# A614/A6097 Major Road Network Improvement Environmental Statement

Volume 1D
Scheme Specific Assessment: Kirk Hill Junction

Via East Midlands Ltd

Project number: 60643622

February 2022

## Quality information

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# 1. INTRODUCTION

1.1.1 Kirk Hill Junction is one of the six Schemes which comprise the A614/A6097 Major Road Network Improvement Project (hereafter referred to as the 'Project').

1.1.2 This volume of the Environmental Statement (ES) reports the findings of the Environmental Impact Assessment (EIA) that has been undertaken in compliance with the Town and Country Planning (EIA) Regulations 2017 (as amended 2018) (hereafter referred to as the 'EIA Regulations') (Her Majesty's Stationery Office (HMSO), 2017).

1.1.3 The assessment has considered the likely significant environmental effects of the Kirk Hill Junction Scheme in isolation through construction and operation, as well as the proposed mitigation measures recommended to avoid, prevent, reduce or offset any significant adverse effects on the environment.

1.1.4 Volume 1 of the ES provides information which is pertinent to the assessment reported herein, but has not been repeated. This includes:

- The background to the Project, the purpose and structure of the ES and the legislative and policy framework which applies to the Project (Volume 1 Chapter 1: Introduction).
- An overview of the need for the Project and a description of the Project and the other Schemes which are proposed to be delivered (Volume 1 Chapter 2: The Project). A specific description of works proposed at Kirk Hill Junction are provided herein.
- An assessment of the reasonable alternatives considered to the Project (Volume 1 Chapter 3: Assessment of Alternatives). Design development relevant to this Scheme is reported herein.
- The general methodology and approach to the environmental assessment (Volume 1 Chapter 4: Environmental Assessment Methodology). The specific methodology applied for the assessment is provided herein.
- Relevant legislation and policy are noted in full within Chapters 5 to 14 of Volume 1.

1.1.5 Volume 1 of the ES also provides the assessment of the cumulative impacts of the Schemes on each environmental topic when considered as one Project (Volume 1 Chapters 5-12) and the assessment of in-combination and cumulative effects in conjunction with other projects (Volume 1 Chapters 13 and 14).

1.1.6 Supporting figures can be found within Volumes 2 and 2D, and appendices are within Volumes 3 and 2D.

# 2. THE SCHEME

## 2.1 Existing Situation

2.1.1 The existing Kirk Hill Junction is a signalised four-arm traffic junction. The A6097 Bridgford Street runs in a north-west to south-east direction. Kirk Hill (the road) joins the A6097 from the north, providing access to East Bridgford village. East Bridgford Road provides access to Newton village to the south. Both A6097 approaches are characterised by two lanes, one of which is a dedicated right turn lane, with the other used for ahead and left movements. Both Kirk Hill and East Bridgford Road are single lane approaches.

2.1.2 The junction is in a rural location, predominantly bordered by agricultural land. Residential dwellings are located in an area of land between the A6097 and Kirk Hill.

2.1.3 A narrow footway runs east-west along the northern side of the A6097. At the junction with Kirk Hill, the footpath diverts from the A6097 and continues along Kirk Hill into the village of East Bridgford. There is no crossing provision for walkers, cyclists, or horse riders at the junction currently.

2.1.4 Public bridleway East Bridgford Bridleway No. 28 (BW28) runs parallel with the A6097, on the north-eastern side of the A6097. It extends north-west to Trent Lane and south-east to further public bridleways parallel with the A46(T). The recorded definitive line of this bridleway is not useable on the ground in the vicinity of the Kirk Hill junction. It is obstructed by dense vegetation and a steep unmade gradient. Instead, users navigate along a cut-through path to the bend on Kirk Hill before joining the narrow footway to the junction. This cut-through is neither recorded as a Public Right of Way (PRoW) nor adopted highway but is accepted by the public as an alternative route to the obstructed definitive line of BW28.

2.1.5 In addition to the above, there are further public rights of way in the vicinity of the junction: East Bridgford Footpath No. 27 (BW27) diverges from the bridleway near the Kirk Hill junction before passing over a small copse and out into the fields beyond; and Shelford Footpath No. 9 meets the A6097 approximately 220 m north-west of the junction.

2.1.6 A local toll ride arrangement is in place for equestrians in the area. Riders can pay an annual fee to access a network of routes over private land. One of the entrances to this network is located on the north-west side of East Bridgford Road, very close to its junction with Kirk Hill. Users of this toll ride network account for many of the equestrian movements around the Kirk Hill Junction.

2.1.7 The junction currently experiences significant journey delays (especially during the morning and evening peaks) because of insufficient capacity to cater for current traffic demands. An Experimental Road Traffic Order (ETRO) at Trent Lane, East Bridgford, has increased through-traffic at this junction.

2.1.8 Current speed limits approaching the junction in all directions is 60 mph.

2.1.9 Key environmental constraints include but are not limited to:

- residential properties in close proximity to the junction;
- East Bridgford Conservation Area which part of the Scheme lies within; and
- Public Rights of Way (PRoW) near the junction.

2.1.10 Key environmental constraints and receptors are illustrated in figures associated with each topic chapter (Chapters 5 to 11) in Volume 2D.

### Future Situation

2.1.11 Without improvement, the capacity issues at this junction will remain, with future traffic growth along the route corridor likely to exacerbate journey delays.

## 2.2 Scheme Description

2.2.1 The Kirk Hill Junction general arrangement plan (located in Appendix 2-1 of Volume 3) illustrates the Scheme layout and its key components and features.

2.2.2 Proposed improvements at this junction consist of localised widening of the A6097 junction approaches to provide two straight ahead lanes in each direction and separate right turn lanes into Kirk Hill and East Bridgford Road. It is further proposed to carry out localised widening on Kirk Hill to facilitate improved negotiation of left turns into the road by large vehicles. These changes would require upgrades and improvements to the traffic signals at the junction.

2.2.3 A reduction in the speed limit from de-restricted to 50 mph beyond the existing 40 mph terminal point around 930 m north-west of the Kirk Hill to the junction with the A46 around 1.1 km south-east of the Kirk Hill Junction. This would make the speed limit consistent with the rest of the A6097 and A614 corridors.

2.2.4 The proposals also include the provision of a 5 m wide bridleway link (diversion) to remove the gap in provision of BW28. A new Pegasus crossing is also proposed at a point approximately 100 m to the south-east of the junction, to facilitate the north-south equestrian movement identified in NMU surveys and public consultation.

2.2.5 Street lighting would be upgraded to align with current design standards and all sodium lanterns would be replaced by LED type.

2.2.1 The total area needed for the Scheme construction and operation is approximately 7.4 hectares (ha) as shown on the red line planning boundary on the general arrangement plans in Appendix 2-1 of Volume 3.

### Land Take

2.2.1 Construction of the Scheme requires both permanent and temporary land take outside of the current highway boundary.

2.2.2 Permanent and temporary land take is shown on the Land Affected plans within Appendix 2-3 of Volume 3D. Where permanent land take is required outside of the current highway boundary this would be acquired by negotiation or a Compulsory Purchase Order.

2.2.3 Both permanent and temporary land take would consist of agricultural land. Temporary land would be restored to current condition or better on return to the landowner.

2.2.4 A new highway boundary formed that would encapsulate the required permanent land take for the Scheme.

### Earthworks and Landform

2.2.5 The proposed embankment slope on the south side of the A6097 would be constructed to address the level difference between the carriageway and adjacent field replicating the existing situation. Embankment slopes would be cut to a maximum gradient of 1:3.

2.2.6 Earthworks would be required to facilitate the widening of Kirk Hill in order to accommodate the new bridleway connection and associated visibility splays at the

crossing point (the north bend) as well as widening of the carriageway in vicinity of the traffic signal control line.

2.2.7 The extent of vegetation clearance is shown in Appendix Figure 2-1 in Volume 3D.

### Drainage

2.2.8 Carriageway and footway surface water would be collected by a mixture of means consisting of kerb drainage units, carriageway gullies and filter drains connected into a number of catchpit chambers.

2.2.9 Catchpit chambers would outfall into underground storage tanks, the size of which would be confirmed through the detailed design process. Flow rate from the storage tanks would be attenuated by flow control chambers to limit discharge.

2.2.10 On the north side of the junction, it is proposed for some filter drain to outfall into a series of soakaways which would outfall into an existing ditch running parallel to the A6097 running in an easterly direction toward the A46(T).

### Lighting and Signage

2.2.11 Street lighting design at the Kirk Hill Junction has been designed in line with current design standards taking into account required Sight Stopping Distance and proposed speed limits. LED lanterns would be installed.

2.2.12 Lighting columns would be situated approximately 2 m to 3 m back from carriageway edge in the verge. All LED lanterns specified have a colour temperature of 4000K (Neutral White) which would be maintained through the junction as this is the focal area of any potential conflict zone[1].

2.2.13 New post mounted verge signage would be provided at the junction, as well as new road markings/ lining in the carriageway.

2.2.14 It is proposed that all bollards on splitter islands would be lit. Not all new signs would be illuminated; in line with the Traffic Signs Regulations and General Directions (2016).

2.2.15 The lighting design is shown on Figure 8-2 in Volume 2D.

### Fencing and Boundary Treatment

2.2.16 New boundary treatments would consist of a post and four rail timber fence as a minimum and would generally be supplemented by the planting of species rich hedgerow, tying into existing where necessary. A landscape design has been prepared (see Appendix 2-2 of Volume 3D).

