is anecdotal evidence of surface water ponding on local agricultural land adjacent to the unnamed watercourse.

On the basis that there are no significant flood risk receptors within the floodplain of the Pincey Brook and its tributary (unnamed watercourse 1), the sensitivity of local receptors is Low.

Harlowbury Brook

The EA Flood Zone Map shows that the existing Gilden Way in the vicinity of where it crosses the Harlowbury Brook is located within Flood Zone 2 and 3 and is already subject to fluvial flood risk.

In January 2011, WSP consulting engineers (working for ECC) produced a FRA in support of a planning application for a residential development of land to the north of Gilden Way (Planning Application Number HW/PL/15/00007). WSP consulting engineers undertook 1D hydraulic modelling of the Harlowbury Brook to

estimate the 1% (1 in 100) AEP flood extent and levels, including a 20% allowance for climate change. The modelled area comprised the section of the Harlowbury Brook immediately upstream of Gilden Way Bridge to the upstream side of the railway crossing to the north.

The WSP model indicates that the floodplain extents immediately upstream and downstream of Gilden Way Bridge are significantly narrower than the EA flood zones. The modelled 1% (1 in 100) AEP plus climate change peak flood level upstream of the bridge is 49.31m Above Ordnance Datum (AOD), with the downstream level being 49.05m AOD. Given that the existing ground level at Gilden Way Bridge is approximately 50.46m AOD, the modelling suggests that existing ground levels are at least 1.4m above the predicted peak flood level during the 1% AEP plus climate change flood event and therefore Gilden Way would not be at significant risk of fluvial flooding.

The model does not extend further upstream of Gilden Way Bridge and therefore, does not indicate whether areas upstream of the bridge are at risk of flooding. For the purpose of this outline design stage assessment, however, the WSP model results are considered to provide an indication of the fluvial flood risk to Gilden Way. On this basis the sensitivity of Gilden Way to flooding by the Harlowbury Brook is Low.

Residential properties on The Oxleys (to the north of Gilden Way) are located at a lower level than the road. Therefore, it is important to consider the effects of the proposed road surface improvements on the flood risk to these properties. There are no known instances of historical flooding of residential properties on The Oxleys. However, there are records of flooding in the local vicinity. The Harlow Council Surface Water Management Plan 'Historical Flooding Overview' shows the extent of the EA Historic Flood Map upstream of Gilden Way Bridge on the western bank and affecting Sheering Drive. There are also recorded instances of flooding in June and July 2006 close to Gilden Way Bridge. Exact details of the flooding extent are unknown. Essex County Council confirmed that they hold no recorded flood incidents. On this basis, the sensitivity of residential properties close to Gilden Way Bridge is High.

Unnamed watercourses 2 and 3

There are no known instances of significant flooding of unnamed watercourses 2 and 3 other than anecdotal evidence of surface water ponding on local agricultural land. The flood risk and sensitivity of receptors is therefore Low.

Surface water flood risk

Jacobs obtained the Harlow Council Surface Water Management Plan from ECC and were informed that the document is yet to be completed for the Epping Forest District Council. It should be noted that only the Gilden Way aspect of the development area falls within the Harlow Council area covered by the Surface Water Management Plan.

The Harlow Council Surface Water Management Plan shows that a portion of the London Road Roundabout at the very south western end of Gilden Way is located at the corner of one of the areas delineated as a Critical Drainage Area (CDA) (Ref No. 13). The Surface Water Management Plan also shows that Gilden Way Bridge is located in a local flood risk zone. However, the 1% (1 in 100) AEP surface water flood map reproduced in that figure does not show any flood depths at this location. The floodplain along Harlowbury Brook does show flooding, but this is within the fluvial flood extents and appears to reflect fluvial flooding.

The online EA surface water flood risk map shows four surface water flow paths within the study area draining through agricultural land towards the Pincey Brook. In the existing site condition, these surface water flow paths flow through rural agricultural land with sparse housing. Therefore, existing surface water flood risk and sensitivity of receptors is considered to be Low.

Groundwater flood risk

Harlow Council Surface Water Management Plan 'Susceptibility to Groundwater Flooding Map with Reported Historic Incidents' indicates a variable susceptibility to groundwater flooding along the Gilden Way corridor. The level of risk ranges from Very Low to Very High, with the majority being at High. This includes Gilden Way either

side of the Harlowbury Brook. The areas of greatest risk generally correspond with the underlying Head and Lowestoft Formation Deposits. However, the map does not show any recorded incidents of groundwater flooding within the study area.

The GI recorded shallow groundwater at several locations (i.e. less than 1m bgl). A groundwater level of 0.5m bgl was recorded within Alluvium (associated with the Pincey Brook) to the southeast of Sheering Road Bridge. Shallow groundwater was also recorded at the following locations:

- land immediately to the north of the western dumbell roundabout off the northbound carriageway of the M11 (0.7m bgl);
- land immediately to the north of the proposed link road (0.9m bgl);
- land beneath the proposed link road to the east of the Sheering Road Roundabout linking to Sheering Road (0.6m bgl); and
- land to the south of Gilden Way and west of Mayfield Farm (0.9m bgl).

All of these locations are underlain by the Lowestoft Formation.

The risk of groundwater flooding is largely considered to be low except in the few isolated areas of monitored shallow groundwater, where there is considered to be a moderate risk. Here there is a risk that any shallow groundwater within the superficial deposits could rise and break the surface following prolonged rainfall. There are no significant flood risk receptors in these locations, only agricultural land. Based on the absence of historical records of groundwater flooding, the likelihood of flooding occurring is considered to be low. In addition, the observed locations of shallow groundwater are not located close to low points of the Proposed Scheme. On this basis the sensitivity of local receptors is considered to be Low.

It should be noted that there could be shallow groundwater in the location of Gilden Way Playing field to the south of Gilden Way and east of Churchgate Roundabout. Whilst no groundwater was recorded in the nearest boreholes (to the north), boreholes immediately to the west of Churchgate Roundabout recorded a groundwater level of 2.7m bgl. The topographic survey does not extend to the recreation ground; however, visually this feature appears to be lower than Gilden Way. Given these level differences, it is unlikely that groundwater flooding would affect the road.

Reservoir flood risk

The EA online reservoir flood risk map indicates that there are four reservoirs near the development area affecting the Pincey Brook. The four reservoirs are listed in Table 13.3. The EA define a reservoir as high risk if peoples' lives are likely to be in danger as a result of an uncontrolled release of water.

Table 13.3: Reservoirs near the proposed development

Name	Grid reference	Owner	Area	EA risk designation
Hatfield Forest Lake	(554187, 219751)	The National Trust	EA – Hertfordshire and North London	To be determined
Shrubbs Farm Reservoir (ID395)	(551864, 213504)	Liddell	EA – Hertfordshire and North London	Not high-risk
Balancing Pond C	(554966, 221427)	Stansted Airport Ltd	EA – Hertfordshire and North London	To be determined
Kingstons Reservoir	(555577, 212874)	McGowan	EA – Hertfordshire and North London	To be determined

Reservoir flooding is extremely unlikely to happen. The EA reports that there has been no loss of life in the UK from reservoir flooding since 1925. All large reservoirs must be inspected and supervised by reservoir panel engineers. As the enforcement authority for the Reservoirs Act 1975 in England, the EA ensure that reservoirs are inspected regularly and essential safety work carried out.

According to the EA online reservoir flood risk map, in the unlikely event of the aforementioned reservoirs failing then the Pincey Brook could be subject to increased discharges thereby increasing flood risk to nearby receptors. The flood extents on the reservoir flood risk map appear to corroborate with the modelled 0.1% (1 in 100) AEP flood outline. This indicates that the consequence of reservoir flooding would be moderate. However, given that reservoir flooding would be extremely unlikely to happen, the risk (which considers both likelihood and consequence) can be considered to be Low. The Harlowbury Brook crossing under Gilden Way would be unaffected, with no reservoir flood extents shown. Given the low risk and minimal number of viable receptors that fall within the reservoir flood extent, the sensitivity of receptors is Low.

Flood risk from existing services

Thames Water provided surface water and foul drainage infrastructure for the existing developments in the study area whilst Affinity Water supplied potable water information. It is likely that surface water drainage serving the M11 and Gilden Way could come under the authority of either ECC or HE. The locations of any such assets are not known.

The Thames Water Asset Location Search Plan indicates the presence of surface water and foul drainage infrastructure along Gilden Way, the residential areas around the Churchgate Street/Sheering Road area, the residential areas around the London Road/Walfords Close area and the residential area around the Watlington Road/Mulberry Green area. According to the Sewer Flood History Report there have been no incidents of flooding in the area as a result of surcharging public sewers.

The Affinity Water Asset Location Search Plan indicates the presence of potable water supply pipes running along Gilden Way and branching out into the residential areas referred to above. Affinity Water has not confirmed any historical flooding from their potable water supply infrastructure. Essex County Council has confirmed that they do not hold asset location plans.

The sensitivity of nearby flood receptors to flood risk from existing services is considered to be Low as there is no known existing issue with flooding of properties and roads from this source.

13.4.2.2 Geomorphology and water quality

The Proposed Scheme is located within the Upper Lee management and operational catchment within the Thames River Basin District. The Proposed Scheme could potentially affect five watercourses located within two WFD water body catchments. The following provides the baseline conditions for each of the water features.

Pincey Brook

The Pincey Brook channel routes 21.6km from Takeley (adjacent to Stansted Airport) to Harlow where it meets it's confluence with the River Stort. The watercourse has a 54.6km^2 catchment area mainly on London Clay with chalk headwaters. The river channel follows through a predominantly rural landscape compromising tilled arable land with some small settlements including The Campions adjacent to the Proposed Scheme.

The Pincey Brook has an irregularly meandering planform which has not significantly altered since 1875, according to online historical maps. Historical maps from 1974 shows that a secondary channel was created at Sheering Hall with a flow gauge installed. This has resulted in the original channel course becoming largely redundant. The M11 between Junctions 7 and 8 was constructed over the Pincey Brook in 1975 with the channel being artificially straightened and culverted beneath the carriageway.

The contemporary channel morphology of the Pincey Brook within the study area is relatively uniform except for the section by Sheering Hall which has a dynamic morphology. The bed of the channel was noted to be made up of mainly gravel, with local areas of fine silt deposition particularly within the slacker flowing areas. The banks were found to consist of earth and some clay material. Erosion was also observed. The channel was estimated to be approximately 4-5m wide with some evidence of narrowing through depositional features. Some large woody debris and overhanging terrestrial vegetation was present creating diversity of flow types. The channel appeared incised and generally disconnected from its floodplain and the steep profile of the banks

also indicated possible historical channel engineering/dredging. Some outfalls were recorded within the study area including road and field drains, namely from the M11 and Sheering Road.

The channel was noted to be lined by occasional clumps of trees providing some channel shading (but minimal bank stabilisation), with the exception of the reach adjacent to the M11 motorway. Some marginal terrestrial vegetation was found to be present along both banks; however, no significant riparian buffer zone was noted. The adjacent land use is likely to act as a source of fine sediment to the channel, particularly in periods of high flows. Bank protection was also noted alongside the garden and property at Sheering Hall and to the west of Sheering Road, formed of sand bags and wooden stakes/willow spilling.

Unnamed watercourse 1

Unnamed watercourse 1 is an artificially straightened channel that comes from The Mores Wood north of Morgan Farm. The watercourse then follows north for approximately 0.6km before entering a 125m culvert under the agricultural fields before outfalling into the Pincey Brook. The watercourse adjoins a mixture of wet woodland and coniferous woodland in the upstream reach and arable agricultural land in the downstream reach. The downstream reach was observed to have a limited vegetated riparian buffer noted to consist mainly of nettles, with tilled land typically abutting the bank top. The watercourse was estimated to be approximately 0.2-0.5m wide. The substrate was found to consist predominantly of silt with some fine gravel. The terrestrial vegetation was observed to encroach into the channel.

Unnamed watercourse 2

Unnamed watercourse 2 is a straight drain flowing along the edge of Sheering Road, with a course through the woodland south of Sheering Road Bridge to a confluence with the Pincey Brook. The watercourse is adjoined by coniferous woodland in its upstream reach and arable land in the downstream reach. At the time of survey the watercourse was noted to be dry, with detritus (predominantly leaf litter) filling the channel cross-section. The cross-section was observed to be uniform and the watercourse determined to be likely to be man-made or have been historically modified or diverted to enhance or maintain flow capacity.

Unnamed watercourse 3

Unnamed watercourse 3 is a tributary of the Harlowbury Brook. It was recorded as having a straightened planform and uniform trapezoidal cross-section. The watercourse is likely to be a man-made drain created for agricultural purposes. The watercourse is fed by drains culverted under the urban area south of Gilden Way but the exact source is unknown. The channel emerges from a culvert to the west of Churchgate Roundabout. The watercourse then routes northwards alongside a residential area, before crossing through agricultural fields and joining the Harlowbury Brook.

The watercourse was noted to be culverted for a distance of approximately 200m beneath an access track upstream of its confluence with the Harlowbury Brook. The substrate was found to typically consist of silt with some fine gravels. The channel had limited morphological diversity and few habitats. Historical maps from 1875 suggest that the watercourse is likely to have been part of a mill leat and is unlikely to have been formed naturally.

Harlowbury Brook

The Harlowbury Brook is designated a “Main River” by the EA and is sourced from several agricultural field drains to the north and east of Church Langley. The Harlowbury Brook channel routes northwards through agricultural fields and the residential area of Old Harlow to a confluence with the River Stort channel approximately 1.5km downstream of Gilden Way.

The watercourse typically has a sinuous planform, with some straightened reaches within the urban areas. Analysis of historical maps shows that Harlowbury Brook was artificially straightened to the east of Harlowbury between 1889 and 1897. Since the early 1900’s, there appears to have been no significant planform change to the watercourse. There are a number of culverts facilitating road and rail crossings, altering the cross-section and nature of the watercourse.