### Non-motorised User Provisions

2.2.17 As such, it is proposed that BW28 is to be diverted around the north side of Kirk Hill, crossing at the northern most bend of Kirk Hill and linking through to the cut-through path which is currently used as an unofficial diversion route. The crossing at Kirk Hill would be uncontrolled.

2.2.18 It is proposed that this crossing would link into the public bridleway on the northern side and a new path with fencing would be created on the southern verge of the A6097 to link the route to East Bridgford Road.

2.2.19 PRoW Shelford Footpath No. 9 (FP9) meets the A6097 approximately 220 m north-west of the junction. There are no proposals to change the provision at this location

[1] Conflict zones are areas where traffic, either motorised or pedestrian, converges from many directions.

and it would remain as it is currently.

## 2.3 Environmental Design and Enhancement

2.3.1 The potential for adverse effects on landscape and visual amenity have been recognised as part of the iterative Scheme designs to avoid or reduce adverse effects or to offset or compensate for unavoidable adverse effects, providing replacement vegetation and habitat to compensate for any loss of trees, grassland and hedgerows. The landscaping design at the Kirk Hill Junction includes specific planting to support the local environment. A landscape design has been prepared (see Appendix 2-2 of Volume 3D).

2.3.2 The proposed planting supports feedback received during the Scoping exercise and includes flowering native dry meadow grassland. Where possible and where tree quality has been identified as good by arboricultural survey, proposed tree removal would be kept to a minimum. The location of the stop line at East Bridgford Road has been altered to allow for retention of quality trees in the west verge.

2.3.3 Tar-bound material has been identified in the A614 carriageway at various locations along the route. Where possible the detailed designer and Principal Contractor would work to reduce the amount of this type of waste removed from site using innovative methods including in-situ recycling of tar-bound material in any new footway construction. It is also intended that any existing suitable carriageway construction (including kerbs) removed during site clearance would be recycled and used as sub-base in new carriageway construction, subject to the appropriate consents.

2.3.4 Where possible, sites would be identified for the trial of any emerging and innovative sustainable construction methods and materials, should they be considered suitable during the detailed design stage.

## 2.4 Construction, Operation and Long-Term Management

2.4.1 The approach to construction described below is indicative and subject to change during detailed design but it is representative of the likely approach to be adopted.

### Construction Compound Location

2.4.2 The construction compound would be located within an arable field to the south-west of the A6097 accessed from East Bridgford Road. This is expected to include temporary offices, compounds, vehicle parking and storage areas.

### Construction Programme and Phasing

2.4.3 Scheme construction is expected to commence in Autumn 2023 and take approximately 38 weeks.

2.4.4 Construction of the Scheme is likely to follow the following phasing:

- installation of the construction compound including temporary offices and welfare facilities, construction vehicle parking, material storage areas, worksites and accesses;
- vegetation clearance and soil removal;
- utilities diversions, drainage and ducting;
- infrastructure construction activities;
- installation of kerbing and road pavements;

- capping in stone;
- resurfacing, including high friction surfaces, white lining and any required topsoiling;
- installation of lighting and signage; and
- landscaping works.

## Workforce and Working Hours

2.4.5 During the construction phase, the core working hours would be as defined in Table 2-1.

Table 2-1: Working hours

| | Core working hours |
|---|---|
| **All works including earth works** | 07.30 – 16:00 Monday to Friday<br>07.30 – 13:00 Saturdays with no working on Bank Holidays |

2.4.6 Any night-time working would be conducted between the hours of 20:00 to 06:00 to avoid peak traffic flow periods.

## Construction Activities

2.4.7 Scheme construction activities are anticipated to require the following activities:

- installation and use of the construction compound, including temporary offices and welfare facilities, construction vehicle parking, material storage areas and worksites;
- installation and use of temporary accesses and movement of vehicles;
- vegetation clearance and soil removal;
- removal of existing infrastructure;
- ground and excavation works (also known as earthworks);
- infrastructure construction activities, including installation of new road infrastructure and drainage and resurfacing;
- routing of services and utilities;
- accommodation work; and
- installation of verge furniture (e.g. new lighting and new or replacement signage) and planting of vegetation.

### Earthworks

2.4.8 Earthworks activities would be planned to release materials from sections of the Scheme where there is a surplus of materials to allow it to be placed in the areas where fill is required. This would reduce the requirement to import and export material from the site and reduce the extent of material storage required.

2.4.9 The general sequence of earthworks activities would be as follows:

- Strip topsoil and place into topsoil storage areas. Topsoil would only be stored to a maximum height of 2 m from existing ground level.
- Pre-earthworks drainage assets would be installed next, wherever practicable.

- Areas where the levels are to be changed to the largest extent would then be worked, including any ground improvement (stabilisation) which needs to be undertaken. If practicable, drainage works would be undertaken prior to levels being lifted. This is to achieve the safest working method possible by avoiding deep excavation works.
- Areas requiring surcharge fill and monitoring would be constructed as soon as practicable to allow maximum programme efficiencies.
- Once earthworks materials placement is completed, capping material and Type 1 material[2] would be placed in readiness for road pavement construction to take place.
- Once all works are completed, topsoil shall be placed as per the detailed landscape design specification, with any surplus materials removed from site for reuse where possible.

2.4.10 Dust control procedures would be in place during periods of dry weather, specifically with the earthworks operations. Damping down of working areas would be via water suppressant, likely from a bowser. If required, roads would be swept using a road sweeper.

2.4.11 Although fuel storage facilities would be at the main compound, it is anticipated that re-fuelling of earthworks plant may need to be undertaken using a mobile facility. The re-fuelling plant would be kept at the main construction site compound and be stored and used in accordance with the Control of Substances Hazardous to Health Regulations 2002 (HM Government, 2002), and the Control of Pollution (Oil Storage) (England) Regulations 2001 (HM Government, 2001).

### Highways works

2.4.12 The general sequence of works is envisaged as follows for highways works:

- complete service diversions, if not yet completed;
- install deep drainage, if not yet completed;
- install gullies;
- install ducting and associated infrastructure;
- install kerbs and edgings;
- final trim to stone in readiness for pavement laying;
- lay base and binder course;
- set all ironworks to final level including gullies;
- lay surface course;
- install road markings and high friction surfacing if required; and
- commission traffic signals where applicable.

2.4.13 Wherever practicable, concrete wash out facilities would be installed at the point of work. Suitable facilities for concrete wash water (e.g. geotextile wrapped sealed skip, container or earth bunded area) would be adequately contained, prevented from entering any drain, and removed from the Site for appropriate disposal at a suitably permitted waste facility.

2.4.14 All vehicles would be supervised to ensure they wash out before driving onto the

[2] Type 1 material is a granular material with a maximum permitted top size of 63mm, graded down to dust, which is used to provide a stable sub-base for road surfaces and pathways.

live carriageway. All compound areas would have a concrete wash out facility.

### Structures works

2.4.15 No works structures works are required at Kirk Hill other than embankment slopes.

### Plant

2.4.16 The following is a list of the types of construction equipment expected to be used during construction of the Scheme. This list is not exhaustive, and may be subject to change, but has been prepared to inform this ES:

- prime moving excavators – earthworks plant, size anticipated up to approximately 40 tonnes (t);
- secondary moving excavators – earthworks plant up to approximately 20t;
- articulated dump trucks up to approximately 40t;
- eight-wheel road wagons;
- excavators up to approximately 30t;
- mini diggers;
- dumpers up to approximately 9t;
- cranes;
- concrete pumps;
- vacuum excavation machine;
- road paver;
- mobile re-fuelling trucks;
- fuel bowsers;
- water bowsers;
- compaction plant – rollers, trench compactors etc;
- abrasive wheels including cut-off saws;
- mulchers, chainsaws and site clearance equipment;
- traffic management equipment including mobile variable messaging signs; and
- impact protection vehicles for traffic management.

## Temporary Traffic Management

2.4.17 To enable the construction of the junction improvement, the proposed traffic management would include phased lane closures, narrow lane running and use of multiway temporary traffic lights. The type of traffic management used would depend on the construction activity that needs to be accommodated. For example, the narrow lane running would enable maximum through-put of traffic while enabling construction activities to be undertaken.

2.4.18 Some night-time work and possible road closures may be required during construction, however the detail of this is currently uncertain and would be defined at a later date in the detailed design process.

2.4.19 It is anticipated that it would be necessary for closure of East Bridgford Road in both directions for duration of the works. A suitable diversion would be agreed with NCC's Network Management team. Lane closures with temporary traffic signals would be required on the A6097.

2.4.20 The bridleway BW28 would need to be closed and/or diverted for the duration of construction. A suitable alternative would be identified in collaboration with the PRoW team and would be communicated using site notices, targeted communications including email and social media marketing.

2.4.21 The A614 and A6097 is used as a diversion route for planned and unplanned activities on the strategic road network (SRN) including the A1(T) to the north of Ollerton Roundabout and the A46(T) east of the Kirk Hill Junction.

2.4.22 Close liaison and collaboration with the Network Management and Road Space Booking team at National Highways (formerly Highways England) would inform the programme of construction activities to avoid closures of the A614 when the route would be needed to support the SRN. Similarly, should closures be required, the Contractor would work closely with National Highways to ensure there are no network clashes.

2.4.23 NCC's Network Management team is currently involved in the planning and development of the Project and are working collaboratively with designers to confirm traffic management proposals and diversion routes as the detail of the Scheme and construction phasing emerges.

### Construction Environmental Management Plan

2.4.24 An ISO 14001 (or equivalent) compliant Construction Environmental Management Plan (CEMP) is to be prepared by the Principal Contractor prior to the start of construction works. The CEMP would be based on the required mitigation as outlined within this ES (including Volumes 1 and 1A to 1D).

2.4.25 The aim of the CEMP is to provide an overarching and strategic framework for the management of environmental effects and the implementation of measures prior to, and during, the demolition and construction phase of the Scheme. The CEMP will be a 'live' document and will be continually reviewed and updated by the Principal Contractor.

2.4.26 The CEMP will include (but not be limited to) the following information:

- Site information:
  - location of the works, including a site plan, showing construction site boundaries and any sensitive receptors (e.g. retained trees, water courses, local residents etc);
  - detailed management structure and key contacts (such as the appointed Site Environmental Manager, the relevant NCC contacts and contacts at the Environment Agency in the event of an emergency); and
  - procedures for environmental training of all permanent and temporary site staff, which staff will be covered within the 'Toolbox Talks', a series of training sessions relating to specific health and safety issues relating to the construction industry.
- Construction information:
  - a description of the works to be undertaken and a detailed programme of the construction activities;
  - proposed working hours during construction, including any abnormal hours;
  - details of the main haulage routes and site access points;
  - proposed dates and sequence of the works;
  - equipment and plant to be used; and

  - method of delivery/ removal of materials and plant.

- Environmental management:
  - an internal environmental audit programme, e.g. ISO 14001 or details of policies specific to the Applicant;
  - an Environmental Mitigation Register with associated procedures, which show how environmental risks will be addressed for each activity;
  - schedule of potential environmental effects relating to each activity (based on the effects identified in the ES);
  - procedure for neighbourhood liaison and dealing with complaints;
  - measures to exclude the public from the vicinity of the site during construction and ensure maintenance of public safety;
  - measures to reduce visual impact of the construction site, including nuisance from construction lighting;
  - arrangements for the removal of contaminated material, where appropriate;
  - arrangements for the storage of raw materials on-site (including potentially contaminative material, such as fuels);
  - waste storage and removal arrangements (either as part of the CEMP or a separate Resource Management Plan);
  - measures to be followed to minimise noise, dust and vibration levels during demolition and construction, including limits to be complied with for certain activities, as appropriate;
  - measures to minimise effects on ecology and monitor the impact of dust on the ecological designated sites in close proximity to the junction;
  - measures to deal with waste water generated during construction activities, to minimise the risk of potentially contaminative material entering the local drainage network or waterbodies; and
  - emergency procedures to be followed in the event of an environmental incident (e.g. spillage).
- Monitoring:
  - targets for continuous improvement on construction environmental performance, such as energy and water use, carbon emissions and waste;
  - monitoring requirements and procedures for recording and reporting the results and for taking remedial action in the event of a non-compliance with specified limits (if appropriate);
  - monitoring proposals, which should include details on the receptors for which monitoring will be undertaken; frequency of monitoring; factors against which the monitoring results will be analysed; threshold levels; list of organisations/ individuals to whom results will be distributed; and actions to be taken in the event that thresholds are breached;
  - procedures for monitoring construction processes against the project environmental objectives and for the appropriate action if thresholds have been breached; and
  - procedures for co-ordinating the monitoring results to ensure that the combined effect of the works in different locations does not trigger threshold levels.
- Legal requirements:

- schedule of appropriate environmental legislation and good practice that will be adhered to, which is both current at the time of contract and which may come into force during the course of the contract;
- a list of specific objectives and targets that have been imposed by planning conditions and agreed in consultation with third parties; and
- a register of permissions and consents required, with responsibilities allocated and a programme for obtaining them.

2.4.27 The CEMP will be updated and developed throughout the construction phases in consultation with NCC where necessary. The CEMP will be regularly monitored during the construction works and revised to reflect any changes to programme or events and activities on-site.

2.4.28 Further details on specific measures to be included within the CEMP to mitigate potential effects identified within this ES are provided within Volume 1 and Volumes 1A to 1D.

### Construction, Excavation and Demolition Waste

2.4.29 Waste arising from earthworks and construction is expected to include mainly excavated soils, road arisings and metal.

2.4.30 Any clean excavated material that cannot be reused on-site will be removed by licensed waste carriers and sent for reuse at another permitted development site or for disposal at appropriately licenced facilities (these are expected to be inert waste landfill sites).

2.4.31 All relevant contractors will be required to investigate opportunities to minimise and reduce waste generation in line with the Waste and Resources Action Programme (WRAP) 'Halving Waste to Landfill' initiative by:

- agreeing with material suppliers to reduce the amount of packaging or to participate in a packaging take-back scheme;
- implementing a 'Just In Time' material delivery system to avoid materials being stockpiled, which increases the risk of their damage and disposal as waste;
- using standard size components in design detailing to eliminate risk at source where possible to do so;
- paying attention to material quantity requirements to avoid over-ordering and generation of waste materials;
- re-using materials wherever feasible, e.g. re-use of excavated soil for landscaping (the Government has set broad targets of the use of reclaimed aggregate, and in keeping with best practice, contractors will be required to maximise the proportion of materials recycled);
- segregating waste at source where practical;
- re-using and recycling materials off-site where re-use on-site is not practical (e.g. through use of an off-site waste segregation facility and re-sale for direct re-use or re-processing);
- colour coding and signposting skips to reduce risk of cross contamination and covered to prevent dust and debris blowing around the site, these will be cleared on a regular basis; and
- not burning waste or unwanted materials on-site.

2.4.32 The Principal Contractor and subcontractors will be required to carry out works in such a way that, as far as is reasonably practicable, the amount of spoil and waste

to be disposed of by landfill is minimised. Any waste arisings from the site are to be transported and disposed of in accordance with relevant legislation including the following:

- the Environmental Permitting (England and Wales) Regulations 2018 (as amended) (HMSO, 2018);
- the Waste (England and Wales) Regulations 2011 (as amended) (HMSO, 2001);
- the Waste Management (England and Wales) Regulations 2006 (HMSO, 2006c); and
- the Clean Neighbourhoods and Environment Act 2005 (HMSO, 2005).

2.4.33 Whilst the Site Waste Management Plan (SWMP) Regulations (HM Government, 2008) were revoked as of the 1 December 2013, the Principal Contractor will prepare an SWMP as good practice to promote the waste hierarchy of avoid, reduce, reuse, recycle and recovery of waste rather than disposal. This will improve efficiency and profitability, reduce fly-tipping; and increase environmental awareness.

2.4.34 The SWMP will set out the principles for construction waste management, identify measures to minimise waste by design, estimate construction waste quantities, set targets for waste minimisation and a framework for construction waste monitoring that the Principal Contractor will be required to implement on site. Furthermore, the SWMP will set out measures required for compliance with waste legislation and relevant planning policies.

### Considerate Constructors Scheme

2.4.35 The Project will be registered with the ‘Considerate Constructors Scheme’. This is a national initiative through which construction sites and companies registered with the scheme are monitored against a Code of Considerate Practice. This code is designed to encourage environmental and social best-practice during the construction period beyond statutory requirements.

### Neighbour and Public Relations

2.4.36 A key aspect of the successful management of the Scheme will be the maintenance of good relations with neighbours and the general public. The project team is engaged in consultation with a range of stakeholders and neighbours and this will continue through the various phases of the Scheme.

2.4.37 To manage neighbour and public relations during demolition and construction works, the following actions will be undertaken:

- Initial contact: Prior to any works being undertaken, the project team will make formal contact with the nearest neighbours and those who would be affected by the Scheme; and
- Contact during the works period: A single point of contact will be established, with a senior member of the project team nominated for the role. This person would usually be the Construction or Logistics Manager. Outside normal working hours, site security will act as the main point of contact via a dedicated phone number. Security will alert the Construction or Logistics Manager if necessary (available 24 hours). Any complaints will be logged, fully investigated and reported to the relevant department within NCC as soon as possible. The complainant will be informed as to what action has been taken.

- Contact with neighbours and the general public will be proactively maintained throughout the construction period.

## Management of Sub-Contractors

2.4.38 Individual contracts will incorporate relevant requirements in respect of environmental control, based largely on the standard of 'good working practice' as outlined within the CEMP, as well as statutory requirements. All sub-contractors will be required to demonstrate how they will adhere to procedures set out within the CEMP, satisfying regulations and industry standard practices regarding environmental control.

# 3. ASSESSMENT OF ALTERNATIVES

3.1.1 The assessment of alternatives is provided in Volume 1, Chapter 3.

# 4. ENVIRONMENTAL ASSESSMENT METHODOLOGY

4.1.1 The general environmental assessment methodology is provided in Volume 1, Chapter 4.

4.1.1 An EIA Scoping Report (AECOM/Via, 2021) (hereafter referred to as the 'Scoping Report') was submitted in to NCC in June 2021. A Scoping Opinion was provided by NCC Planning for each Scheme (See Appendix 1-1 of Volume 3). As per Regulation 18 (4)(a) this ES is based on be based on the scoping opinion issued by NCC. Further information relating to agreed scope of the assessments can be found in Section 4.1 of Volume 1.

4.1.2 The Scoping Opinion and the comments from consultees have been considered in undertaking the EIA and in preparing this ES. A table of the Scoping Opinion comments and consultee comments received, and responses to these are provided in Appendix 4-1 of Volume 3.