The watercourse was observed to have a gravel bed with some pebbles and cobbles. The channel was noted to be locally narrowing with depositional features consisting of gravels, particularly in the upstream reaches south of the Gilden Way. The Harlowbury Brook was recorded to have a riffle-pool sequence, with deeper pools creating slacker flowing areas. Some silt was observed on the channel bed. The banks were noted to be typically steep consisting of mud with some erosion observed particularly downstream of structures such as bridges and pipe crossings. Channel modifications were observed, including a long section of new gabion baskets immediately downstream of the Gilden Way culvert. Within the residential area some geotextile matting had also been staked into the banks to hold them in place where the channel abuts residential gardens.

Other surface water features

There are a number of pond features within the study area, including two south of The Mores Wood at Morgan's Farm, two within The Coach House west of The Campions and one at the disused plant nursery south of Gilden Way. A larger lake was also recorded to the north of The Coach House on the right bank of the Pincey Brook.

Water Framework Directive

The study area falls within two WFD water body catchments (Figure 13-2). The Pincey Brook is a WFD designated catchment and is bordered by the northern extent of the Proposed Scheme. The catchment includes The Campions. The Pincey Brook water body is currently achieving Moderate Status. Table 13.4 provides further details of the status and quality elements of the water body based on the 2015 Cycle 2 data (EA, 2015).

The Proposed Scheme south of The Campions, incorporating the Gilden Way improvements, lies within the "Stort and Navigation, Harlow to Lee WFD water body catchment" (hereafter referred to as Stort and Navigation). This encompasses unnamed watercourse 3 and the Harlowbury Brook. The water body is currently achieving Moderate potential. Table 13.4 provides a summary of the status and the quality elements based on the 2015 Cycle 2 data (EA, 2015).

Table 13.4: Water Framework Directive (WFD) elements for the two WFD water bodies within the study area

Water Body ID	GB106038033380	GB106038033281
Water Body Name	Pincey Brook	Stort and Navigation, B. Stortford to Harlow
Hydromorphological Status	Not Designated A/HMWD	Heavily Modified Water Body
Current Overall Status	Moderate	Moderate
Current Chemical Status	Good	Good
Biological Quality Elements		
Fish	No data	High
Invertebrates	High	Good
Physico-chemical Quality Elements		
Phosphate	Poor	Poor
Ammonia	High	High
Dissolved Oxygen	High	High
pH	High	High
Temperature	High	High
Hydromorphological Supporting Elements		
Hydrological Regime	Supports good	Supports good
Morphology	Supports good	No data
Mitigation Measures Assessment	Not Applicable	Moderate or less

Water quality

Both the Pincey Brook and the Stort and Navigation WFD water bodies are classified as achieving Good chemical status under the WFD (EA, 2015). Phosphate levels for both water bodies are shown to be Poor and have been noted as issues in the past.

The study area is located within a Surface Water NVZ and a Surface Water SgZ. A NVZ is an area of land draining into water known to be polluted by nitrates. A SgZ is an area that influences the water quality at water abstraction sites at risk of failing the drinking water protection objectives. There is one surface water abstraction consent within the study area, located approximately 250m from the proposed route (Envirocheck, 2015).

13.4.2.3 Groundwater

Aquifer designations

British Geological Society online maps indicate that the majority of the study area is underlain by rocks of the Thames Group (the London Clay Formation) described as a predominantly clayey sequence up to 140m thick essentially containing no groundwater. The EA classifies this geological unit as Unproductive Strata. The London Clay Formation is therefore not considered as a groundwater receptor and is not assessed further as part of this EIA.

The western end of the Gilden Way and the area between the Churchgate Roundabout and the proposed Sheering Road Roundabout is underlain by the Lambeth Group (Thanet Sand Formation and Lambeth Group). This is described as a low productivity aquifer comprised of a variable sequence of clays, shell beds, fine sand, silt and pebble beds yielding low volumes of groundwater; although it is noted to be occasionally in hydraulic continuity with the underlying chalk aquifer. The EA classifies this geological unit as a Secondary A aquifer.

The area between the London Road Roundabout and Churchgate Roundabout is predominantly underlain by the White Chalk Subgroup (Lewes Nodular Chalk Formation). Designated a Principal aquifer by the EA, the highly productive chalk can be up to 450m thick and yields up to 50-100l/s from large diameter boreholes. Water is typically hard to very hard but good quality. The EA classifies this geological unit as a Principal aquifer.

The EA classifies the superficial Head deposits (comprised of clay, silt, sand and gravel) and the Lowestoft Formation (diamicton) as Secondary Undifferentiated aquifers. The Glaciofluvial deposits and alluvium are classified as Secondary A aquifers, capable of supporting water supplies at a local rather than a strategic scale and in some cases forming an important source of base flow to rivers.

Groundwater abstractions

Based on the EA's website, the route does not lie within any groundwater SPZ. The nearest SPZ is located to the north west of the study area with the outer zone (Zone 2) located approximately 1.5km from the proposed route (Figure 13-3).

There are two groundwater abstraction licences recorded within the study area; one located approximately 50m and the other 100m from the Proposed Scheme (Envirocheck, 2015). Both of these are located near to Sheering Road Bridge.

Consultation with the Local Authority indicated no groundwater abstractions for human consumption were present within 250m of the proposed route.

Groundwater levels

Limited groundwater level information is available and constitutes data collected between 1st December 2015 and 17th February 2016 from 22 boreholes, located in the east of the study area between Mayfield Farm and the M11 carriageway. Groundwater levels vary between 0.2m and 18.8m bgl. This limited groundwater level data coupled with the complex geology makes interpretation of the groundwater data difficult, but some general comments can be made.

Groundwater levels are noted to be generally shallow in the area north of the proposed route, between the Sheering Road Roundabout and the Pincey Brook. Borehole logs indicate sands and gravels are present between 3-8m bgl in this area and could point to a degree of hydraulic connectivity between the Pincey Brook and the surrounding granular deposits. Boreholes located near the Sheering Road Roundabout are screened in granular deposits of the Thanet Sand Formation and Lambeth Group with groundwater levels in the range 6.5m bgl to 11.3m bgl.

Further east towards the M11 carriageway, groundwater levels are more variable and range from 0.85m bgl to 13.13m bgl. This variability within the unit could indicate the presence of discontinued areas of perched groundwater, although this cannot be confirmed with the limited borehole log information.

The direction of groundwater flow within the superficial deposits cannot be confirmed with the available information but is likely to be controlled by topography and to flow towards the surface water channels. Groundwater flow direction within the bedrock is currently unknown.

Groundwater quality

Groundwater vulnerability maps, available from the EA website, identify the Principal chalk bedrock aquifer as a Major Aquifer of High to Intermediate Vulnerability. The bedrock Secondary A Aquifer is characterised as a Minor Aquifer of Intermediate Vulnerability and the superficial Secondary A Aquifer is generally identified as a Minor Aquifer of High Vulnerability. The superficial Secondary Undifferentiated Aquifer appears to be marked as a Minor Aquifer of Low Vulnerability.

Chemical analyses were conducted on samples collected from each of the 22 boreholes and indicate that groundwater quality is generally good, with no exceedances of the DWS for hydrocarbons, herbicides nor pesticides observed in any of the samples collected. However, exceedances of the EQS have been recorded for Chromium, Copper, Nickel and Zinc at various boreholes and indicate metals are present in groundwater at low concentrations across the eastern portion of the study area.

Ecological receptors

No springs were identified within the study area. Ecological receptors are therefore associated with ponds and surface water features present within the study area.

13.4.3 Value of receptors

Following the baseline assessment each of the identified receptors has been assigned a sensitivity based on the criteria provided in Table 13.1. Table 13.5 summarises the sensitivities used throughout the assessment to derive an overall significance of effect for each water environment receptor.

Table 13.5: Receptor sensitivity

Receptor name	Sensitivity	Description
Flood Risk		
Fluvial flood risk - River Stort	Scoped out	Located too far downstream to have an effect on the Proposed Scheme for a range of design floods up to the 1% (1 in 1000) AEP flood, therefore scoped out from assessment
Fluvial flood risk - Pincey Brook	Low	Very few residential and industrial properties in the floodplain. Hydraulic modelling indicates that contrary to the EA Flood Zone Map the localised sparse housing/sheds at Gardencare Tree Services are shown to be outside the floodplain
Fluvial flood risk - unnamed watercourse 1	Low	No residential and industrial properties in the floodplain. No known significant flooding other than anecdotal evidence of ponding of water in adjacent agricultural fields
Fluvial flood risk - Harlowbury	Low	The road level of the bridge is at least 1.4m above the peak

Receptor name	Sensitivity	Description
Brook - Gilden Way Bridge		flood level during the 1% AEP plus climate change flood event
Fluvial flood risk - Harlowbury Brook – Residential properties (The Oxleys)	High	There are no recorded incidents of historical flooding of The Oxleys; however, the properties are located at a lower level than the road so there remains a risk
Fluvial flood risk - unnamed watercourse 2	Low	No known significant flooding other than anecdotal evidence of ponding of water in adjacent agricultural fields
Fluvial flood risk - unnamed watercourse 3	Low	No known significant flooding other than anecdotal evidence of ponding of water in adjacent agricultural fields
Ponds	Scoped out	The ponds have been scoped out from assessment given that they would not be affected by the Proposed Scheme and do not directly affect it
Surface water flood receptors	Low	The online EA surface water flood risk map shows four surface water flow paths within the study area draining through agricultural land towards the Pincey Brook
Groundwater flood receptors	Low	A few isolated areas of monitored shallow groundwater within the superficial deposits. These boreholes are not located close to low points of the Proposed Scheme. Based on the absence of historical records of groundwater flooding, the likelihood of flooding is considered to be low
Reservoir flood receptors	Low	Properties and roads appear to be outside of the EA reservoir flood maximum flood extents
Flood receptors from existing services	Low	No known existing issues with flooding of properties and roads
Geomorphology and Water Quality		
Pincey Brook	High	A main river with some lengths of morphological diversity. Classified as Good status under the WFD with Good chemical status
Unnamed watercourse 1	Low	A small uniform channel, likely to be man-made
Unnamed watercourse 2	Low	A small uniform channel, likely to be man-made
Unnamed watercourse 3	Low	A small uniform channel, likely to be man-made
Harlowbury Brook	Medium	A main river with short lengths of morphological diversity. The watercourse is significantly modified. Falls within a WFD water body catchment with Moderate status and a failing chemical status
Ponds	Low	Man-made ponds, small in nature
Lake	Low	Man-made lake used by local fishermen
Groundwater		
Glaciofluvial deposits and alluvium	High	Secondary A superficial aquifer
Lowestoft Formation and Head deposits	Medium	Secondary Undifferentiated superficial aquifer
Thanet Sand Formation and Lambeth Group	High	Secondary A aquifer
Lewes Nodular Chalk Formation	Very High	Principal Aquifer

13.5 Significant Effects

13.5.1 Construction effects

13.5.1.1 Flood risk

This section describes the potential effects of the Proposed Scheme on flood risk during construction that could arise in the absence of specific mitigation. Due to the nature of and/or distance from the Proposed Scheme, it is considered that unnamed watercourses 2 and 3 would not be affected or that there would be no potential significant effect. These watercourses have therefore not been considered further with respect to flood risk.

Potential construction effects concerning hydrology and flood risk include:

- increased runoff and alterations of flow paths from soil compaction due to works traffic; and
- temporary haul roads could cause a temporary increase in runoff due to reduced infiltration rates in the area of the road.

Mitigation measures for each of these risks are incorporated in the Proposed Scheme and discussed in Section 13.6.1.

13.5.1.2 Geomorphology and water quality

During the construction period, soil excavation/removal, piling and the removal of areas of riparian vegetation would be likely to create surfaces of bare earth within the construction area and adjacent to watercourses. This could potentially alter surface water runoff and drainage processes within the localised catchment, leading to possible effects on the downstream receiving watercourses. The movement of construction vehicles could also lead to soil compaction, potentially affecting the speed of surface water runoff. Bare earth surfaces, storage areas of construction materials (such as crushed rock) or stockpiles of top soils could cause an increase in the fine sediment loading of the watercourses/water features receiving runoff from the site. This would have the potential to increase the amount of deposition within a channel, thereby altering existing in-channel features and smothering gravels and other aquatic habitats. Deposition of silt from the construction site would cease at the end of the construction period. However, the effects could potentially continue into the medium to longer terms.

During construction three temporary crossings would potentially be required over unnamed watercourse 1 in the form of pipes being laid in the channel. These structures would be sized appropriately for flood conveyance and only be in place during the phases required. The culverts could lead to changes in the downstream movement of sediment and modify fluvial processes. Vehicular traffic over the structure would also lead to compaction of the bed and increase potential for fine sediment input into the watercourse. One of the haul roads is also located within 6m of the Pincey Brook near Sheering Road Bridge. This has been designed to accommodate smaller construction vehicles.

The construction of proposed structures (such as outfalls and culverts) on watercourses would be likely to require removal of riparian vegetation and replacement of natural bank material with artificial material. This could potentially alter the surface water runoff to the channel as well as affect the lateral connectivity of a channel with its floodplain. In addition, any potential in-channel works would be likely to cause a disturbance to existing channel bed forms (such as pools, riffles, depositional features), either resulting in an alteration to the baseline conditions or complete removal of these features. Physical alteration of channel cross-sections could also affect channel processes.

Potential effects on surface water quality during construction would potentially arise from the following activities:

- general site clearance, stripping of vegetation and topsoil from the works area;
- construction traffic movements including across temporary haul roads;
- fuel leaks from works undertaken within the proximity of watercourses;
- river engineering construction works including culverts and outfalls;
- stockpiling of soil; and
- sewage and surface water arising from the site compounds.

The above activities would have the potential to introduce suspended solids and/or polluting substances into watercourses in the study area. In terms of the physico-chemical parameters relating to water quality, the primary contaminant likely to be present during the construction phase would be suspended solids. Suspended solid concentrations could affect flora and fauna, including clogging of fish gills, smothering spawning surfaces, reducing light penetration for vegetation growth and adding bacteria and algae to the water. Nutrients are often associated with solids, including inorganic nutrients (such as phosphorus) and organic nutrients (such as hydrocarbons or sewage if present). These could cause a deterioration of water quality and damage to aquatic life due to eutrophication.

13.5.1.3 Groundwater

Road development activities could affect groundwater receptors in the following ways:

- Effects on underlying groundwater aquifers, for example, through the dewatering of aquifers as a result of construction works involving excavation;
- Risk of spillage or leakage of fuel or oil from storage tanks or construction plant, which without suitable mitigation measures, could enter aquifers; and
- Effects of changes to groundwater flow or quality on secondary receptors such as groundwater abstractions, surface water or ecological receptors.

Groundwater quality

In the event of accidental spillage during the construction or operational phases, potential contamination could migrate through the upper unsaturated zone reaching the shallow drift aquifer and impair groundwater quality, unless appropriate measures for control of discharge and drainage were taken.

Superficial aquifers would be at a higher risk of contamination from surface pollutants as they have less material cover separating them from the surface, whereas bedrock aquifers could be afforded a greater degree of protection. However, the Principal chalk aquifer within the study area is overlain by a Secondary A superficial aquifer and so might not be protected; hence its magnitude has been provisionally assigned as Major, without mitigation. This is also consistent with this aquifer being classified of High to Intermediate vulnerability (refer to Section 13.4.2.3). The assessment of potential effects from accidental spillages on these aquifers is summarised in Table 13.6.

Table 13.6: Potential effect of accidental spillages on key hydrogeological units during both construction and operation phases without mitigation

Hydrogeological unit	Sensitivity	Magnitude
Secondary A superficial aquifer (glaciofluvial deposits and alluvium)	High	Major
Secondary Undifferentiated superficial aquifer (Lowestoft Formation and Head deposits)	Medium	Major
Secondary A aquifer (Thanet Sand Formation and Lambeth Group)	High	Moderate
Principal aquifer (Lewes Nodular Chalk Formation)	Very High	Major

Groundwater flow

Based on information available at this stage, five areas of road cutting have been identified as having the potential to intercept groundwater within superficial aquifers. The assessment of the likely effects on groundwater flow as a result of these road cuttings is summarised in Table 13.7. It should be noted that potential impacts of road cuttings within the non-aquifer areas have been screened out.

Table 13.7: Assessment of impact on groundwater flow due to areas of proposed cuttings without mitigation

Cutting ID	Underlying hydrogeological unit (receptor)	Sensitivity of receptor	Magnitude of impact
M11 Slip Road and Link Road	Secondary Undifferentiated superficial aquifer (Lowestoft Formation)	Medium	Minor
SuDs Attenuation Pond (Sheering Road Roundabout)	Secondary Undifferentiated superficial aquifer (Lowestoft Formation)	Medium	Minor
SuDs Attenuation Pond (M11)	Secondary Undifferentiated superficial aquifer (Lowestoft Formation)	Medium	Minor
SuDs Attenuation Pond (Churchgate Roundabout)	Secondary Undifferentiated superficial aquifer (Lowestoft Formation)	Medium	Minor
SuDs Attenuation Pond (Gilden Way- South)	Secondary Undifferentiated superficial aquifer (Lowestoft Formation)	Medium	Minor

The construction of embankments could result in local compaction of drift deposits. This would result in localised effects of Negligible magnitude for groundwater flow, without mitigation. No effect on bedrock aquifer has been anticipated.

Abstractions

Two groundwater abstractions were identified in close proximity to the Sheering Road Roundabout attenuation pond cutting, but these are understood to be deep wells drawing water from the underlying chalk aquifer. As such, no effect on flow to these abstractions would be expected due to the proposed excavations. Groundwater quality at these abstractions would be at the same risk as the chalk aquifer as a whole and is described in Table 13.7.

Indirect groundwater dewatering effects on surface waters and ecological receptors

The Pincey Brook is located approximately 20m beyond the SuDs attenuation pond. It is identified in Table 13.7 as having a Minor magnitude of effect on the superficial aquifer (without mitigation). The superficial aquifer has been described in the baseline as having a good degree of hydraulic connectivity with the Pincey Brook in this area; as a consequence the potential magnitude of effect on the Pincey Brook and associated ecological receptors has been assessed as Negligible. No effect would be expected on surface waters and ecological receptors as a result of the M11 Slip Road cutting.

13.5.2 Operational effects

13.5.2.1 Flood risk

Construction phase effects on flood risk have the potential to become long-term operational effects. Additional potential effects are:

- introduction of new impermeable areas within surface water catchments could potentially increase the volume and peak flow of surface runoff reaching water features and could therefore contribute an increased flood risk;
- the road and its drainage system could also act as a barrier to water movement within existing catchments, increasing flooding upstream; and
- alteration to, or the construction of, culverts or bridges could affect flow carrying capacity of a channel. Imposing a constriction would potentially result in high flood levels upstream. Conversely opening up a culvert could worsen the flood risk if it increased runoff rates downstream of the culvert.

Mitigation measures for each of these risks are incorporated into the Proposed Scheme and discussed in Section 13.6.2.

Fluvial flood risk

Pincey Brook

The Pincey Brook is culverted under the M11. The proposals would not affect the Pincey Brook watercourse or floodplain as estimated by hydraulic modelling undertaken (Appendix 13.2 'Flood Risk Assessment').

The surface water drainage strategy proposes two attenuation ponds as part of the Proposed Scheme within the Pincey Brook catchment: one to the northwest of the proposed junction and one to the north of Sheering Road Roundabout. The only significant fluvial flood receptors partly in areas likely to flood are shown in Figure 13-1. The proposed ponds and their outfalls would be Flood Control Infrastructure and therefore Water Compatible Development (as defined in the NPPF online guidance). This is appropriate in Flood Zones 2 and 3. Hydraulic modelling as part of the FRA shows that the ponds are located outside the 1% (1 in 100) AEP and 1% (1 in 100) AEP plus 70% climate change flood extent. The ponds would therefore not cause a loss of floodplain storage up to this design event. They have been designed to incorporate a freeboard to allow for the potential effects of climate change.

The sensitivity of the nearby flood receptors to fluvial flood risk has been considered to be low as there are very few flood receptors in the Pincey Brook floodplain. The magnitude of the potential effect on nearby flood receptors has been assessed to be Minor Adverse. Although the remainder of the development is proposed to be largely outside the Pincey Brook floodplain, the Sheering Road Bridge road embankment is proposed to extend slightly into the Pincey Brook floodplain and could cause a small loss of floodplain storage for very high return period events. With-scheme modelling has, however, confirmed that there would be no significant increase in water levels resulting from this loss. The significance of the potential effect has therefore been deemed to be Neutral.

Unnamed watercourse 1

The Proposed Scheme intersects the unnamed watercourse in the reach from The Mores Wood to the Pincey Brook. The sensitivity of the nearby flood receptors to fluvial flood risk has been assessed to be Low as there are no flood receptors in the unnamed watercourse floodplain except small areas of agricultural land. The magnitude of the potential effect on nearby flood receptors has been assessed to be Negligible or Minor Beneficial as the proposed development would be largely outside the floodplain. As well as this, the proposed culvert crossings have been designed to not increase water levels in the tributary for a range of design floods. The existing culverted length (twin 300mm diameter pipes) was modelled to flood as a result of the capacity being exceeded. This would no longer be the case with the new culverts and watercourse alignment. The significance of the potential effect has been assessed to be Neutral. The sensitivity, magnitude and overall significance of the potential effect have been determined through hydraulic modelling for the with-scheme condition.

Harlowbury Brook

WSP modelling has shown that the road level of the Gilden Way Bridge would be at least 1.4m above the peak flood level during the 1% (1 in 100) AEP plus 20% climate change flood event. It is not envisaged that there

would be any changes to the hydraulic arrangement at this location as part of the improvement works to Gilden Way as the proposed road widening would be within the existing road embankment profile.

The sensitivity of the nearby flood receptors to fluvial flood risk has been assessed to be Low for the road and potentially High for the adjacent properties as there are some flood receptors (residential properties at The Oxleys) within the floodplain. The magnitude of the potential effect on nearby flood receptors has been assessed to be Negligible as the Proposed Scheme would be largely outside the floodplain. Also the proposed Gilden Way road crossing has been designed to not increase water levels in the tributary for a range of design floods up to the 1% (1 in 100) AEP flood. This would be achieved by ensuring the widened road remained within the existing embankment profile at the crossing. The significance of the potential effect has been assessed to be Neutral.

Surface water flood risk

The proposed link road between the M11 and Sheering Road would increase the area of hardstanding from the baseline condition. This would result in increased surface water runoff rates from the proposed development. Without appropriate mitigation surface water flood risk could potentially be increased by the development and adjacent area. The proposed link road would also cross four existing surface water flow paths. Without mitigation, the link road would obstruct surface water flow paths towards the Pincey Brook.

For the improvement works to Gilden Way there would also be an increase in impermeable area which could lead to increased surface water runoff rates and increased surface water flood risk if left unmitigated.

Potential mitigation measures concerning surface water flow paths and increased surface water runoff rates are discussed in Section 13.6.

The sensitivity of the nearby flood receptors to surface water flood risk has been assessed to be Low as there are no flood receptors that would be likely to be directly adversely affected by the proposals. The Proposed Scheme itself has been considered as a new receptor and, as a local main road, it has been assessed to be of Medium sensitivity. The magnitude of the effect of the Proposed Scheme has been determined through hydraulic modelling of the proposed surface water drainage systems. The FRA includes a full assessment of this risk (see Appendix 13.2).

Groundwater flood risk

The risk of groundwater flooding to the new M11 junction and link road has been assessed as Low. Despite known shallow groundwater within the Lowestoft Formation in this area, the link road would be raised above the existing ground level on earth embankments. The risk to parts of Gilden Way has been assessed as Moderate due to potential shallow groundwater at local topographic low spots, such as Gilden Way Recreation Ground immediately to the south of the road.

The sensitivity of the nearby flood receptors (agricultural land and potentially Gilden Way Recreation Ground) to groundwater flood risk has been assessed to be Low. The magnitude of the effect of road widening along Gilden Way would be likely to be Negligible as the road widening would remain within the existing road corridor with no significant level differences. In general, the introduction of additional impermeable areas and the effective management of the resulting runoff by the new drainage systems would tend to reduce groundwater flooding risks. Therefore the overall significance of effect of the Proposed Scheme has been assessed as Neutral.

Reservoir flood risk

The presence of the Proposed Scheme would not be expected to significantly change reservoir flood risk. The likelihood of reservoir flooding is very low with the last recorded incident in the UK occurring in 1925. The EA online reservoir flood risk map indicated that the proposed link road between the M11 and Gilden Way development would be outside the maximum flood extents for reservoir flooding. Therefore there would not be any increased reservoir flood risk to nearby receptors. Also, given no reservoir flood extent associated with the

Harlowbury Brook, the Gilden Way improvement works would also not increase reservoir flood risk to the surrounding area.

The sensitivity of the local receptors to reservoir flood risk has been assessed as Low as properties and roads would be beyond the EA reservoir flooding maximum flood extents. The magnitude of effect has been assessed as Negligible or Minor Adverse as the Proposed Scheme would be almost entirely located outside the reservoir flood extents. Therefore, the overall effect of the Proposed Scheme on the environment due to reservoir flood risk has been assessed as Neutral.

Flood risk from services

Based on the Proposed Scheme design currently available it is not thought likely that the risk of flooding from services would be increased. The development would be designed in detail to avoid creating areas where the runoff from services could collect and form a flood risk.

The magnitude of the effect cannot be fully assessed until detailed positions of the proposed services are fully established; hence, the overall effect of the Proposed Scheme on the environment through flood risk from existing services cannot yet be fully confirmed at the outline design stage. The drainage system details would be designed in detail such that there would be a Neutral effect on the flood risk. Given a low sensitivity of Gilden Way to sewer flooding and an assumed Neutral magnitude of effect, the significance of effect has been assessed to be Neutral.

13.5.2.2 Geomorphology and water quality

Outfalls

The Proposed Scheme would seek to make use of existing outfall locations already present in both the Pincey Brook (one outfall by the M11 culvert) and Harlowbury Brook (two outfalls either side of the Gilden Way road bridge). Only one new outfall structure would be required in the Pincey Brook. The headwalls of the new outfall would require a length of the bank to be replaced with hard reinforcement (such as concrete). The new discharges in all three watercourses could potentially lead to:

- changes to flow and sediment dynamics due to new/changed discharges and potential changes to the channel cross-section;
- potential changes in erosion upstream and downstream of the structure (particularly with the new structure) due to changes in flow processes from new discharges; and
- increased suspended sediment input into the river potentially disturbing existing geomorphological features (including riffles, pools and areas of deposition).

Culverts

Two permanent crossings in the form of culverts are proposed on unnamed watercourse 1; the following are some of the key potential effects that could result from the use of culverts:

- changes to flow velocities, altering flow patterns within a channel;
- changes to the hydraulic roughness of a channel, i.e. altering the bed substrate, flow dynamics and sediment transport processes;
- changes in the amount of surface water runoff (including riparian drainage) entering a channel, potentially affecting the flow regime;
- increased potential for blockage with knock-on effects both upstream and downstream;
- potential alteration of downstream processes, including bed and bank stability;
- changes to patterns of erosion and sedimentation (both upstream and downstream), including disturbance to existing bed forms (i.e. pools and riffles); and
- changes to the cross-sectional size and shape of a channel, creating a uniform, artificial channel.

Other effects

The Proposed Scheme would also potentially increase the area of impervious surfaces (i.e. highway 'black-top' surfaces), particularly along the new offline section. An increase in the area of impervious surfaces could potentially alter the local drainage network, increasing surface water runoff; however, the flows would be largely attenuated.

Toe drains would be incorporated into the drainage design to capture surface water runoff from the adjacent agricultural land (i.e. natural runoff following a rainfall event). The drains would discharge into unnamed watercourse 1, via an open channel connection. The drains would be unlikely to require any additional modification to the watercourse and would discharge un-contaminated flows.

Water quality

During routine operation, pollutants such as oils and hydrocarbons from fuel combustion, salts or herbicides from road maintenance and metals such as copper and zinc from vehicles would be deposited on the road surfaces, resulting in the following primary pollutants:

- suspended solids;
- de-icing materials (i.e. salts);
- heavy metals; and
- hydrocarbons.