4.1.3 The study area and assessments of environmental effects have been undertaken in accordance with the DMRB LA 104 Environmental Assessment and Monitoring Revision 1 (Highways England, 2020b), other relevant DMRB guidance documents and other published guidance as applicable.

4.1.4 Therefore the two assessment boundaries used for the assessments based on the following (these are shown on Figure 4-1 Comparison of Assessment Boundaries within Volume 2D):

- The full extent of highways improvement works (i.e. carriageway realignment, earthworks and resurfacing works), excluding new signage and lighting which extends away from the works within the existing highway verge area). This area has been considered within the assessments air quality, geology and soils, noise and road drainage and the water environment. This area is shown as Boundary A on Figure 4-1 in Volume 2D).
- The full extent of highways improvement works as described above, plus the extent of new proposed lighting. The biodiversity and landscape assessment have considered this area. These assessments have not considered remote areas of new signage where these are providing replacement or single additional signs within the existing highway verge remote from the main improvement works. This area is shown as Boundary B on Figure 4-1 in Volume 2D).

4.1.5 It should be noted that whilst an opening year of 2023 was used for the purposes of assessment, the whole Project would not be open to traffic at this point. This is considered to be a worst case assumption for the purposes of the assessment within this ES. Air quality is forecast to improve over time as a result of vehicle technology improvements, therefore 2023 would be a reasonable worst case year for the operational air quality assessment. In terms of the operational noise assessment, a future year is included in the assessment (2027) to consider any worsening that background traffic growth would give rise to.

# 5. AIR QUALITY

## 5.1 Introduction

5.1.1 This chapter provides a study of the potential changes in local air quality associated with the Scheme.

5.1.2 The Scheme has the potential to affect air quality during both the construction and operational phases. During the construction phase, potential effects may arise from nuisance dust as well as health effects associated with particulate matter. During the operational phase potential air quality effects would be associated with vehicle exhaust emissions and the impact on pollutant concentrations (nitrogen dioxide ($NO_2$) and particulate matter ($PM_{10}$)) at sensitive receptors.

5.1.3 This chapter should be read in conjunction with Figures 5-1 and 5-2 within Volume 2D, and Appendix 5-1 of Volume 3.

## 5.2 Legislation and Policy

5.2.1 Full details of relevant legislation and policy are provided in Chapter 5: Air Quality of Volume 1.

## 5.3 Consultation

5.3.1 In September 2020, RBC's Environmental Health Officer (EHO) was consulted with regards to the proposed air quality assessment methodology and more specifically the use of one monitoring site to verify the model for all Schemes. Communication was via email between AECOM's air quality specialist and RBC's EHO, sent 9th September 2020. RBC's EHO replied on 14th September and agreed with our approach.

5.3.2 A summary of the air quality related responses from the Scoping Opinion is included in Table 5-1.

## Table 5-1 Scoping Response Summary

| Stakeholder | Comment made | Response and where addressed in the ES |
|---|---|---|
| Natural England | The assessment should take account of the risks of air pollution and how these can be managed or reduced. Further information on air pollution impacts and the sensitivity of different habitats/designated sites can be found on the Air Pollution Information System (APIS) (www.apis.ac.uk). Further information on air pollution modelling and assessment can be found on the Environment Agency website. | The assessment has taken into account the risks of air pollution as reported in Section 5.7 of this chapter. The relevant information for designated habitats has been obtained from APIS. |
| Nottinghamshire Wildlife Trust | I note that only 1 actual monitoring location will be used to field test the modelling, at Ollerton Roundabout, but given the potential impacts on the SAC and ppSPA, NWT would expect to see further monitoring undertaken in a key protected habitats site such as the SAC or a heathland SSSI, to ensure that the modelling is correct for the areas of potential greatest irreversible habitat impact. This is because emissions modelling was incorrect for several years in using a predicted falling baseline of $NO_x$ that did not occur in reality, and this information is therefore crucial in such a sensitive area to the impacts of $NO_2$ and N. The results should be closely monitored, with a plan in place for how it could be rectified if a problem is shown to have arisen.<br>The latest APIS data on critical load for N deposition of 7.9 kg N $ha^{-1}$ $a^{-1}$ for acid grassland 8.8 kg N $ha^{-1}$ $a^{-1}$ for heathland should be used. | There are not expected to be any designated sites at risk with this Scheme, therefore no monitoring is proposed.<br>The relevant information for the specific designated habitats has been obtained from APIS. |

## 5.4 Assessment Methodology

### Baseline Conditions

5.4.1 The air quality baseline conditions have been determined with reference to the following sources of information:

- RBC 2020 Air Quality Annual Status Report (RBC, 2020);
- Defra's 2018-based background concentration maps (Defra, 2020a);
- Defra's 2020 Pollution Climate Mapping (PCM) Model (Defra, 2020b); and
- Ordnance Survey Mastermap (Ordnance Survey, 2021a), Ordnance Survey Addressbase Plus (Ordnance Survey, 2021b), and Google Earth (Google, 2020) mapping and imagery were used to identify receptor point locations.

### Study Area

#### Construction Phase

5.4.2 The study area for the construction dust assessment is defined as the area within 200 m of dust-generating activities.

5.4.3 The assessment boundary for the Scheme has been chosen as a proxy for the area within which dust-generating activities will occur. This is a cautious assumption as dust generating activities are unlikely to occur right at the assessment boundary.

5.4.4 The construction dust assessment study area is illustrated in Figure 5-2 of Volume 2D.

5.4.5 Assessment of air quality impacts due to construction traffic has been scoped out of the assessment as described in paragraph 5.4.15 of this chapter.

#### Operational Phase

5.4.6 The following screening criteria for the changes in traffic between the Do Minimum (DM) scenario (without the Scheme) and the Do Something (DS) scenario (with the Scheme) in the opening year of 2023 were applied to determine the study area for the local air quality assessment for the operation of the Scheme:

- road alignment will change by 5 m or more;
- annual average daily traffic (AADT) flows will change by 1,000 or more;
- heavy duty vehicle (HDV) (vehicles greater than 3.5 tonnes, including buses and coaches) flows will change by 200 AADT or more; or
- there will be a change in speed band.

5.4.7 Volume 1 Chapter 4: Environmental Assessment Methodology contains further explanation with regards the traffic modelling undertaken, and why the opening year is set to 2023 for the assessment.

5.4.8 The roads which trigger these criteria make up the Affected Road Network (ARN) for the local air quality assessment of the operation of the Scheme.

5.4.9 The resultant study area is within the local authority area of RBC.

5.4.10 The operational phase local air quality assessment study area is illustrated in Figure 5-1 of Volume 2D.

## General Assessment Methodology

5.4.11 The methodology for the air quality assessment follows the guidance set out within the DMRB LA 105 Air Quality Revision 0 (Highways England, 2019). The assessment includes the following elements:

- construction dust assessment to identify areas that could be affected by construction-phase activities;
- local air quality assessment for the construction of the Scheme for public exposure and designated habitats;
- local air quality assessment for the operation of the Scheme for public exposure and designated habitats; and
- compliance risk assessment for $NO_2$.

5.4.12 The overall aim of the assessment of the elements listed above is to identify potential likely significant air quality effects and the effect of the Scheme on the UK's ability to comply with the Air Quality Directive.

5.4.13 Key methodology documents of relevance to the air quality assessment are as follows:

- DMRB LA 105 Air quality; and
- Defra (2018), Air Quality Management Technical Guidance (TG16) (LAQM.TG(16)).

## Methodology for Determining Construction Effects

### Scoping

5.4.14 A construction phase dust assessment has been undertaken. The key pollutants considered for the construction phase dust assessment are particulate matter with an aerodynamic diameter of less than 10µm ($PM_{10}$) and dust (i.e. larger particles) with the potential to settle around construction sites and cause soiling/ deposition effects on surfaces.

5.4.15 Consideration of the potential effects from construction traffic has been scoped out of the assessment. As set out in DMRB LA 105, the impact of traffic generated by construction activities shall be assessed where construction activities are programmed to last for more than two years. If the construction activities are less than two years it is unlikely that the construction activities would constitute a significant air quality effect or impinge on the UK's reported ability to comply with the Air Quality Directive given the short-term duration of the construction activities as opposed to the long-term operation of the Project.

5.4.16 The construction programme is anticipated to last for approximately 9 months for the Kirk Hill Junction Scheme and therefore consideration of the potential air quality effects associated with construction vehicle emissions was scoped out of this assessment.

### Methodology

5.4.17 The construction phase assessment requires the air quality assessor to determine the construction dust risk potential of the Scheme to the receiving environment, which informs the appropriate level of mitigation.

5.4.18 The construction dust risk potential is determined based on the following criteria:

- Large: large smart motorway projects, bypass and major motorway junction improvements; and

- Small: junction congestion relief project i.e. small junction improvements, signalling changes, short smart motorway projects.

5.4.19 Sensitive receptor locations were then identified within 0-50 m, 50-100 m and 100–200 m from construction activity. The receiving environment sensitivity to construction dust is then determined according to Table 5-2.

Table 5-2 Receiving environment sensitivity to construction dust.

| Construction dust risk potential | Distance from Construction Activities | | |
|---|---|---|---|
| | 0 to 50 m | 50 to 100 m | 100 to 200 m |
| Large | High | High | Low |
| Small | High | Low | Low |

## Methodology for Determining Operational Effects

### Scoping

5.4.20 Determination of the appropriate level of air quality assessment required for the operational phase has been carried out following the methodology illustrated in DMRB LA 105 and as detailed below.