The following effects could potentially occur:

- suspended solids could smother substrate and increase turbidity with a consequent reduction in light penetration and lowering of oxygen levels;
- de-icing materials could cause high levels of Biological Oxygen Demand (BOD);
- heavy metals would be predominantly in soluble form and therefore potentially be more "bio-available" and particularly toxic; and
- main types of hydrocarbons would be PAHs. Polycyclic aromatic hydrocarbons are of particular concern as they are toxic to fresh water organisms.

Potential pollution effects can be classified into two groups; those directly and indirectly affecting water quality and those affecting the aquatic habitat quality. In broad terms, the former are metals that could chemically impair biological functions and the latter are sediments smothering feeding and breeding grounds and physically altering the habitat.

The following pollutants have been incorporated within the assessment process (i.e. HAWRAT):

- soluble pollutants associated with acute pollution effects, for dissolved copper and zinc; and
- sediment-bound pollutants associated with chronic pollution effects, total copper, zinc, cadmium, pyrene, fluoranthene, anthracene, phenanthrene and total PAH.

The watercourse receiving discharges have been assessed using the HAWRAT based on DMRB guidance from HD45/09. Table 13.8 provides an overview of the outcomes of the individual and in-combination outfall assessments (for Harlowbury Brook only).

Table 13.8: HAWRAT results for the Proposed Scheme

Outfall reference	Soluble – acute result	Sediment – chronic result	Assessment against Environmental Quality Standards (EQS)	Mitigation requirements
Pincey Brook (M11 drainage)	Pass	Pass	Pass	None required but wet attenuation pond incorporated in design
Pincey Brook (Sheering Road pond)	Pass	Pass	Pass	None required but wet attenuation pond incorporated in design
Harlowbury Brook (left bank)*	Pass	Pass	Pass	Failed initially so included a wet attenuation pond, oil interceptor and sediment trap acting to provide a 'Pass' across all parameters
Harlowbury Brook (right bank)*	Pass	Pass	Pass	Failed initially so included a wet attenuation pond, oil interceptor and sediment trap acting to provide a 'Pass' across all parameters
Harlowbury Brook (combined – both outfalls)*	Pass	Pass	Pass	Failed initially so included for each pond a wet attenuation pond, oil interceptor and sediment trap acting to provide a 'Pass' across all parameters

***Note: the low flow values for the Harlowbury Brook were not known and as a result a nominal 0.004 m^3/s has been assumed as worse case. The watercourse has been observed in the dry summer season and still contained flow, so would not be considered to have 'no flow'.**

13.5.2.3 Groundwater

Operational effects are the same as those in the construction phase, as detailed above in Section 13.5.1.3, with the exception of potential effects on groundwater quality due to the presence of SuDS ponds.

Surface runoff from operational carriageways could contain elevated concentrations of pollutants such as oils, suspended solids, metals (i.e. copper and zinc) and in winter, salt and antifreeze agents (i.e. ethylene glycol) leading to pollution of the aquifers. During the operational phase SuDS could provide a route for potential contamination to migrate through the unsaturated zone and affect groundwater quality of underlying aquifers. This has been assessed, prior to mitigation, as having a potential magnitude of effect of Moderate/Large.

13.6 Proposed Mitigation

13.6.1 Construction mitigation

13.6.1.1 Flood risk

The locations of services need to be ascertained before any work commences on site to avoid pipe bursts during construction and the development would be designed to avoid creating areas where the runoff from services could collect and form a flood risk.

To mitigate for the risk to surface water flooding during construction standard best-practice mitigation would be the development and implementation of a CEMP. The CEMP would include details of all temporary surface water drainage considerations. All consents and licences for working within the watercourses and associated

floodplains, and in close proximity to any existing water utilities, would be sought prior to any works commencing on site.

13.6.1.1 Geomorphology and water quality

To mitigate construction effects, a Code of Construction Practice (CoCP) would be implemented. All necessary consents and licences would be in place prior to the commencement of any works. The risk of pollution during construction would be reduced by adoption of good working practices and adherence to the EA's PPG and CIRIA Reports (CIRIA, 2006; CIRIA, 2007a; CIRIA, 2010). Pollution Prevention Guidelines are no longer current government guidance for England and a review is underway. Pollution Prevention Guidelines have been referred to in this chapter as a source of information on good practice only. It is acknowledged that the review will result in a replacement guidance series, with new branding and title "Guidance for Pollution Prevention".

Mitigation measures and best practices would be applied prior to and during construction. These would include but not be limited to:

- provision of sediment fences and sediment-trapping matting/bunds, reducing sediment input into watercourses;
- limiting the extent of vegetation clearance to necessary areas only thus reducing sediment input during clearance and the potential for release of sediment from bare ground following clearance;
- constructing structures during periods of low flow (typically during summer months) to reduce the risk of scour and erosion around the structure or to the disturbed river bed;
- use of drip trays under mobile plant;
- constructing adequate temporary storage lagoons to contain surface runoff and silt during the construction period;
- separating construction activities (including stock piling and vehicle washing) from the watercourse in accordance with the EA's PPG;
- provision of oil spill clean-up equipment (including absorbent material and inflatable booms) for use in the event of an oil spill or leak;
- using site construction materials free from contamination, avoiding any potential contamination of watercourses;
- ensuring that wet cement never comes into contact with watercourse or groundwater;
- testing of made and reworked soils to identify any contamination; and
- preparing an incident response plan prior to construction. This would be present on site throughout construction, informing all site workers of required actions in the event of a pollution incident.

13.6.1.2 Groundwater

Consultation with landowners would be undertaken at the detailed design stage to confirm no further unrecorded private water supplies were present in the vicinity of the Proposed Scheme.Additional GI information on soil and groundwater quality testing would still be required. Based on this, an appropriate level of water quality monitoring and treatment would be put in place (if required) to ensure no pollution at the discharge location. Mitigation measures have been proposed for surface water protection during construction and operation preventing or reducing potential for accidental contamination of all identified aquifers.

The Principal Contractor would be required to implement the CoCP. Contractors would also be required to operate in accordance with the EA's PPGs. Pollution Prevention Guidelines are no longer current government guidance for England and a review is underway as detailed above. All fuel, oil and chemicals would be stored in accordance with the requirements of the Control of Pollution (Oil Storage) Regulations 2001. Site runoff would be captured in temporary drainage arrangements, allowing any silt mobilised during construction to be deposited. Other possible mitigation measures would include treatment, if required, to ensure no pollution was caused at the point of discharge.

13.6.2 Operational mitigation

13.6.2.1 Flood risk

Fluvial

The two new culverts on unnamed watercourse 1 would be 2m by 2m diameter box culverts, significantly larger than that of the existing twin pipe culvert capacity. These have been sufficiently sized to convey the 1% (1 in 100) AEP flood event, including an allowance for climate change; allowing a sufficient capacity of flow. The proposed size of the two new culverts would also meet the criteria for mammal passage. Low flows would be accommodated by a low flow channel, to lower the risk of blockage and to minimise health and safety hazards.

The remainder of the watercourse would be realigned into an open channel. As the watercourse currently drains through a small culvert and runoff spills out for all but the smallest design storms, there would be a beneficial effect on flooding for the downstream reach of the unnamed watercourse. Should the water level exceed the bank height during floods (exceeding the 1% (1 in 100) AEP design event) water would flow overland to the Pincey Brook to the north. There would be no significant flood receptors in the flow path. The open channel would be appropriately positioned to avoid works occurring in close proximity to the route of the existing high pressure gas main.

The changes to the M11 road culvert across the Pincey Brook have been specifically designed to avoid any effects on the floodplain.

Surface water

The proposed development would result in additional hardstanding, with mitigation required to limit the runoff rates from the proposed development for a range of design storms up to the 1% (1 in 100) AEP event plus climate change. Desktop analysis and on-site soakage testing have confirmed that infiltration rates are currently generally low and groundwater levels could be relatively close to the surface. Hence, the proposed SuDS mitigation is to drain to the adjacent watercourses. In the case of discharge to watercourses, attenuation storage measures would be required to facilitate the restriction of surface runoff to the existing condition greenfield runoff rates for a range of design storms. Runoff discharge rates from areas/surfaces considered to be brownfield (i.e. the M11 and Gilden Way) are to be restricted by up to 50% of the existing 1 in 1 year rates.

Toe drains along the upslope (southern) side of the link road embankments would be required to collect runoff from the upslope greenfield catchment (including from the embankment slope) and drain it to the unnamed watercourse 1. At the proposed Sheering Road Roundabout cut off drains at the top of the small cutting slope on the southern side would be collected for discharge to the existing drainage ditch currently serving the area. The proposed drainage crossings would be designed not to cause flooding for flood events up to the 1% (1 in 100) AEP design storm. Appendix 13.2 provides the FRA which has details of the proposed drainage crossings.

The development would be designed and landscaped to avoid creating areas where the runoff from services could collect and create a flood risk.

Groundwater

The attenuation ponds would be lined to prevent the ingress of rising groundwater, with the design needing to also prevent flotation of the lining system when groundwater levels were high.

13.6.2.2 Geomorphology and water quality

Outfalls

The Proposed Scheme would make use of three existing outfall locations on the Pincey Brook and Harlowbury Brook, minimising in-channel modification and removal of the natural watercourse bed and/or bank. The new outfall on the Pincey Brook would be designed following good practice guidance and minimising the size of the

structure. The outfall would be located where the channel is currently culverted, so no natural bed and/or banks would be lost. It is recommended that the new outfall configurations are:

- directed downstream to minimise the effect to flow patterns;
- directed away from the banks of the watercourses to minimise any potential risk of erosion (particularly on the opposite bank); and
- minimised in size and extent of headwalls to reduce the potential effect on the banks.

All of the outfalls would be connected to attenuation ponds/systems, encouraging deposition of suspended sediments and providing some control to discharge levels.

Culverts

The lengths of the watercourse proposed to be culverted on the unnamed watercourse 1 would be designed in accordance with good practice, including:

- allowing for the passage of water and sediment for a range of flows (including low flow conditions). This could mean introducing a low flow channel into the bed of the culvert to retain sufficient depth of flow during low flow periods;
- depressing the invert of culverts to allow for formation of a more natural bed;
- using a culvert of a similar/larger cross-section size to existing (where applicable);
- increasing the roughness of culvert inverts to help reduce water velocities; and
- ensuring culverts were wide enough to allow ledges for passage of animals such as otters where appropriate.

The two culverts would also be mitigated for by the removal (daylighting) of the existing length of culvert on unnamed watercourse 1 currently under the agricultural fields. In total, when considering the new culverts, approximately 50m of channel would be daylighted and reconnected to the Pincey Brook, with an additional 170m of open channel.

Water quality

The proposed drainage design would incorporate measures to attenuate and treat carriageway runoff. This would be embedded as part of the Proposed Scheme, but could also be considered as mitigation. The drainage works would reduce (or eliminate) potential effects to an acceptable level for surface water quality. The two ponds discharging into Harlowbury Brook would have oil interceptors and sediment traps as well to minimise potential effects on water quality.

13.6.2.3 Groundwater

Surface water drainage systems, such as SuDS and swales, would be lined unless further detailed quantitative assessment and/or alternative agreement with the EA was reached during the subsequent detailed design phase. This is due to the proposed SuDS ponds that would be expected to intercept an EA designated Secondary Undifferentiated superficial aquifer. Groundwater level monitoring data are not available in close proximity of the SuDS locations and a degree of uncertainty remains on the thickness of unsaturated zone present (if any) below these SuDS locations. The majority of road runoff would pass through attenuation ponds prior to discharge, trapping sediment.

Other potential mitigation measures would include:

- treatment put in place, if required, to ensure no pollution caused at the point of discharge; and
- mitigation against any effect of settlement.

13.7 Residual Effects

13.7.1 Flood risk

Small areas of the Proposed Scheme would be located just outside the 1% (1 in 100) AEP river flood extents. Therefore, it has been assessed that there would be a residual risk that these areas of the Proposed Scheme could be exposed to flooding during very rare flood events (i.e. rarer than the event with a 0.1% (1 in 1000) AEP). Such rare events would need to be managed by the responsible authority with temporary speed restrictions, road closures and/or post-event structural checks and maintenance. The two proposed attenuation ponds adjacent to the Pincey Brook would have a reduced capacity during such floods and might be unable to attenuate the runoff from the road surfaces during local storms. If these attenuation ponds spilled over, the runoff across the embankments would enter the Pincey Brook directly.

The proposed highway surface water drainage system would be sized to a given storm exceedance probability in accordance with the relevant design guidance (i.e. DMRB or Sewers for Adoption for roads to be adopted by the local council). Therefore, it has been assessed that there would be a residual risk that the capacity of the proposed surface water drainage system could be exceeded, surcharging the system and in extremes, flooding the road.

Inadequate maintenance of existing and proposed surface water drainage systems could result in a build-up of sediments/organic matter thereby reducing the capacity of the piped drainage system. In the worst case, blockages could occur along the drainage network. The reduction in conveyance capacity and/or blockage could cause the affected drainage system to surcharge and potentially flood nearby flood receptors.

13.7.2 Geomorphology and water quality

The assessment has concluded that for both the construction and operational phases of the Proposed Scheme, all effects to geomorphology and surface water quality would be unlikely to have a significant residual effect on watercourses. The significance of effect has therefore been assessed to be **Neutral** or **Slight Adverse**.

Appendix 13.1 provides a summary of the WFD assessment. The assessment has concluded that the Proposed Scheme would not lead to the deterioration or prevention of the WFD objectives for either the Pincey Brook or Stort and Navigation WFD water bodies. It has been assessed that with the appropriate mitigation in place through inclusion of attenuation ponds, use of existing outfall structures and daylighting of approximately 50m of watercourse with an additional 170m of open channel, the Proposed Scheme would not have a significant effect on the WFD water bodies.

13.7.3 Groundwater

The Proposed Scheme has the potential to affect the groundwater quality of aquifers present in the study area and associated receptors. However, with implementation of appropriate mitigation measures, the overall significance of effect has been assessed to be **Neutral** to **Slight Adverse**. No mitigation measure would be required in terms of groundwater flow and associated receptors.

13.8 Summary and Conclusions

Overall the significance of effect from the Proposed Scheme on all sources of flood risk, geomorphology and water quality and groundwater has been assessed to be **Neutral** to **Slight Adverse**, if the appropriate mitigation outlined in Section 13.6 is implemented as part of the Proposed Scheme.

The proposed effects, mitigation and residual effects for the road drainage and the water environment are summarised in Table 13.9.

Table 13.9: Summary of water impacts

Description of effect	Significance of effect (prior to mitigation)	Proposed mitigation	Residual effect (after mitigation)
Construction effects			
Flood risk	Slight Adverse	Minimise working areas within the floodplain; implementation of a CEMP	Neutral
Fine sediment input to watercourses	Slight Adverse	Implementation of good practices and an EMP during construction	Neutral
Altering surface water runoff and drainage processes	Slight Adverse		Neutral
In-channel working leading to fine sediment input downstream, physical alteration of the channel cross-section	Moderate Adverse	Implementation of good practices and an EMP during construction. Minimising length of time working within the channel. Work at periods of low flow	Neutral
Water quality effects from construction vehicles and fine sediment	Moderate Adverse	Implementation of good practices and an EMP during construction	Neutral
Contamination risk to groundwater	Moderate to Large Adverse	Implementation of good practices and an EMP during construction.	Slight Adverse
Construction of embankments leading to compaction of drift deposits	Neutral	None required	Neutral
Operation effects			
Fluvial flood risk	Neutral	Hydraulic modelling for the with-scheme condition has been completed for the Pincey Brook and unnamed watercourse 1	Neutral
Surface water flood risk	Neutral	Hydraulic modelling of the proposed surface water drainage system proposals has been undertaken	Neutral
Groundwater flood risk	Neutral	Lining of detention basins	Neutral
Reservoir flood risk	Neutral	None required	Neutral
Flood risk from services	Neutral	None required	Neutral
Changes to fluvial geomorphology through presence of outfalls, particularly altering flow processes (Pincey Brook and Harlowbury Brook)	Moderate Adverse	Mitigation through following good practice design, using existing outfall structures and inclusion of attenuation ponds	Slight Adverse
Changes to fluvial geomorphology through new	Slight Adverse	Mitigation through following good practice design.	Neutral

Description of effect	Significance of effect (prior to mitigation)	Proposed mitigation	Residual effect (after mitigation)
two new culverts (unnamed watercourse 1)		Minimising length of culvert and extent of bank modification upstream and downstream. Removal of existing extensive culvert downstream and daylighting of approximately 50m of channel, with an additional 170m of open channel	
Altering surface water runoff through increasing impervious surfaces	Slight Adverse	Mitigation through design and appropriately designed drainage strategy	Neutral
Pollution incidences effecting water quality	Minor to Moderate Adverse	Appropriate SuDS and emergency procedures in place	Neutral to Slight Adverse
Road cuttings intercepting groundwater	Slight Adverse	Mitigation is not possible. Slight Adverse impact considered acceptable	Slight Adverse
SuDS providing a route for potential contamination to groundwater	Moderate to Large Adverse	Lining of ponds. Implementation of an appropriately designed drainage system	Slight Adverse

14. Cumulative Assessment

14.1 Proposed Scheme

This chapter provides an assessment of the potential cumulative effects of the Proposed Scheme, and those of the Proposed Scheme in combination with other major proposed developments. Cumulative effects occur when incremental environmental, social and economic impacts caused by past, present and reasonably foreseeable activities combine to create an additive or synergistic level of effect. They can occur during both the construction and operation stage of a scheme.

DMRB HA218/08 provides guidance on cumulative impact assessment (Highways Agency et al., 2008a) and advice that a cumulative effects normally fall into two categories, which are as follows:

Type 1 - Cumulative effects from a single project (or intra-development effects)

The effect arises from the combined action of a number of different environmental topic specific impacts upon a single receptor/resource.

Type 2 - Cumulative effects from different, nearby projects, in combination with the project being assessed (or inter-development effects)

The effects could arise from the combined action of a number of different projects, in combination with the project being assessed, on a single receptor/resource. This could include multiple impacts of the same or a similar type from a number of projects upon the same receptor/resource.

14.1.1 Legislative and planning context

The assessment of cumulative effects is required in EIA, in line with the Town and Country Planning (EIA) Regulations 2011 (amendment 2015) and guidance within DMRB Volume 11, Section 2, Part 5 (Highways Agency et al, 2008)

14.1.2 Study area

The study area for the identification of potential cumulative effects covers an area extending approximately 3km from the Proposed Scheme boundary.

14.2 Assumptions and Limitations

The traffic model used to inform the air quality and noise and vibration assessment takes into account projected traffic growth from planned development in the surrounding area of the Proposed Scheme. Therefore, the cumulative impact of development in terms of traffic has already been included as part of the environmental assessment and is therefore not reported separately in this chapter.

The ES has considered the emerging local plans from EFDC and EHDC in terms of indicative overall planned growth. However, Harlow has yet to publish their emerging local plan and each allocation lacks detail and has therefore not been assessed in this chapter.

14.3 Methodology and Assessment Criteria

14.3.1 Methodology

A checklist matrix approach has been used to assess the potential effects associated with interactions between environmental impact topics. (intra-development effects) The checklist provides an indication of what the combined impact of different impacts would be on each type of sensitive receptor.

For in combination effects a desk study has been completed to identify other committed developments (projects) in Harlow within 3km of the Proposed Scheme. Sensitive receptors have been identified based on consultation feedback, desk-based study and the results of specialist topic assessments. Professional judgement has been used to identify whether potential cumulative impacts could occur across the topics.

The following factors have been used in determining the potential significance of cumulative effects:

- The receptors/resources that could be affected;
- How the activity or activities could affect the condition of the receptor/resource;
- The likelihood of such effects occurring; and
- The ability of the receptor/resource to absorb further effects before the change becomes irreversible.

Effects are identified as direct, indirect, permanent or temporary. Their magnitude is identified, standard mitigation measures have been taken into account, and the residual significance of the effects assessed, using the guidance in DMRB Volume 11, Section 2, Part 5.

14.3.2 Assessment of magnitude and significance

The five categories adopted from DMRB Volume 11, Section 2 part 5 Table 2.6 were used as a framework for determining significance of cumulative effects as shown in Table 14.1 below

Table 14.1 Framework for determining significance of cumulative effects

Significance	Effect
Severe	Effects that the decision-maker must take into account as the receptor/resource is irretrievably compromised.
Major	Effects that may become key decision-making issue.
Moderate	Effects that are unlikely to become issues on whether the project design should be selected, but where future work may be needed to improve on current performance.
Minor	Effects that are locally significant.
Not Significant	Effects that are beyond the current forecasting ability or are within the ability of the resource to absorb such change..

14.4 Baseline Environment

A planning history search was carried out using the electronic planning application registers and searching on ECC, EFDC and HC websites. Table 14.2 lists details of local schemes known to be planned for construction between 2016 and 2022. There locations can be seen on Figure 14.1.

Table 14.2: Schemes and developments within 3km of the Proposed Scheme

Development (Scheme)	Description	Programme	Distance from Proposed Scheme (approx) (km)
A414 Edinburgh Way/ Cambridge Road Junction Improvement Scheme	Widening of the A414 Edinburgh Way leading from Cambridge Road Roundabout to a dual carriageway, as far as the	• Preliminary works due to commence late 2016 • Construction expected to start early	0.8

Development (Scheme)	Description	Programme	Distance from Proposed Scheme (approx) (km)
	River Way Roundabout and the existing signals at East Road upgraded.	2017.	
A414/First Avenue Roundabout Junction Improvement Scheme	Widening of First Avenue (B183) to two lanes in each direction between the A414 and London Road and a dedicated left turn created onto the A414.	• Main construction late autumn 2015 and expected to continue until 2016/2017	Adjacent
Harlowbury Housing Development	Planning permission has been granted for Harlowbury housing development and it is under construction. Planning permission reference HM/PL/00055 granted outline planning permission in November 2012 for 1,100 dwellings, a new primary school, community buildings and commercial/retail/live work accommodation. Reserved Matters approval has been granted for Phase 1 of 716 homes and a community building under planning permission reference 15/00006 and for Phase 2 was granted for a further 195 homes in December 2015, planning reference HW/REM/15/00389 and HW/PL/15/00389. The total number of homes with full planning permission at Harlowbury currently stands at 911.	• Development completion was expected in Dec 2018 but commencement has been delayed as not all pre-commencement conditions have been discharged	Adjacent
London Road Enterprise Zone Access and Link Road	Improvement to the A414/ London Road Enterprise Zone access and link road. Signal controlled junction with the A414 and the Enterprise Zone site, and construction of a new link road from the junction with the A414 through the Enterprise Zone Site to	• Advance works to move utility cables and plant in July 2015 • Main construction in Oct 2015 and is expected to continue until winter of 2016/2017	0.4

Development (Scheme)	Description	Programme	Distance from Proposed Scheme (approx) (km)
	London Road.		
London Road North Enterprise Zone	14 hectare Greenfield site available for design and build opportunities with a focus on the Med Tech, Life Science and ICT sectors.	• First building on site by the end of 2016. • Local Development Order in place.	0.3
London Road South (Kao Park) Enterprise Zone	9 hectares re-development site at the London Road Campus; comprise the creation of a 32,000m^2 data centre complex combined with the development of a 20,000m^2 business park providing grade A offices space on the remainder of the site.	• Work commenced in Dec 2014, still on-going in 2016.	1.0
New Hall Phases I and II Housing Development	Phase 1 to build 440 homes is nearing completion. Planning permission reference HW/PL/04/00302 granted in June 2012 for 2,300 dwellings including parkland and recreation, employment and a neighbourhood centre. Reserved Matters approval for Parcel 1 of Phase II (328 homes via two linked applications) was granted in June 2013. Reserved Matters Approval for Phase II Parcel 2 (239 homes) was granted in March 2014. Reserved Matters applications for further phases of development are yet to be confirmed. The site of the nursery on Gilden Way is identified to accommodate the car park and pavilion for the proposed playing fields as part of Phase II.	• Reserved matter permission has been granted for 440 homes in Phase I nearing completion. Phase II parcels 1 and 2 secured Reserved Matters approval in 2013 and 12014 respectively amounting to a further 567 homes. • Further phases of development are pending.	Adjacent
Templefields Access	New access from Cambridge Road to the	• Works due to begin in spring 2017 and will	1.0

Development (Scheme)	Description	Programme	Distance from Proposed Scheme (approx) (km)
Road	Templefields Enterprise Zone on River Way. The access will be signal controlled junction with traffic only being able to turn right out of River Way and access left from Cambridge Road. This works will run parallel with the Edinburgh way/ Cambridge works.	take up to a year.	
Templefields North East Enterprise Zone	Existing industrial estate offering SME manufacturing space and longer term re-development opportunities. A condition of the LDO is that additional employment growth at this site cannot be brought forward without the provision of Junction 7a on the M11.	• Local Development Order in place.	1.0

14.5 Cumulative Assessment

There are two main types of cumulative assessment as identified in DMRB Section 2 Part 5 IX c:

- Type 1 cumulative effect from a single scheme can only be identified as part of the EIA process and there is no additional baseline information for this Scheme to that already described in Chapters 5 – 13.
- Type 2 cumulative effects from different project; in combination with the project being assessed requires an understanding of local development and specific schemes.

Each of these types could have temporary (construction) effects and permanent (for the life of the scheme and beyond) effects. Most of the effects would be caused by direct impacts such as a change in air quality. However there could also be indirect effects such as houses being built and the owners having cats that prey on local wildlife. These are separated out within the following sections.

14.5.1 Type 1 cumulative assessment

Table 14.3 gives an indication as to the main areas where these effects could occur (based on guidance given in DMRB section 2 part 5).

Table 14.3: Type 1 – Interactions between M11 Junction 7A environmental topics

Sensitive receptors	Construction phase								Operation phase								
	Air Quality	Noise and Vibration	Construction traffic	Road Drainage and Water Environment	Landscape Changes	Visual changes	Direct land take	Access	Air Quality	Noise and Vibration	Traffic flows	Road Drainage and Water Environment	Landscape Changes	Visual Changes	Direct land take	Community Effects	Access
Local residents – London Rd - Churchgate	X	X	X	N	X	X	n/a	X	✓	X	✓*	N	X	X	n/a	X	✓
Local residents – Churchgate – Mayfield Farm	X	X	X	N	X	X	n/a	X	✓	✓*	✓*	N	X	X	n/a	X	✓
Local residents – Mayfield Farm – Pincey Brook roundabout (The Campions)	X	X	X	N	X	X	n/a	X	✓	✓	✓*	N	X	X*	n/a	✓	✓
Recreational users	X	X	X	N	X	X	X	X	✓	X	✓*	N	X	X	X	X	✓
Road/rail users	n/a	n/a	X	N	X	X	n/a	X	n/a	n/a	✓*	N	X	X	n/a	✓	✓
Non-motorised users	X	X	X	N	X	X	n/a	X	✓	X	N	N	X	X	n/a	✓	✓
Agriculture (including allotments)	X	X	X	N	X	n/a	X#	n/a	✓	N	n/a	N	n/a	n/a	X#	N	X
Businesses	X	X	X	N	X	X	n/a	n/a	✓	N	n/a	N	n/a	X	X	✓*	✓

Sensitive receptors	Construction phase								Operation phase								
	Air Quality	Noise and Vibration	Construction traffic	Road Drainage and Water Environment	Landscape Changes	Visual changes	Direct land take	Access	Air Quality	Noise and Vibration	Traffic flows	Road Drainage and Water Environment	Landscape Changes	Visual Changes	Direct land take	Community Effects	Access
Wider community including schools	X	X	X	N	X	X	n/a	X	✓	X	X	N	n/a	X	n/a	n/a	✓
Protected species/ ecology	X	X	X	N	X	X	X	n/a	✓	X	X	✓	✓*	X	X*	n/a	n/a
Cultural Heritage	n/a	X	n/a	n/a	X	X	X	n/a	n/a	x	n/a	n/a	N	X	n/a	n/a	n/a
Groundwater	n/a	n/a	n/a	N	n/a	n/a	n/a	n/a	n/a	n/a	n/a	N	n/a	n/a	n/a	n/a	n/a
Flood Risk	n/a	n/a	n/a	N	n/a	n/a	n/a	n/a	n/a	n/a	n/a	N	n/a	n/a	n/a	n/a	n/a
Landscape Character	n/a	n/a	n/a	X	n/a	n/a	X	n/a	n/a	n/a	n/a	X*	n/a	n/a	X	n/a	n/a

Key

X - Indicates a potential negative impact

✓ - Indicates a potential positive impact

N – Neutral

n/a – not applicable i.e. the receptor not affected by the aspect i.e. protected species and air quality whereby no ecological receptors within identified range

X* Across all assessment areas the effect is a potential negative effect although within the assessment there are some individual potential positive impacts

✓* Across all assessment areas the effect is a potential beneficial effect although within the assessment there are some individual potential negative impacts

X# Potential for very short-term significant impact to remain

As can be seen from Table 14.3 local residents along Gilden Way and Sheering Road, recreational users, NMUs, agriculture, businesses and protected species would all be affected by a combination of factors during the construction phase. Cultural heritage would be affected by noise and vibration and visual changes at a number of locations such as within the Conservation Areas and Mayfield Farm. There would be a net loss of archaeology from landtake. Within the ES, none of these factors has been considered to be significant on its own for any of the receptors. However, in combination it could be considered that a more significant effect would occur. The outline EMP which accompanies this report itemises good practice and procedures that a contractor would follow to minimise the adverse effects from construction processes. It is therefore considered that the negative cumulative effects would only be locally significant. Hence a Minor effect would be expected. The loss of archaeology would be considered to be off-set by recording practices as described in Chapter 6 (Cultural Heritage) and would not have an increased cumulative effect.