5.4.21 The screening criteria for the changes in traffic between the Do Minimum scenario and the Do Something scenario in the opening year of 2023 were applied to establish if the Scheme may cause changes in air quality. These are set out in Paragraph 5.4.6.

5.4.22 These criteria have been triggered on roads within and surrounding the Scheme, and therefore an air quality assessment is required. The roads which trigger these criteria make up the ARN for the local air quality assessment of the operation of the Scheme. The ARN is illustrated in Figure 5-1 of Volume 2D.

5.4.23 Traffic was modelled using a series of isolated junction models as opposed to a strategic model. As such, only links with traffic moving directly towards or away from the junction were modelled. Links along each road from the junction were extended to either 1 km from the junction or, less than 1 km away if there was a T-junction. The purpose of the Scheme is to reduce congestion at the junction and therefore reduce queue lengths. As such the speed band change criteria was met; however, AADT and HDV flows remained unchanged, with or without the Scheme operating.

5.4.24 To determine the appropriate level of assessment, both the potential of the project to result in changes to air quality and sensitivity of receiving environment have been considered. As the Scheme involves changes in road layout and speed bands on roads approaching the junction with sensitive receptors in close proximity, a detailed air quality assessment has been undertaken.

5.4.25 Representative worse case sensitive receptors were selected within 200 m of the junction and queue links. This constitutes the air quality study area for the local air quality assessment of the operation of the Scheme.

5.4.26 There are no designated ecological sites within the air quality study area and therefore has not been considered further in this assessment.

5.4.27 The PCM model is a collection of models designed to fulfil part of the UK's Air Quality Directive requirements to report on the concentrations of particular pollutants in the atmosphere. No road links which are part of Defra’s 2020 PCM model (Defra, 2020b) and are within the ARN were identified. Therefore, an

assessment to evaluate the effect of the Scheme on the UK's ability to comply with the Air Quality Directive was not required.

### Methodology

5.4.28 The operational assessment has predicted annual mean $NO_2$ concentrations for the baseline year (2018) and the opening year (2023) with the Scheme (Do Something) and without the Scheme (Do Minimum).

5.4.29 A detailed air quality assessment constitutes the following elements:

- traffic input in the form of period flows (morning peak (AM), inter-peak (IP), afternoon peak (PM), and overnight (OP));
- the use of a detailed air quality dispersion modelling;
- identification of sensitive receptors; and
- model verification.

5.4.30 Traffic data has been provided for road links for a base year, and for the opening year both with and without the Scheme in place. Data was provided for each of the AM, IP, PM and OP time periods and consisted of:

- number of vehicles per hour;
- percentage of HDVs; and
- speed bands as defined by DMRB LA 105.

5.4.31 Queue lengths were provided for links with a speed band of light or heavy congestion. Following discussions with the project transportation team, where a queue length was less than two car lengths it was not considered to be a queue. For the section of the link which was considered to be queueing, the speed band of light or heavy congestion was assigned by the traffic team and applied to this data. For the remainder of the link i.e. non-queuing section, a speed band of free flow was applied.

5.4.32 Using the traffic data provided, air quality predictions were made for the following scenarios:

- Baseline year 2018;
- Do Minimum opening year 2023 without the Scheme (DM); and
- Do Something opening year 2023 with the Scheme (DS).

5.4.33 The assessment used the latest version of the ADMS-Roads (v5) detailed dispersion model (Cambridge Environmental Research Consultant (CERC) Ltd., 2020) to calculate the air quality road contribution to pollutant concentrations. ADMS-Roads is a modern dispersion model that has an extensive published track record of use in the UK for the assessment of local air quality impacts, including model validation and verification studies.

5.4.34 ADMS-Roads calculates concentrations of pollutants emitted from roads at specified receptor locations using the following parameters:

- spatial information of the modelled roads (location, geometry and road widths);
- emission factors which account for vehicle numbers, composition, and speed; and
- meteorological information from a suitable nearby meteorological station.

5.4.35 Detailed information on the inputs used within the modelling for the local air quality

assessment are provided in Appendix 5-1 of Volume 3.

5.4.36 The outputs of ADMS-Roads are road-contributions to annual mean $NO_X$ concentrations (in µg/m$^3$) and annual mean road-contributions of $PM_{10}$ (in µg/m$^3$) concentrations at selected sensitive receptor locations.

### Model performance

5.4.37 When using modelling techniques to predict concentrations, it is necessary to make a comparison between the modelling results and available roadside monitoring data, to ensure that the model is reproducing actual observations. Where systematic bias is evident in the base year verification, the modelled results are factored to better match the monitoring data and reduce the overall uncertainty in the model predictions.

5.4.38 LAQM.TG(16) guidance (Section 'Model Validation, Verification, Adjustment and Uncertainty', Paragraphs 7.519-7.547) was followed. Annual mean $NO_2$ concentrations were predicted at one monitoring site within the Project study area in the base year of 2018 and was compared against the monitored concentration for that year. The adjustment factor was derived to bring modelled concentrations into line with the monitored concentration. The adjustment factor was 5.5 and used to adjust raw model $NO_X$ outputs at all receptors.

5.4.39 The high factor is likely due to an additional local source that was not accounted for in the Defra modelled background contribution. The application of a high adjustment factor to the raw model $NO_x$ outputs will likely overpredict impacts at receptors and therefore it is considered to be a cautious approach.

5.4.40 In the absence of appropriate $PM_{10}$ monitoring within the study area, the adjustment factor calculated for $NO_2$ was applied to modelled $PM_{10}$ outputs, as recommended in LAQM.TG(16).

5.4.41 Further details regarding model verification and adjustment are provided in Appendix 5-1 of Volume 3.

### Public exposure receptors

5.4.42 Sensitive receptors are those where the AQOs apply, for example residential properties, schools, and hospitals. Sensitive receptors were chosen to represent locations where pollutant concentrations are expected to be highest (those closest to the road) and where changes due to the Scheme are expected to be greatest. Model predictions are made at 1.5 m height to be representative of human exposure (or 4.5 m to be representative of human exposure at a first-floor residence).

5.4.43 Predictions of total pollutant concentrations at receptors were calculated by combining the verified modelled road pollutant contributions with background concentrations. Background concentrations are those from many sources not explicitly modelled which individually may not be significant, but collectively, over a large area, need to be considered. Details of how background concentrations have been derived and used in this assessment are provided in Section 5.5.

5.4.44 The following post-processing methods were applied to the dispersion model outputs:

- Adjustment factors derived via model verification (Appendix 5-1 of Volume 3) were applied to bring modelled concentrations into line with monitored concentrations.

- Road contribution $NO_X$ concentrations as outputted by ADMS-Roads were converted to $NO_2$ concentrations using Defra's $NO_X$ to $NO_2$ Calculator (Defra, 2020d) for comparison against the AQO for $NO_2$.
- Highways England $LTT_{E6}$ projection factors were applied to the modelled Do Minimum and Do Something $NO_2$ concentrations to account for the observed gap between projected vehicle emission reductions and the estimated annual rate of improvement in annual mean $NO_2$. Further details are provided in the Assessment Assumptions and Limitations section.
- Road contribution $PM_{10}$ concentrations as outputted by the model were adjusted and added to background concentrations to determine total $PM_{10}$ concentrations.

5.4.45 The modelled annual average pollutant concentrations were compared against the relevant AQOs and predicted exceedances identified. As set out in DMRB LA 105, annual mean $PM_{10}$ concentrations are presented for the base year to demonstrate that pollutant concentrations are well below the objective value and therefore there is no risk of exceedance of these thresholds due to the Scheme.

5.4.46 Research projects completed on behalf of Defra and the Devolved Administrations (Laxen and Marner, 2003; AEAT, 2008) concluded that the hourly average $NO_2$ AQO is unlikely to be exceeded if annual average concentrations are predicted to be less than 60 µg/m$^3$. Therefore, this assessment has evaluated the likelihood of exceeding the hourly average $NO_2$ objective by comparing predicted annual average $NO_2$ concentrations at all receptors to an annual average equivalent threshold of 60 µg/m$^3$. Where predicted concentrations are below this value, it can be concluded that the hourly average $NO_2$ objective is likely to be achieved.

### Significance Criteria

5.4.47 Where a receptor is predicted to experience concentrations of $NO_2$ below the AQOs in both the Do Minimum and the Do Something scenario, it will not inform the judgement of significance.

5.4.48 Where annual mean concentrations of $NO_2$ at receptors are predicted to exceed the AQOs in the Do Minimum and/or Do Something, magnitude of change descriptors will be applied in line with DMRB LA 105 guidance as shown in Table 5-3.

Table 5-3 Definitions of the magnitude of change criteria

| Magnitude of change criteria | Concentration range applicable to |
|---|---|
| Imperceptible | The change in concentration of $NO_2$ between DM and DS is less than or equal to 0.4 µg/m$^3$ (≤1% of the AQO). |
| Small | The change in concentration of $NO_2$ between DM and DS is greater than 0.4 µg/m$^3$ but less than or equal to 2.0 µg/m$^3$ (1-5% of the AQO). |
| Medium | The change in concentration of $NO_2$ between DM and DS is greater than 2.0 µg/m$^3$ but less than or equal to 4.0 µg/m$^3$ (5-10% of the AQO). |
| Large | The change in concentration of $NO_2$ between DM and DS is greater than 4.0 µg/m$^3$ (>10% of the AQO). |

5.4.49 The number of receptors assigned to 'small', 'medium' and 'large' change descriptors, for both worsening and improvement, will be tabulated as shown in Table 5-4.