During operation of the Proposed Scheme, air quality would generally improve along Gilden Way and Sheering Road, except for some properties towards the west end of Gilden Way. The cumulative assessment has assumed the noise barriers as outlined in Chapter 11 (Noise and Vibration). As such some residents from London Road to Churchgate would suffer from increased noise levels, lower air quality, visual degradation and possibly a severance from some community facilities due to increased traffic and positioning of noise barriers. This would be considered as a Moderate effect which would benefit from improvements. With further noise modelling and careful positioning of noise barriers, it is expected that this would reduce to a local or Minor effect. Many residents would however benefit from improved air quality, less congestion and improved access to the motorway network when the Proposed Scheme is complete. Residents from Churchgate Roundabout to Princey Brook Roundabout (including The Campions) would be affected by changes in views and landscape. They would however benefit from an improvement in air quality, traffic flows and at The Campions a traffic reduction along the old Sheering Road as the majority of traffic would divert onto the new highway. It is considered that in the area of The Campions there would be a Minor positive cumulative impact.

Some recreational users would be affected by increases in noise levels, loss of land (from positioning of the attenuation pond) and visual changes. However, many would benefit from the positioning of noise barriers alongside the playing field near the Churchgate Roundabout, reducing noise levels, loss of balls and visual intrusion. It is considered that the cumulative effects on this user group would be Not significant or Minor positive.

Non-motorised users would be adversely affected by noise and visual changes. NMUs generally would be between the road and the noise barriers so would suffer increased noise levels (as seen on Figure 11.2 and in Chapter 11 Noise and Vibration). They would also be affected by partial severance from community facilities such as bus stops by the installation of noise barriers and increased amounts of traffic. The effects on NMUs have therefore been assessed as a Moderate effect which could benefit from improvements. Further work is expected to be carried out to refine the positioning of the noise barriers and utilise low noise surfacing which could mitigate this effect. There would, be improvements in air quality, increased locations to cross the Gilden Way and improved footway/cycleway for NMUs.

Nature conservation of the area would be affected by an increase in noise levels, traffic increases leading to collisions and visual disturbance from increased lighting all mainly in the Link Area. This cumulative impact would increase the likelihood of disturbance to the local wildlife and has been assessed as a Minor effect.

14.5.1 Type 2 cumulative assessment

14.5.1.1 Construction

Potential environmental impacts of the developments outlined in Table 14.2 could combine with those identified from the Proposed Scheme. These developments have already been accounted for within the traffic models used for the air quality and the noise assessments and therefore included within the air and noise quality assessments for the operational phase of the Proposed Scheme. They have therefore not been considered any further.

It is difficult to accurately predict those developments which would be under construction at the same time as the Scheme. The Harlowbury Housing Development (which directly abuts the Proposed Scheme between the Churchgate Roundabout and Marsh Lane) is scheduled to be complete by the end of 2018 but is currently behind schedule. This proposed development along the Gilden Way is due to commence with advanced vegetation clearance and environmental mitigation works at the beginning of 2018. There would therefore be some overlap of works creating a potential cumulative impact particularly in the areas surrounding the Harlowbury development. This would be limited to some extent in that the main construction works of the development would not be due to start until mid-2019. There would, however, potentially be increased impacts of noise, dust and air quality, visual intrusion and construction traffic on local residents, road users, NMUs, and the local ecology. In addition to this there could be a cumulative impact of time in that if the Harlowbury Development was not built in the same time period as the Proposed Scheme there would be an extended period of construction impacts.

The New Hall Phase I development has already been partially built but it is possible that construction of New Hall Phase II would take place in the same time period as that for the Proposed Scheme. New Hall Phase II housing development would be adjacent to the Gilden Way at the London Road end with playing fields directly abutting the road. It would continue to the south of the properties on Gilden Way and the Gilden Way Meadow local wildlife site (LWS) as shown on Figure 14.1. This would produce cumulative impacts on residents in the Chippingfield area of Old Harlow, the Allotment Gardens, the cricket grounds, users of local footpaths, the LWS including great crested newts, the setting of the Scheduled Monument and spillage risks to the Harlowbury Brook.

The other proposed developments would be unlikely to produce significant cumulative impacts other than from construction traffic accessing on local roads. The two A414 schemes are due to be completed by 2017, prior to commencement of the Proposed Scheme.

Air quality

There would be an increase in the incidence of dust with additional developments. However, with the appropriate mitigation measures implemented at these sites, the residual effect has been assessed as not being significant.

However any additional construction traffic would potentially cause a significant change in heavy duty vehicle (HDV) flows on local roads with relevant receptors (i.e. DMRB HA207/07 screening criterion HDV Change >200 vehicle per day) A significant effect has been assessed. Further assessment and possibly further modelling would be required to determine the impact and mitigation measures where necessary.

Cultural heritage

Construction of the proposed Harlowbury development north of Gilden Way and New Hall Phase 2 housing developments would result in further removal of archaeological remains (Roger Evans Associates 2004; LDA Design 2011). After implementation of appropriate mitigation measures, this effect has been assessed to be Not significant. Visual and noise impacts on the setting of heritage assets during construction of both developments would be temporary in nature and have also been assessed as Not significant.

Nature conservation

There would be a reduction in nesting habitat for birds, particularly due to a decrease in arable farmland as a result of the development of the Harlowbury and New Hall sites. Cumulative impacts of dust, noise and lighting disturbance would occur. Construction methodologies and timings are indicative for all developments at this stage, construction traffic and noise levels would need to be modelled to assess the effects on bat roosts at a later date once contractors had been appointed. Construction lighting impacts would need to be assessed for effects on foraging and commuting bats particularly where there are key flight lines for bats crossing the Gilden Way in the vicinity of the Harlowbury development. Dust and spillage impacts on local habitats and in particular on pond water quality in the Gilden Way Meadow with its knock on effects on GCN would need to be controlled by methodologies outlined in the development CEMPs.

Geology and soils

Due to the possible excavation and removal of soil from the New Hall Phase II Housing Development and the Harlowbury Housing Development developments during construction, there could be a potential for the superficial geology to be exposed at the surface following construction. This could expose superficial aquifers to contamination. This could add to the amount of aquifer exposure for the Proposed Scheme.

The New Hall Phase II Housing Development and the Harlowbury Housing Development could result in accidental spills or leaks of contaminants during construction potentially impacting on groundwater quality. This could increase the contaminant loading on groundwater making it less resilient to potential contamination caused by accidental releases from the Proposed Scheme.

The Harlowbury Housing Development is shown overlying the former gravel pit bordered by Marsh Lane and Gilden Way. This old gravel pit has possibly been infilled with domestic waste. If this material were to be disturbed, it could add to the potential contamination impacts caused by the Proposed Scheme, such as mobilising contamination and impairing groundwater quality, releasing landfill gas, creating new gas migration pathways to nearby properties or other infrastructure, or generating contaminated dust or mud. Alternatively, the development could lead to remediation of the former waste tip such that potential impacts caused by the Proposed Scheme were reduced.

Materials

The potential for inter-project effects to occur for waste and materials is considered in the context of the developments (projects) listed above. It is anticipated that the developments (projects) would all generate waste during construction and operation, and that waste would require treatment and/or disposal at third party waste management facilities. The developments (projects) would also require the import of materials such as blacktop, steel and concrete during construction. The waste and material arisings anticipated to be generated by these projects or the timescales over which waste and materials would be generated and materials required, are not known at this time. However, as some of the developments would create demand for resources and waste treatment at a similar time to the construction of the Proposed Scheme.

During the construction works, best practice waste management would be expected to be carried out and, in line with policy, the waste hierarchy implemented. It is assumed that any wastes generated on site, considered as materials such as topsoil, rock and aggregates, would be reused on the site of the Proposed Scheme or on other development sites.

Noise and vibration

Noise and vibration for the Proposed Scheme has been based on specific construction techniques at specific locations. To carry out a full cumulative assessment, similar detail from other developments would need to be obtained. Without knowledge of site layouts or construction techniques it is not possible to carry out an accurate assessment. However, it is likely that with the increased number of construction sites in the area, there would be an overall increase in noise levels. With appropriate on-site controls as described in Chapter 11 Noise and Vibration and in the outline EMP the cumulative noise effect would be considered to be Not significant. Vibration effects generally only occur very locally (no more than 8 metres distance) and therefore this type of effect has not been considered any further in this cumulative assessment.

People and communities

There would be a cumulative increase in the amount of agricultural land lost, although the classification of these areas is not known. There would be increased effects from noise, dust, construction traffic and inconvenience due to footpath diversions for residents, businesses and NMUs. These effects would be temporary and would be considered Not significant.

Water quality and drainage

Cumulative effects for the water environment cover flood risk, geomorphology and Water Framework Directive and groundwater. There are two developments that would be likely to potentially feed into the same fluvial and groundwater systems as the Proposed Scheme. These are the Harlowbury Housing Development and the New Hall Phase II Housing Development. Also during construction, the Proposed Scheme has been assessed as a Neutral effect with mitigation in place.

14.5.1.2 Operation

As explained earlier in this chapter, the traffic data provided for the do-something scenario (DS) for air quality and noise considered the proposed and committed developments. These topics are therefore not covered in this section. During the operation of the Proposed Scheme and the developments listed in Table 14.2, the following issues would be expected to suffer from cumulative effects:

Cultural heritage

Environmental Statements prepared for the New Hall Phase II and Harlowbury housing developments have not identified any significant residual effects on cultural heritage assets following mitigation (Roger Evans Associates 2004; LDA Design 2011). Consequently, the significance of the cumulative impact including the Proposed Scheme has been assessed as Slight adverse for all three cultural heritage subtopics.

Landscape and visual

The Proposed Scheme would serve in part to accommodate the additional traffic of people living in the Harlowbury development and the New Hall development (soon to commence construction). The Harlowbury development is in a Special Restraint Area (Adopted Replacement Harlow Local Plan 2006) north of Gilden Way. This is land protected until needed to meet future development needs. It is within the landscape character area of Little Hallingbury Ridges and Slopes. This area is rated in the Harlow Area Landscape and Environment Study (2005) as potentially having a moderate sensitivity to substantial or very extensive urban development. The New Hall Development south of Gilden Way is in the Jack's Hatch to Church Langley Ridge and Slope area with a low sensitivity rating for substantial or very extensive urban development. Both of these developments would substantially expand the developed area of north Harlow into rural land. There would be road improvements connected with the development.

The proposed roundabouts at the M11 and near Sheering Road would also provide convenient points of access to rural land on the south slope of the Pincey Brook valley within the Green Belt. This would be likely to cause pressure for further reviews and revisions of the Green Belt, allowing further substantial urban development or incremental smaller developments. The potential result of this is an eventual expansion of the developed area of Harlow north to Pincey Brook.

This assessment for cumulative effects adopts criteria in Appendix 7.1 (Methodology for Assessment of Landscape and Visual Effects, Table 5, Descriptors of significance of landscape and visual effects). Taken collectively the Proposed Scheme and its development implications as described above would:

- conflict with the character (including quality and value) of the landscape (in the Pincey Brook valley especially);
- diminish a sense of place (as experienced by anyone walking along Footpath 204_17 near to Pincey Brook, and by residents in the Grade II* Listed Sheering Hall).

For these reasons the cumulative landscape impact of the Proposed Scheme is assessed as moderate adverse.

Nature conservation

The loss and fragmentation of habitats across the Proposed Scheme would be exacerbated due to additional land take on the Harlowbury and New Hall developments. Whereas some fauna could move into the adjacent fields from the verges along Gilden Way, the nearby developments would lead to the loss of habitat. The New Hall Development to the south of Gilden Way would in particular isolate the Gilden Way Meadow LWS where GCN and other fauna have been found to be located. This could restrict the extent of habitats available to the newts.

There would be an increase in traffic leading to increased risk of collision (birds, bats, otter, badger, great crested newt), increased air pollution, increased risk of surface water pollution events (i.e. due to spillages on roads) and an increase in noise;

More housing would cause an increase in numbers of cats, leading to increased bird, bat, amphibians and reptile predation (an example of an indirect effect). In addition, there would be an increase in night-time light levels causing disturbance to wildlife.

Post construction a slight negative effect has therefore been predicted for birds in respect of the loss of nesting habitat. For bats there would be a loss of flight lines and lighting impacts. This would also apply to birds, bats, amphibians and reptiles in respect of cat predation.

Geology and soils

The New Hall Phase II Housing Development would result in the loss of Grade 2 agricultural land. This would add to the loss of this grade of land in the same area as caused by the Proposed Scheme.

The Harlowbury Housing Development could result in the loss of Grade 3 agricultural land. This would add to the loss of this grade land in the same area as caused by the Proposed Scheme.