5.4.50 Table 5-4 defines guideline bands that are used to inform whether the project triggers a significant air quality effect. Where the total number of receptors are greater than the upper guideline band in any of the magnitude categories, the project shall trigger a significant air quality effect. Where the total number of receptors are smaller than the lower guideline band in any of the magnitude categories, the project is unlikely to trigger a significant air quality effect.

Table 5-4 Guideline band for the number of properties informing a judgement of significant air quality effects.

| Magnitude of change in annual mean $NO_2$ ($\mu g/m^3$) | Total number of receptors with: | |
|---|---|---|
| | Worsening of an air quality objective already above the objective or the creation of a new exceedance | Improvement of an air quality objective already above the objective 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 |

5.4.51 Where the total number of receptors falls within the guideline bands in any of the magnitude categories the following criteria will be considered to inform the judgement of significance:

- the absolute concentration at each receptor i.e. is the modelled concentration 40 $\mu g/m^3$ or 60 $\mu g/m^3$;
- how many receptors are there in each of the magnitude of change criteria i.e. does the Scheme create more worsening than improvements; and
- the magnitude of change in concentration at each receptor e.g. a modelled change in concentration of 1.8 $\mu g/m^3$ would carry more weight than a change of 0.6 $\mu g/m^3$ despite both falling within the 'small' magnitude of change category.

### Overall significance determination

5.4.52 The overall significance of the Scheme with respect to air quality is determined for the construction phase and the operation phase.

5.4.53 In each case, the assessment of significance is informed by:

- the effects on human health (as determined by the significance of the local air quality assessment for public exposure receptors);
- the effects on designated habitats (as determined by the significance of the local air quality assessment for designated habitats); and
- the outcomes of the compliance risk assessment.

## Assumptions and Limitations

5.4.54 Model verification has been carried out to minimise, where possible, uncertainties in the modelling and adjustment of the model output has been undertaken to account for local factors unable to be represented in the modelling. Model performance has been assessed and results are provided in Appendix 5-1 of Volume 3. The accuracy of the future year modelling results is relative to the accuracy of the base year results, therefore greater confidence can be placed in the future year concentrations where good agreement is found for the base year.

5.4.55 There is only one monitoring location in the Project study area, at Big Fish Roundabout, Ollerton (now a Costa Coffee). The verification factor derived from this location has been used for all Schemes. This was considered an appropriate approach as the traffic data for all Schemes were generated using the same workbooks, the isolated junction models are unaltered from previous forecasts and the environmental setting of each Scheme was similar i.e. rural location, with junction improvements to the A614/A6097 corridor.

5.4.56 The air quality modelling uses a traffic dataset consisting of the most likely forecast traffic flows. Uncertainty associated with traffic data has been minimised by using validated traffic models. Details regarding the traffic modelling undertaken to support the Scheme are detailed in the Transport Assessment (AECOM, 2021).

5.4.57 The use of the latest version of the Defra background concentrations and tools available when the assessment was undertaken has also minimised the uncertainty associated with the air quality predictions presented.

5.4.58 Uncertainties associated with vehicle emissions data have been minimised by using the speed band emission factors described within DMRB LA 105, which is based on version 10.1 of Defra's Emissions Factors Toolkit (EFT) (Defra, 2020c). Speed bands are assigned on a link-by-link basis as informed by the pivoted speeds provided by the appointed traffic consultant.

5.4.59 The forecasting method used to predict future $NO_2$ concentrations is the gap analysis methodology as described in DMRB LA 105. The gap analysis is the application of adjustment factors which take into consideration the assumed roadside rates of reduction in $NO_X$ and $NO_2$ by Defra's modelling tools compared to observed roadside trends. This prediction methodology is more cautious than the projections used by Defra.

5.4.60 The construction air quality assessment is based on the construction information that is currently available. As with all construction air quality assessments, the exact details of construction activities will not be known before a specific contractor is appointed to complete the works. Once appointed, the Principal Contractor would determine their exact construction methods and programme during the detailed design stage.

5.4.61 The base year traffic data provided by the traffic consultants was for 2018, therefore a base year of 2018 has been used for the air quality assessment.

## 5.5 Baseline Conditions

5.5.1 The base year of 2018 was considered for the purpose of the air quality assessment.

### Air Quality Monitoring

5.5.2 RBC undertake automatic (continuous) and non-automatic (passive) monitoring of $NO_2$ across their jurisdiction, however no monitoring of $NO_2$ is undertaken by RBC within the study area. Therefore, monitoring from nearby NSDC has been used in this assessment.

5.5.3 NSDC undertakes monitoring at one location in the Project study area at the Ollerton Roundabout (monitoring site name 'Big Fish Roundabout, Ollerton' (Big Fish is now Costa Coffee). Annual mean $NO_2$ concentrations at this location have remained below the AQO since 2016. As this is the only monitoring location in the study area, this location has been used for verification for all Schemes. Details of this monitoring location are shown in Table 5-5.

Table 5-5 $NO_2$ Monitoring in Rushcliffe Borough and Newark and Sherwood District, 2016 – 2019.

| Site ID | X | Y | Location | $NO_2$ Annual Mean Concentration ($\mu g/m^3$) | | | |
|---|---|---|---|---|---|---|---|
| | | | | 2016 | 2017 | 2018 | 2019 |
| 18N | 465090 | 367595 | A614, North of Big Fish Roundabout, Ollerton | 36.0 | 34.6 | 33.9 | 32.1 |

*Source: RBC, ASR 2020; NSDC, ASR 2020*

5.5.4 No monitoring of particulate matter is undertaken by RBC or NSDC within the study area.

### Pollutant Background Maps

5.5.5 Annual mean background pollutant concentration estimates for 1 km grid squares throughout the UK are available from Defra for the years 2018 – 2030 based on 2018 reference year projections (Defra, 2020a). Background concentrations have been sourced from Defra's 2018-based background maps for the study area for $NO_2$ and $PM_{10}$.

5.5.6 Contributions from motorways, trunk A-roads and primary A-roads within the grid squares of the background maps have been removed from the mapped concentrations using the Sector Removal Tool provided by Defra (Defra, 2020c), as these sources are explicitly modelled in the assessment.

5.5.7 The range of background concentrations for each 1km x 1km square intersecting the study area for the baseline is presented in Table 5-6. Background concentrations are predicted to be below the AQOs in all areas.

5.5.8 In years subsequent to 2018, background concentrations are predicted to decrease year-on-year. This trend is reflected in the projected background concentrations for the opening year of 2023, which are also presented in Table 5-6.

Table 5-6. Summary of estimated background pollutant concentrations across the study area in the base year and opening year.

| Coordinates | Background Annual Mean $NO_2$ ($\mu g/m^3$) | | Background Annual Mean $PM_{10}$ ($\mu g/m^3$) | |
|---|---|---|---|---|
| | 2018 | 2023 | 2018 | 2023 |
| 468500_342500 | 9.8 | 8.2 | 15.6 | 14.7 |

## 5.6 Design, Mitigation and Enhancement Measures

5.6.1 The Scheme would be subject to measures and procedures as defined within the CEMP for the Scheme. These would include a range of Best Practicable Means (BPM) associated with mitigating potential environmental impacts. A CEMP would be developed by the selected Principal Contractor and implemented for the duration of the Scheme construction phase.

5.6.2 The CEMP would include a range of industry standard good practice construction phase dust mitigation measures required during all works undertaken based on the level of construction dust risk at sensitive receptors.

5.6.3 Environmental considerations have been accounted for during the development of

the Scheme design, to avoid and reduce potential impacts upon nearby sensitive receptors.

5.6.4 No specific air quality mitigation measures have been incorporated into the Scheme design. However, the Scheme design aims to reduce congestion at the junction which will reduce the risk of air quality impacts at receptors where the road alignment remains unchanged.

## 5.7 Assessment of Likely Significant Effects

### Construction

5.7.1 The Scheme has the potential to affect air quality during construction, in the following ways:

- by increased emissions of dust during construction of the Scheme from dust-generating activities on site;
- by emissions associated with non-road mobile machinery (NRMM) undertaking construction works; and
- by changes in vehicle activity (flows, speeds and composition) during construction, as a result of temporary traffic management measures and/or additional vehicles travelling to and from the construction site transporting materials, plant and labour.

5.7.2 The types of activities with the potential to generate dust during the construction phase include:

- installation and use of the construction compound, including material storage areas and worksites;
- movement of vehicles;
- vegetation clearance and soil removal;
- removal of existing infrastructure;
- earthworks;
- installation of new road infrastructure and drainage;
- surfacing works; and
- installation of verge furniture (such as lighting and signage) and planting of vegetation.

5.7.3 There is the potential for adverse dust effects during the construction of the Scheme, although any effects would be temporary (i.e. during the period of the construction works only) and could be suitably minimised by the application of industry standard mitigation measures.

5.7.4 There are a number of sensitive public health and designated habitat receptors located within 200 m of the Scheme as illustrated on Figure 5-2 of Volume 2D. The construction dust risk potential is considered to be ‘small’ for the Scheme as it is a small junction improvement. Therefore, the sensitivity to potential dust effects is considered to be ‘High’ for receptors located within 50 m of the construction activity and ‘Low’ for any receptors located between 50 and 200 m.