During operation of the New Hall Phase II Housing Development and the Harlowbury Housing Development there could be some low loading of groundwater from petroleum hydrocarbons, metals and suspended solids from the new road surfaces. There would also be a potential for spillages of minor volumes of hydrocarbons increasing the contaminant loading.

Overall the additional impacts would not change the original assessment of neutral to slight or slight to moderate for agricultural soils.

Materials

Given the nature of the developments (projects) , effective waste management procedures would be expected to be implemented on site including waste minimisation, reuse and waste segregation. This would ensure the effective management of wastes to minimise the amount of waste and to recover the maximum value from the wastes produced. It has not been possible to assess the inter-project effects due to the lack of waste arising and materials information. However, it is recognised that the inter-project effects would be likely to increase the amount of materials.

People and communities

It has been assessed that there would be improved access for cyclists and pedestrians along the Gilden Way in the form of a joint pedestrian/cycleway. This cycleway would be expected to link into the one being built as part of the Harlowbury scheme to allow access along the length of Gilden Way. New community facilities are proposed as part of the Harlowbury and New Hall developments benefitting the community.

There would be a negative cumulative effect on the quantity of best and most versatile agricultural land already assessed to be major negative for the Proposed Scheme. Agricultural land classifications are not known for the land directly affected by surrounding developments.

Road drainage and water environment

The operation of Harlowbury Housing Development and the New Hall Phase II Housing Development alongside the Proposed Scheme would be likely to require additional discharges to either the Pincey Brook or the Harlowbury Brook (or both), as these are the two key watercourses within the study area. The new outfall structures and additional discharges have not been assessed as significant cumulative effects, on the assumption that appropriate mitigation would be adopted by the other developments such as: controlled rates of discharge, standard design, good practice and allowance for climate change. The Proposed Scheme and the Harlowbury Housing Development combined would have the potential for a cumulative effect on the flood zones along the Harlowbury Brook. Cumulative effects have not been assessed as significant. Both schemes would be required to independently mitigate impact on flood risk.

14.6 Summary and Conclusions

In summary, there are several locations along the Gilden Way and in the Link Area that would potentially be affected on a cumulative basis. Some of these effects would be temporary (during the construction process) and some more permanent (for the life of the developments/projects).

14.6.1 Type 1 temporary cumulative effects

The combined effects of dust, noise, construction traffic, visual intrusion, direct landtake and restricted access would impact on all residential and business properties along the Gilden Way and Sheering Road, recreational users particularly of the playing field, NMUs and protected species.

It is expected that good construction techniques would be employed on the development site such that dust, noise, and access issues were kept to a minimum. As construction of the Proposed Scheme progressed, construction traffic would be able to access directly from the new M11 Junction 7A alleviating some of these effects.

14.6.2 Type 1 permanent cumulative effects

Some residents along the Gilden Way, particularly between London Road and Churchgate Roundabout would suffer from increased noise levels mitigated by the erection of noise barriers in conjunction with a degradation of views. In addition, there would be some community severance to these properties due to the increase in traffic throughout the area.

Recreational users of the playing fields along the Gilden Way would have a reduction in accessible land area due to the installation of an attenuation pond. However, they would benefit from a more enclosed area with an improvement in air quality and noise levels and ease of access into Harlow and to the M11.

NMUs would be adversely affected by increased noise levels and may feel some severance from facilities and visual intrusion due to noise barriers lining the footpath/cycleway. They should however find travel in the area easier due to the provision of a new footpath/cycleway although crossing the Gilden Way could be harder due to the increase in traffic flows. This has been mitigated by the provision of more toucan crossing points throughout.

Protected species and ecology would be negatively impacted by increased noise and light levels and traffic (causing traffic strike) across the Proposed Scheme. Although there would be a loss of habitats particularly in the Link Area, this would be off-set by replacement planting and drainage installations creating a beneficial habitat effect. In addition, improved air quality would most likely have a beneficial effect.

14.6.3 Type 2 temporary cumulative effects

It is difficult to predict the nature of cumulative effects of adjacent developments since the construction programmes of Harlowbury, New Hall and other sites are not known at the time of writing. However, it is assumed that Harlowbury and New Hall Phase II would at some point be under construction in the same period of time as the Proposed Scheme. It would therefore be reasonable to expect an increased impact of dust, noise, construction traffic, community severance and a degradation of views, on all residents and NMUs in the immediate vicinity.

In addition, there would be an increased risk of spillages and release of contaminants increasing the possibility of contamination of waterways and aquifers. It is assumed that the surrounding developments would follow good practice as laid out in a CEMP, and thereby minimise these effects.

The ecology of the area would be likely to be detrimentally affected by adjacent construction, with increased disturbance from noise, construction traffic and lighting and the increased deposition of dust.

It is expected that good construction techniques would be employed on the development site such that dust, noise and access issues were kept to a minimum. Construction traffic would increase in volume. However, should the Proposed Scheme be built prior to or concurrently with the other developments, there would be scope for the construction traffic for all developments to access via the M11 Junction 7A rather than via local roads from Junction 7, therefore reducing associated effects from construction traffic within an urban environment.

14.6.4 Type 2 permanent cumulative effects

The traffic figures used as the basis for the air quality and noise assessments have taken account of the New Hall and Harlowbury developments; hence these have already been accounted for in both assessments.

The main topic areas where there would be a significant increase in effects as a result of other developments in the area are nature conservation, landscape and visual and people and communities, particularly the loss of agricultural land.

Wildlife in the area would suffer from increased general noise and lighting disturbance and mortality from traffic strike and cat predation. In addition, populations could become more fragmented. The landscape character and views in the area would increasingly change from rural to more urban. An increased area of agricultural soils would be lost with the associated loss of agricultural business.

15. Summary and Conclusions

This section summarises the findings of the Environmental Impact Assessment (EIA) reported in this Environmental Statement (ES). These are summarised in Table15.1 for each topic area. The potential impact is described in the first column, whilst the final column shows the residual effects following mitigation (described in the middle column of the table). For further explanation and detail, the reader is to refer to the individual topic chapters.

Table 16.1: Summary of residual environmental effects after mitigation

Description of impacts	Proposed mitigation	Residual effects (after mitigation)
Air Quality (no residual effects) (Chapter 5)		
Cultural Heritage (Chapter 6)		
Archaeological remains	Implementation of a staged programme of archaeological investigation, followed by assessment, analysis and publication of results.	Slight Adverse
Setting of historic buildings	Photographic survey informed by Historic England guidance and landscape planting referred in Landscape and Visual section below.	Neutral to Slight Adverse
Landscape and Visual (Chapter 7)		
Loss of mature woodland protected by Tree Preservation Order (TPO) (0.43 hectares (ha))	Proposed woodland planting totalling over 16ha. Woodland planting could not be fully mitigated for the loss of mature trees.	Moderate Adverse
Loss of other woodland/hedges and scrub (3.12ha)	Proposed woodland hedges and other native planting totalling over 19ha (including the 16ha above), plus planting areas of scattered scrub and 361 individual trees of a larger size. Woodland planting could not fully mitigate for the loss of mature trees.	Slight Adverse
Effect of proposed lighting	Proposed planting would not mitigate for road lighting. The new LED lighting would have full cut-off lanterns focused on the road and limit light spill to adjacent properties.	Neutral in Harlow (urban), Moderate Adverse in the countryside (rural)
Effects of scheme earthworks on landform	Proposed earth mounding would not mitigate effects on landform but landscape planting would soften and disguise embankments and cuttings. However, the impact would still remain the same.	Moderate Adverse
Reduction of tranquillity	Extensive screen planting with woodland, hedges, scrub and planting of many individual trees.	Slight Adverse

Description of impacts	Proposed mitigation	Residual effects (after mitigation)
Effect on the townscape of the Harlow local character areas due to vegetation losses and the visual severance effect of road widening and noise barriers	Replacement hedge and tree planting and amenity planting; hedges and climbing plants to screen noise barriers.	Slight Adverse
Effect on the landscape character in the Pincey Brook valley due to encroachment of roads roundabouts, lighting and traffic into the Pincey Brook valley	Earth mounding, extensive screen planting with woodland, hedges, scrub and planting of many individual trees.	Moderate Adverse (local)
Visual effects at residential properties	Reinstatement of roadside hedges and other screen planting.	0 Large Adverse; 9 Moderate Adverse; 73 Slight Adverse; and 9 Slight Beneficial (Year 15)
Visual effects on road users (Sheering Road north of Pincey Brook)	Reinstatement of roadside hedges and other screen planting.	Slight Adverse (Year 15)
Visual effects on Public Right of Ways (PRoWs) (Each PRoW only recorded once at location with greatest effect)	Reinstatement of roadside hedges and other screen planting; however, for one receptor the impact would still remain the same.	1 Large Adverse; 0 Moderate Adverse; and 9 Slight Adverse (Year 15)
Nature Conservation[14] (Chapter 8)		
Habitat loss – Gilden Way Roundabout Protected Wildlife Verge (PWV)	Compensation and enhancement landscape planting of species-rich grassland especially Betony (local rare plant). However, the impact would still remain the same as the PWV would be lost.	Slight Adverse
Habitat loss – bats	Removal of recorded bat roost trees to be undertaken under Ecological Protected Species (EPS) licence. Compensation planting and woodland reinforcing planting would be carried out for the loss of confirmed and high potential roost habitat. However, the impact would still remain the same.	Slight Adverse
Reduction in local birds population from habitat loss/fragmentation especially for skylark	Timings control on vegetation clearance in construction programme to ensure that the bird nesting habitat is removed outside the nesting season. Introduction of hop-over fences, acoustic fencing and	Slight Adverse

[14] It should be noted that the term 'adverse' is used in preference to 'negative' as is used in the CIEEM Guidelines and in Chapter 8 – Nature Conservation within the Environmental Statement in this table. This is to provide consistency in terminology across all discipline sections within the table.

Description of impacts	Proposed mitigation	Residual effects (after mitigation)
	reduction of speed limit to off-set increase risk of traffic collision to birds. Provision of LED lamps, lower lighting columns and landscape planting to reduce disturbance to birds. However, the impact would still remain the same.	
Impact to foraging and commuting bats from traffic collision, noise/air pollution and night-time light levels	Provision of multi-purpose mammal underpasses, hop-over fences, acoustic fences, associated landscape planting, reduction of speed limit and sensitive lighting to reduce disturbance to bats and the risk of collision with traffic.	Slight Adverse
Impacts to local otter population	Implementation of good practices and Construction Environmental Management Plan (CEMP). Provision of multi-species underpasses in combination with fencing, landscape planting and sensitive lighting to reduce disturbance to otters and the risk of collision with traffic.	Neutral to Slight Adverse
Geology and Soils (Chapter 9)		
Dust or mud from soils containing elevated concentrations of contaminants impacting on general public	A Construction Environmental Management Plan (CEMP) would be prepared and implemented to control contamination risk to the public.	Neutral to Slight Adverse
Loss of high grade agricultural soils within the scheme footprint	Manage and reduce loss of soil with Soil Management Plan (SMP) and Materials Management Plan (MMP); however, would not be fully mitigated, loss could only be reduced.	Slight to Moderate Adverse
Gas accumulation in voids	Additional monitoring and gas sample collection to refine gas risk assessment and design mitigation measures as part of the Proposed Scheme, if required.	Slight Adverse
Risk of encountering Unexploded Ordnance (UXO)	Recommended that a targeted investigation would be carried out prior to any construction works commencing. There is a risk associated with UXO. The slight adverse effect refers to the risk posed.	Slight Adverse
Risk of encountering unstable ground conditions	Potential ground instability would be mitigated as part of the Proposed Scheme design. The slight adverse effect refers to the design risk.	Slight Adverse
Contamination from road operation	Monitoring would be carried out following construction to assess adequacy of protective measures and that any need for corrective action would be identified in a timely manner.	Neutral to Slight Adverse

Description of impacts	Proposed mitigation	Residual effects (after mitigation)
Materials (Chapter 10)		
Material use and depletion (i.e. virgin aggregates)	Maximising the use of local materials and effectively managing materials use on site. Provision of a Site Waste Management Plan (SWMP) incorporating targets for recycling and waste minimisation and CEMP.	Slight Adverse
Use of imported materials (i.e. blacktop, steel, concrete)	Maximising the use of local and/or recycled materials. Provision of a SWMP incorporating targets for recycling and waste minimisation and CEMP. However, the impact would still remain the same.	Neutral to Slight Adverse
Carbon footprint of materials transport and use	Carbon monitoring and management and maximising the amount of material resources and waste to be re-used on-site. Provision of a SWMP incorporating targets for recycling and waste minimisation and CEMP. However, the impact would still remain the same.	Major[15] Adverse
Noise and Vibration (Chapter 11)		
Traffic noise in vicinity of the Proposed Scheme during operation	Provision of noise barriers, landscaping and low noise road surfacing; however, not all receptors would be mitigated from noise due their proximity to the Proposed Scheme and their heights.	Minor to Moderate Adverse (short term) Negligible to Minor Adverse (long term)[16]
Traffic noise to the wider area during operation	Provision of acoustic noise barriers, landscaping and low noise road surfacing; however, not all receptors would be mitigated for noise due their proximity to the Proposed Scheme and their heights.	Overall Beneficial (short term) Overall Neutral to Slight Adverse (long term)[16]
People and Communities (Chapter 12)		
Loss of Best and Most Versatile (BMV) Grades 2 and 3a agricultural land	Loss of good quality land would not be mitigated against, but owners would be compensated.	Large or Very Large Adverse
Entire Scheme (Driver Stress)	Reduced congestion, improved accessibility and lower speed limits	Beneficial[17]
Road Drainage and Water Environment (Chapter 13)		
Contamination risk to groundwater (during construction)	Implementation of good practices and a CEMP would be in place during construction.	Slight Adverse
Changes to fluvial geomorphology through	Mitigation by following good practice design, using existing outfall structures	Slight Adverse

[15] Carbon assessment in DMRB guidance only assess the magnitude of an impact and not sensitivity, therefore, 'Major' has been used.
[16] DMRB HD 213/11 advice, only to assess the magnitude of an operational impact and not sensitivity, terms used to express residual effects in this table are used in line with the guidance.
[17] Views from the road and driver stress have only been assessed as beneficial, neutral and adverse.

Description of impacts	Proposed mitigation	Residual effects (after mitigation)
presence of outfalls, particularly altering flow processes (Pincey Brook and Harlowbury Brook)	and inclusion of attenuation ponds.	
Pollution incidences affecting water quality	Appropriate Sustainable Urban Drainage System (SuDS) and emergency procedures would be put in place.	Neutral to Slight Adverse
Road cuttings intercepting groundwater	Mitigation would not be possible. Slight adverse effect considered acceptable.	Slight Adverse
SuDS providing a route for potential contamination to groundwater	Lining of ponds. Implementation of an appropriately designed drainage system.	Slight Adverse
Cumulative effects - Type 1 (Chapter 14)[18]		
Cultural heritage: noise, vibration and visual changes	Reinstatement of roadside hedges and other screen planting. Provision of noise barriers, landscaping and low noise road surfacing.	Minor Adverse
Some properties in London Road to Churchgate: increased noise levels, decreased air quality, visual degradation and some severance	Careful positioning of noise barriers and mitigation of visual degradation through screen planting including hedges.	Minor Adverse
Properties from Churchgate Roundabout to Pincey Brook roundabout: alterations in views. However they would benefit from improved air quality traffic flows and traffic reduction along the old Sheering Road	Mitigation of visual impacts through screen planting including hedges.	Minor Beneficial
Recreational users of playing fields: loss of land and visual alterations. Reduced noise, retention of games equipment and reduced visual intrusion	Use of screen planting. Loss of land would not be mitigated against, but would be compensated.	Minor Beneficial
Nature conservation: increased noise, traffic collisions and visual disturbance to local wildlife	Provision of multi-purpose mammal underpasses, hop-over fences, acoustic fences, associated landscape planting, reduction of speed limit and sensitive lighting to reduce disturbance to bats and the risk of collision with traffic.	Minor Adverse

[18] DMRB for cumulative impacts uses minor, moderate and major

Description of impacts	Proposed mitigation	Residual effects (after mitigation)
Cumulative effects - Type 2 (Chapter 14)		
Impacts from new developments may increase impact on cultural heritage	None proposed. Assess information on local developments as it becomes available	Slight Adverse
Increased conflict with the character of the landscape and diminished sense of place	None proposed. Assess information on local developments as it becomes available	Moderate Adverse
Loss and fragmentation of habitats would increase. Increased predation by cats. Further loss of bat flightlines and lighting impacts	None proposed. Assess information on local developments as it becomes available	Slight Adverse
Low additional loading of groundwater with pollutants from road surfaces and spillages	None proposed. Assess information on local developments as it becomes available.	Neutral to Slight Adverse
Additional loss of agricultural agricultural soils	None proposed.	Slight to Moderate Adverse
Increased pressure on resources	Lack of waste arising and materials information	Not known
New community facilities may be proposed	None proposed. Assess information on local developments as it becomes available	Minor Beneficial
Loss of best and most versatile agricultural land impacting farming in the locality	None proposed.	Major Adverse
Additional discharges to local watercourses	Assumption that appropriate mitigation will be adopted by the other developments such as: controlled rates of discharge, standard design, good practice and allowance for climate change	

In summary there are eight Neutral to Slight, 17 Slight, four Moderate and two Large Adverse effects. In addition, with respect to visual effects on residential properties, there would be nine Moderate and 73 Slight Adverse effects. One public right of way would have a Large Adverse visual effect and nine would have Slight Adverse effects. There would likely be Beneficial effects in the short term on noise levels in the surrounding area on for reduction of driver stress levels. These figures do not include the cumulative effects as these take into account the effects documented earlier in the table concerning this topic.

Acronyms

Acronym	Definition
AADT	Annual Average Daily Traffic
AAWT	Annual Average Weekly Traffic
ADMS	Advanced Dispersion Modelling System
AEP	Annual Exceedance Probability
A/HMWB	Artificial and Heavily Modified Water Bodies
ALC	Agricultural Land Classification
APIS	Air Pollution Information System
AQMA	Air Quality Management Area
AQO	Air Quality Objective
BAP	Biodiversity Action Plan
bgl	Below ground level
BGS	British Geological Society
BMV	Best and Most Versatile
BNL	Basic Noise level
BOAT	Byways Open to All Traffic
BoCC	Bird of Conservation Concern
BOD	Biological Oxygen Demand
BTO	British Trust for Ornithology
CAFE	The EU Directive on Ambient Air Quality and Clean Air for Europe (CAFE) (2008/50/EC)
C&D	Construction and Demolition
CDA	Critical Drainage Area
CEMP	Construction Environmental Management Plan
CERC	Cambridge Environmental Research Consultants
CIEEM	Chartered Institute of Ecology and Environmental Management
CIRIA	Construction Industry Research and Information Association
CO_2	Carbon Dioxide
CoCP	Code of Construction Practice
CRRN	Compliance Risk Road Network
CRTN	Calculation of Road Traffic Noise
CSM	Conceptual Site Model
DCLG	Department for Communities and Local Government
Defra	Department for Environment, Food and Rural Affairs
DfT	Department of Transport
DM	Do Minimum
DMRB	Design Manual for Roads and Bridges
DS	Do Something
DWS	Drinking Water Standard
EA	Environment Agency
EAR	Environmental Assessment Report

Acronym	Definition
EC	European Commission
ECC	Essex County Council
EcIA	Ecological Impact Assessment
EFDC	Epping Forest District Council
EfW	Energy from Waste
EHER	Essex Historic Environment Record
EIA	Environmental Impact Assessment
EPA	Environmental Protection Act
EPS	European Protected Species
EQS	Environmental Quality Standard
EU	European Union
FRA	Flood Risk Assessment
GCN	Great Crested Newt
HABAP	Highways Agency Biodiversity Action Plan
HAWRAT	Highways Agency Water Risk Assessment Tool
HDV	Heavy Duty Vehicles
HE	Highways England
HEMP	Handover Environmental Management Plan
HLT	Historic Landscape Type
IAN	Interim Advice Note
IAQM	Institute of Air Quality Management
IBA	Incinerator Bottom Ash
KPI	Key Performance Indicator
LDV	Light Duty Vehicles
LMVR	Local Model Validation Report
LNR	Local Nature Reserve
LOAEL	Lowest Observed Adverse Effect Level
LoGS	Local Geological Site
LTTE6	Long Term Trend Euro 6/VI
LWS	Local Wildlife Site
MAFF	Ministry of Agriculture, Fisheries and Food
MMP	Materials Management Plan
N	Nitrogen
NAEI	National Atmospheric Emissions Inventory
NCN	National Cycle Network
NE	Natural England
NHL	National Heritage List
NMU	Non-Motorised User
NNR	National Nature Reserve
NO_2	Nitrogen dioxide

Acronym	Definition
NO_X	Nitrogen oxides
NPPF	National Planning Policy Framework
NVZ	Nitrate Vulnerable Zone
EMP	Environmental Management Plan
PAH	Polyaromatic Hydrocarbons
PCF	Project Control Framework
PCM	Pollution Climate Mapping
PIE	Public information Event
PM_{10}	Particulate Matter 10 micrometres or less in diameter
PPG	Pollution Prevention Guidelines
PPM	Parts Per Million
PRoW	Public Right of Way
PWV	Protect Wildlife Verge
Q10	A discharge of 10% exceedance
Q50	A discharge of 50% exceedance
Q70	A discharge of 70% exceedance
Q95	A discharge of 95% exceedance
RIGS	Regionally Important Geological Sites
SAC	Special Area of Conservation
SFRA	Strategic Flood Risk Assessment
SgZ	Safeguard Zone
SMP	Soil Management Plan
SOAEL	Significant Observed Adverse Effect Level
SPA	Special Protection Area
SPZ	Source Protection Zone
SRS	Soil Resource Survey
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage Systems
SVOC	Semi-Volatile Organic Compounds
SWMP	Site Waste Management Plan
TEMPro	Trip End Model Presentation Program
TFR	Traffic Forecasting Report
TPH	Total Petroleum Hydrocarbon
TPO	Tree Preservation Order
TRRL	Transport and Road Research Laboratory
UXO	Unexploded Ordnance
VOC	Volatile Organic Compounds
WAC	Waste Acceptance Criteria
WebTAG	Web based transport analysis guidance
WEEE	Waste Electrical and Electronic Equipment

Acronym	Definition
WFD	Water Framework Directive
WRAP	Waste and Resources Action Programme

Glossary

Glossary	Definition
Barrow	A barrow is artificial mound of earth, turf and/or stone, normally constructed to contain or conceal burials of prehistoric date.
CadnaA	Noise modelling software.
Conservation Area	An area designated under section 69 of the Planning (Listed Building and Conservation Areas) Act 1990 as being an area of 'special architectural or historic interest, the character or appearance of which it is desirable to preserve or enhance'.
Construction Environmental Management Plan	The Construction Environmental Management Plan (CEMP) is for the construction phase of the development and sets out the intended methods of effectively managing potential environmental effects arising from the construction of the scheme.
Cultural Heritage Assets	The historic environment assets such as archaeological remains, historic buildings and historic landscapes which have archaeological, architectural, artistic or historic value.
Daylighting	Allowing light to come in to a water channel.
Do-Minimum (DM)	This is the situation with the existing highway network. The do-minimum situation is used to compare and assess the predicted situation if the scheme subject to environmental impact assessment were to be built (the do-something scenario).
Do-Something (DS)	Situation if the scheme subject to environmental impact assessment were to be built.
Dumbell	Junction where a motorway crosses a minor road. The motorway is grade separated from the minor road. The off/on slip roads intersect the minor road configured as a pair of roundabouts.
Effects	Defined as the consequences of impacts.
Environmental Impact Assessment	An Environmental Impact Assessment (EIA) is a process of evaluating the likely environmental effects of a proposed project or development, taking into account inter-related socio-economic, cultural and human-health effects, both beneficial and adverse.
Findspot	The place where an archaeological object has been found.
Hamburger-style roundabout	A roundabout where the main road passes through the centre of the roundabout.
Highways Agency Water Risk Assessment Tool	The Highways Agency Water Risk Assessment Tool (HAWRAT) is a revised and updated procedure for assessing the risks of pollution to surface waters from highway runoff.
Holt / Couch	The den of an otter.
Impacts	Impacts are defined as the changes resulting from an action.
Indirect Impacts	In the context of the ES are defined in DMRB HA 205/08, paragraph 1.50 i. and ii. as "those that alter the character, behaviour or functioning of the affected environment because of the knock-on impacts over a wider area or timescale" or "impacts related to pressure as a result of project-induced change".
Listed Building	A building or structure designated under section 69 of the Planning (Listed Building and Conservation Areas) Act 1990 as being of 'special architectural or historic interest'.
National Policy Planning Framework	The National Planning Policy Framework (NPPF) consolidates over two dozen previously issued Planning Policy Statements and Planning Policy Guidance Notes for use in England.
National Trip End Model (NTEM)	Forecasts growth in trip ends (origins and destinations) between a base and forecast year by geographical area with Great Britain and time of day.
Nitrate Vulnerable Zone	Nitrate Vulnerable Zones (NVZs) are areas designated as being at risk from agricultural nitrate pollution.
Noise barrier	A measure intended to reduce existing or enhance noise levels on one or more receptors. The term acoustic barrier is used synonymously with the term noise barrier.
Pennanular	In a form of a ring but with a small part of the circumference missing.
Ploughsoil	Soil that has been thrown up by ploughing.
Polyfocal settlement	A single settlement with its market, places of worship and residential areas in more than one location.

Glossary	Definition
Primary mitigation	An intrinsic part of the project design.
Ramsar Site	Ramsar sites are wetlands of international importance designated under the Ramsar convention.
Residual effect	Effects that would still occur once mitigation measures have been carried out.
Safeguard Zone	A Safeguard zone is an area which can influence the water quality at drinking water abstractions which are at risk of failing the drinking water protection objectives.
Scheduled Monument	Any site assessed as being of National Importance and designated under the Ancient Monuments and Archaeological Areas Act 1979.
Secondary mitigation	Further mitigation required in order to reduce the impact of the scheme.
Secondary Undifferentiated Aquifer	An aquifer that has not been attributed either a category A or B to a rock type. Mostly, this means that the layer has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.
Significance	The significance of the effect of an impact is derived through consideration of the sensitivity of a receptor (sometimes referred to as its value or importance) and the magnitude of the impact.
Site of Special Scientific Interest	A Site of Special Scientific Interest (SSSI) is a conservation designation denoting a protected area in the UK. SSSIs are the basic building block of site-based nature conservation legislation and most other legal nature/geological conservation designations in Great Britain are based upon them, including national nature reserves, Ramsar sites, Special Protection Areas, and Special Areas of Conservation.
Special Area of Conservation	Special Areas of Conservation (SAC) are strictly protected sites designated under the EC Habitats Directive.
Special Protection Area	A Special Protection Area (or SPA) is a site designated under the Birds Directive. These sites, together with Special Areas of Conservation (or SACs), are called Natura sites and they are internationally important for threatened habitats and species.
Special Restraint Area	Planning designation within the adopted Harlow Local Plan.
Sustainable Drainage Systems	Sustainable drainage systems (SuDS) are a sequence of water management practices and facilities designed to drain surface water in a manner that will provide a more sustainable approach than what has been the conventional practice of routing run-off through a pipe into a watercourse.
Tertiary mitigation	Mitigation measures that would be required as a result of legislation or standard industry practice.
Trackout	The transport of dust and dirt from site onto the public road network.
Trip End Model Presentation Program (TEMPro)	TEMPro is a piece of software provided by the Department for Transport to enable users to access the forecasts from the NTEM (National Trip End Model).
Urnfield	a prehistoric cemetery of the European late Bronze Age and early Iron Age, in which cremated remains were placed in pottery vessels (cinerary urns) and buried.
WebTAG	WebTAG (Web based Transport Analysis Guidance), produced by the Department for Transport, contains guidance on the conduct of transport studies. The guidance includes or provides links to advice on how to: • set objectives and identify problems; • develop potential solutions; • create a transport model for the appraisal of the alternative solutions; • how to conduct an appraisal which meets the department's requirements; and • projects or studies that require government approval are expected to make use of this guidance in a manner appropriate for that project or study. For projects or studies that do not require government approval, TAG should serve as a best practice guide.

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