5.7.5 There are approximately five residential receptors (all properties on Kirk Hill) within 50 m of the assessment boundary. There are between five and 10 residential receptors located within 50 and 200 m of the assessment boundary.

5.7.6 There are no designated habitats within 50 m of the assessment boundary.

5.7.7 As the potential dust effects is identified as 'high' for receptors located within 50 m of the assessment boundary, best practice mitigation measures must be identified as outlined in DMRB LA 105. These will be set out in the CEMP for the Scheme that will be prepared by the Principal Contractor.

## Operation

5.7.8 The Scheme has the potential to affect air quality during operation (positively or negatively), in the following ways:

- by changes in vehicle activity (flows, speeds and composition) as a result of the Scheme in proximity to air quality sensitive receptors; and
- by changes in the separation distances between road sources of emissions and air quality sensitive receptors.

### Public Exposure Receptors

5.7.9 Predicted annual mean $NO_2$ and $PM_{10}$ concentrations for the baseline year and opening year and changes in concentrations attributable to the Scheme operation are presented in Table 5-7.

5.7.10 No receptors are predicted to experience concentrations of $NO_2$ or $PM_{10}$ above the AQOs in the modelled scenarios and therefore the air quality impacts at public exposure receptors are considered to be not significant.

Table 5-7. Predicted annual mean $NO_2$ concentrations and magnitude of change bands at public exposure receptors used to inform the judgement of significance

| Receptor ID | Height (m) | 2018 Base Total $PM_{10}$ concentration ($\mu g/m^3$) | 2018 Base Total $NO_2$ concentration ($\mu g/m^3$) | 2023 DM Total $NO_2$ concentration ($\mu g/m^3$) | 2023 DS Total $NO_2$ concentration ($\mu g/m^3$) | 2023 change in total $NO_2$ concentration due to Scheme ($\mu g/m^3$) |
|---|---|---|---|---|---|---|
| R1 | 1.5 | 18.4 | 32.4 | 29.5 | 25.6 | -3.8 |
| R2 | 1.5 | 18.4 | 32.4 | 29.4 | 25.5 | -3.9 |

5.7.11 Both modelled receptors are predicted to experience a decrease in annual mean $NO_2$ concentrations as a result of the Scheme. The greatest decrease is anticipated to occur at receptor R2 (situated on Kirk Hill), at which a decrease of -3.9 $\mu g/m^3$ has been predicted. This is likely due to the proposed realignment of the A6097 to spread traffic over the additional lanes through the junction, including moving the northbound carriageway slightly further away from the property and therefore increasing the distance to the emission source (traffic).

5.7.12 As the annual mean concentrations of $NO_2$ are below 60 $\mu g/m^3$ at all receptors in both the Do Minimum and the Do Something scenario, it is concluded that the hourly average $NO_2$ AQO is unlikely to be exceeded in either scenario.

5.7.13 No receptors are predicted to experience an exceedance of the AQO for annual mean $NO_2$. Therefore in line with paragraph 2.90 of DMRB LA 105, a conclusion of no likely significant air quality effects for human health receptors has been made.

### Overall Significance of Effects

5.7.14 The conclusion of the construction dust assessment is that there would be no likely significant air quality effects for human health during the construction of the Scheme with appropriate best practice mitigation measures.

5.7.15 The conclusion of the operational local air quality assessment is that there would be no likely significant air quality effect for human health during the operation of the Scheme.

5.7.16 The conclusion of the compliance risk assessment is that the Scheme would not affect the UK's reported ability to comply with the Air Quality Standards (Amended) Regulations 2016 in the shortest timescale possible due to either the construction or the operation of the Scheme.

5.7.17 Therefore, the effect of the Scheme is considered to be 'not significant' for air quality for both the construction and operational phases. The Scheme is also considered to be consistent with relevant national and local air quality policy.

## 5.8 Additional Mitigation

### Construction Phase

5.8.1 No mitigation measures are considered to be required for the construction phase of the Scheme as no significant effects are predicted.

### Operation Phase

5.8.2 No mitigation measures are considered to be required for the operational phase of the Scheme as no significant effects are predicted.

## 5.9 Residual Effects

5.9.1 The residual effect of the Scheme is considered to be 'not significant' for air quality for both the construction and operational phases.

# 6. CULTURAL HERITAGE

## 6.1 Introduction

6.1.1 This chapter discusses the findings of an assessment of the likely significant effects on cultural heritage as a result of the proposed Kirk Hill Junction.

6.1.2 This chapter details the legislation and policy context, methodology of the assessment, the baseline conditions and the assessment of the effects of the Scheme on designated and non-designated heritage assets. The physical effects on heritage assets are assessed together with the effects to the value of heritage assets caused by changes to their setting.

6.1.3 Note that planning policy considers the 'significance' of heritage assets in terms of their value. To avoid confusion with the significance of effects, the term 'value' has been used in this chapter.

6.1.4 This chapter is supported by an aerial photograph and map regression exercise produced by Trent and Peak Archaeology (2021) (refer to Appendix 6-2 of Volume 3). The report includes the detailed assessment of the baseline conditions and an assessment of the value of the heritage assets which may be affected by the Scheme. As required by the National Planning Policy Framework (NPPF) (MHCLG, 2021), only heritage assets affected by the Scheme are assessed in terms of heritage value. This chapter should be read in conjunction with Figure 6-1 in Volume 2D.

## 6.2 Legislation and Policy

6.2.1 Information relating to relevant cultural heritage legislation and policy can be viewed in Volume 1, Chapter 6.

## 6.3 Consultation

6.3.1 Consultation with NCC was undertaken on 1st April 2021 and possible mitigation was suggested for each junction. The minutes of the consultation are included in Appendix 6-1 of Volume 3. Consultation was also carried out with a Senior Practitioner of Historic Buildings from NCC on 6th January 2022 to discuss potential impacts and mitigation for built heritage assets.

6.3.2 A summary of the cultural heritage related responses from the Scoping Opinion which relate to the Scheme and responses from NCC's Senior Practitioner for Historic Buildings are included in Table 6-1.

Table 6-1 Scoping Response Summary

| Stakeholder | Comment made | Response and where addressed in the ES |
|---|---|---|
| NCC (Scoping Opinion) and NCC Archaeological and Building Conservation Team | The setting of heritage assets, impacts and mitigation will need careful consideration. Particular regard should be given to the recommendations of Historic England. | The impact to heritage assets, including their setting, is considered in this chapter. |
| | The scheme extends into the designated conservation area of East Bridgford village. The impacts on this designated heritage asset will be considerable and have potential to cause unacceptable levels of harm. | The impact to the conservation area is considered in this assessment. |
| | It is important to recognise that these designated heritage assets each have a 'setting' that contributes to their significance, and could be impacted and potentially harmed by the proposals. There are several listed buildings within view of the junction and as such these will require careful consideration and response within the scheme submission. These heritage assets should be set as receptors in the LVIA to ensure that the evidence is suitable. Noise receptors should be treated similarly. RBC identify the importance of mature landscaping including trees and landscaping of the entrance to the village of East Bridgford and its Conservation Area which should be clearly acknowledged and considered in the preparation of the application submission. | The impact to the conservation area and listed buildings, including their setting, is considered in this assessment.<br>Listed buildings also form part of the LVIA reported in Chapter 7: Landscape and Visual. |
| | Harm to designated heritage assets (including their settings) is in some cases avoidable through carefully considered design. For instance, noise and light pollution should be considered at the design stage to ensure that they do not impact adversely on these heritage assets. Early consultation with the NCC building conservation section and conservation officers at RBC should take place before designs are fully developed to ensure that there is opportunity to avoid adverse impacts and, where possible, introduce suitable enhancements to the scheme that can demonstrably mitigate these. | Likely significant effects have been considered to heritage assets within this chapter, including additional lighting and impacts relating to noise.<br>Consultation was undertaken with the County Archaeologist during the preparation of the EIA, as minuted in Appendix 6-1 of Volume 3. Consultation has been undertaken with the NCC Archaeology and Historic Buildings teams prior to submission of the application. These teams will continue to be engaged during the detailed design. |
| NCC Senior Practitioner for Historic Buildings | Requested that the following be considered and incorporated into the design:<br>• grass verge in place of hard surfaced bridleway;<br>• minimal extension of any hard kerbing; | The final bridleway surfacing details are yet to be confirmed and is being discussed with Countryside Access and Public Rights of Way team. There is |

| Stakeholder | Comment made | Response and where addressed in the ES |
|---|---|---|
| | • speed limit gateway – review where this will occur and adjust signage/chevrons accordingly;<br>• consider the diversion of overhead power lines underground to mitigate the visual impact that will occur when the mature hedge is removed; and<br>• consider whether white line hatching at junction can be omitted. | flexibility in the choice of surface which can be developed throughout the detail design of the Scheme.<br>Kerbing has been discussed at length with the designers. The presence of kerbing will have a positive impact on highway drainage by channelling carriageway surface water run off towards gullies preventing potential saturation of the adjacent verge and proposed bridleway. It is expected that materials in keeping with the East Bridgford Conservation Area would be chosen.<br>The speed limit gateway will be considered through the detailed design stage in partnership with Via's Safer Highways team. Likewise, the feasibility of diversion of overhead cables will be explored during detailed design.<br>The provision of this central hatched area is to encourage the correct vehicle positioning when waiting at the stop line on Kirk Hill. The left turn into the junction is difficult for larger vehicles often resulting in encroachment of some turning vehicles into the opposing lane. However, the provision of these lines will be considered in more depth during detailed design in collaboration with Via's Safer Highways team. |
| Historic England | In line with the NPPF, we would expect the ES to contain a thorough assessment of the likely effects which the proposed development might have upon those elements which contribute to the significance of these assets. | This is included within the assessment in this chapter. |
| | We would expect the ES to proportionately consider the potential impacts on ɔric, architectural, archaeological or artistic interest. | Non-designated assets have been included within the assessment, and effects on these are reported in this chapter. |
| | The assessment should also take account of the potential impact which ɔnstruction, servicing and maintenance, and associated traffic) might have upon appreciation of the heritage assets in the area. | Impacts from associated activities have been considered in Section 6.7 Assessment of Likely Significant Effects in this chapter. |

| Stakeholder | Comment made | Response and where addressed in the ES |
|---|---|---|
| | The assessment should also consider, where appropriate, the likelihood of alterations to drainage patterns that might lead to in situ decomposition or destruction of below ground archaeological remains and deposits, and can also lead to subsidence of buildings and monuments. | Impacts from associated activities have been considered in Section 6.7 Assessment of Likely Significant Effects in this chapter. |

## 6.4 Assessment Methodology

### Baseline Conditions

6.4.1 An archaeological map regression and aerial photography study was produced by Trent & Peak Archaeology (2021) for the project. The report includes the Nottinghamshire Historic Environment Record (HER) data (Nottinghamshire County Council, 2021) of the study area, aerial photographs, LiDAR and historic mapping (Trent & Peak Archaeology, 2021; refer to Appendix 6-2 in Volume 2D of this ES) and has been used to help inform the heritage baseline of this assessment.

6.4.2 The designated heritage assets within this assessment are identified with their National Heritage List for England (NHLE) (Historic England, 2021) reference number. The non-designated heritage assets are identified with their HER reference number which uses the prefix 'MNT'.

6.4.3 A site visit was carried out on 11th June 2021 by an appropriately trained and experienced AECOM Archaeological Consultant. Photographs of the site (the area within the assessment boundary) taken during the walkover survey are presented in Section 6.5. The main considerations of the site walkover were:

- to visually inspect the area and assess the heritage assets, including their setting, that have the potential to be impacted by the Scheme;
- to identify non-designated built heritage assets not identified during desk-based research; and
- to record current land use, ground conditions, and visible evidence of ground disturbance to assess how current and former land use may have affected the archaeological potential of the site.

### Study Area

6.4.4 A study area of 500 m from the assessment boundary has been used in order to identify designated and non-designated heritage assets which may be affected by the Scheme (refer to Figure 6-1 of Volume 2D). These potential effects are discussed in the impact assessment in Section 6.7.

### Methodology for Determining Construction Effects

6.4.5 Temporary construction impacts lasting for all or part of the construction phase of the Scheme may include the following:

- the presence and movement of construction plant and equipment has the potential to impact on the value of heritage assets within the study area, caused by changes to their setting;
- the siting of construction compounds and activities within working areas, including associated construction noise and lighting, have the potential to impact on the heritage value of heritage assets within the study area, caused by changes to their setting; and
- the use of traffic management and increased volumes of traffic on the local road network, which may impact on the value of heritage assets caused by changes to their setting.

6.4.6 Permanent construction impacts lasting beyond the construction phase may include the following:

- impacts on the setting of heritage assets within the study area, associated with the introduction of the physical form and appearance of the Scheme;
- the potential to encounter, disturb or truncate to the depth of construction buried archaeology, particularly within undeveloped areas of agricultural fields. Works within areas of undeveloped agricultural land either side of the current carriageway for road junctions and temporary construction compounds as part of this Scheme have the potential to impact on any archaeological remains located within previously undisturbed ground that has been in long-term agricultural use;
- compaction of archaeological deposits due to plant movement etc.; and
- changes to groundwater levels and possible desiccation of waterlogged archaeological deposits.

6.4.7 These impacts have been assessed through an appraisal of the designated and non-designated heritage baseline supported by a site visit to assess potential impacts on these assets. These effects can be either temporary or permanent.

## Methodology for Determining Operational Effects

6.4.8 Operational impacts of the Scheme may include:

- changes to traffic movements (and associated vehicle lighting), which could affect the setting of heritage assets;
- changes in road noise from vehicle movements, which may affect the setting of heritage assets; and
- the operation of road lighting at junctions and on junction approaches, which may affect the setting of heritage assets.

6.4.9 These have been assessed through an appraisal of the designated and non-designated heritage baseline supported by a site visit to assess potential impacts on these assets.

## Significance Criteria

6.4.10 Guidance contained with the DMRB Cultural Heritage Assessment Revision 1 (LA 106) (Highways England, 2020c) and Environmental Assessment and Monitoring Revision 1 (LA 104) (Highways England, 2020b) has been applied in the assessment to identify the value of archaeological remains, historic buildings and historic landscapes, and to identify and evaluate the impacts and effects that construction and operation of the Scheme would likely have on these assets.

6.4.11 The value of a building, monument, area, site, place or landscape reflects its ‘significance’ as a historic asset, and therefore its sensitivity to change.

6.4.12 Certain types of heritage asset have a level of value that justify official designation, such as scheduled monuments and listed buildings; however, the absence of designation does not necessarily mean heritage assets are of lower value.

6.4.13 The NPPF defines the significance (value) of heritage assets as “The value of a heritage asset to this and future generations because of its heritage interest” (NPPF, Annex 2 Glossary). In addition, the NPPF sets out criteria which should be considered when assessing the value of cultural heritage assets, which include archaeological, architectural, artistic and historic interests. The value of each asset is described in these terms and the contribution the setting of the heritage assets makes to its value is also assessed. The Chartered Institute for Archaeologists guidance (CIfA, 2020) also requires the value of heritage assets to be assessed.

6.4.14 Professional judgement based on knowledge and experience of similar schemes, has been used to identify the value of assets, guided by legislation, national policy, standards, official designations and the following criteria contained within DMRB LA104, reproduced in Table 6-2.

Table 6-2: Environmental value (sensitivity) and descriptions

| Value (sensitivity) of receptor / resource | Typical description |
|---|---|
| Very High | Very high importance and rarity, international scale and very limited potential for substitution. |
| High | High importance and rarity, national scale, and limited potential for substitution. |
| Medium | Medium or high importance and rarity, regional scale, limited potential for substitution. |
| Low | Low or medium importance and rarity, local scale. |
| Negligible | Very low importance and rarity, local scale. |

*Source: DMRB LA 104, Table 3.2N*

6.4.15 Impacts have been identified by reviewing the identified sites, features and areas within the study area against the form and extent of the Scheme, in order to establish which assets would be affected by its construction and operation.

6.4.16 Impacts identified in the assessment relate to the predicted changes to key elements of an asset and/or its setting. These can, for example, derive from temporary or permanent actions such as the physical destruction of buried archaeology during construction works, and the introduction of new highway infrastructure into the historic setting of a building or conservation area.

6.4.17 The identification of impacts takes account of all embedded and standard mitigation measures described in Section 6.6.

6.4.18 The methodology contained in DMRB LA 104 suggests that when assessing magnitude of impact the following descriptions described in Table 6-3 were applied.

Table 6-3 Magnitude of impact and typical descriptions

| Magnitude | Impact | Description |
|---|---|---|
| Major | Adverse | Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements. |
| | Beneficial | Large scale or major improvement of resource quality; extensive restoration; major improvement of attribute quality. |
| Moderate | Adverse | Loss of resource, but not adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements. |
| | Beneficial | Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality. |
| Minor | Adverse | Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements. |

| Magnitude | Impact | Description |
|---|---|---|
| | Beneficial | Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring. |
| Negligible | Adverse | Very minor loss or detrimental alteration to one or more characteristics, features or elements |
| | Beneficial | Very minor benefit to or positive addition of one or more characteristics, features or elements. |
| No change | | No loss or alteration of characteristics, features or elements; no observable impact in either direction. |

*Source: DMRB LA 104, Table 3.4N*

6.4.19 The significance of effects must be reported within Environmental Statements in accordance with the EIA Regulations. The approach to assigning significance of effect relies on reasoned argument, the professional judgement of competent experts and using effective consultation to ensure the advice and views of relevant stakeholders are taken into account. The approach to deriving effects significance from receptor value and magnitude of impacts is based on Table 6-4. Where Table 6-4 includes two significance categories, evidence has been provided to support the reporting of a single significance category.

Table 6-4 Significance matrix

| | | Magnitude of impact (degree of change) | | | | |
|---|---|---|---|---|---|---|
| | | No change | Negligible | Minor | Moderate | Major |
| Environmental Value (Sensitivity) | **Very high** | Neutral | Slight | Moderate / large | Large or very large | Very large |
| | **High** | Neutral | Slight | Moderate / slight | Moderate / large | Large / very large |
| | **Medium** | Neutral | Neutral / slight | Slight | Moderate | Moderate / large |
| | **Low** | Neutral | Neutral / slight | Neutral / slight | Slight | Slight / moderate |
| | **Negligible** | Neutral | Neutral | Neutral / slight | Neutral / slight | Slight |

*Source: DMRB LA 104 Table 3.8*

6.4.20 The matrix has been used to guide the identification and assessment of effects on cultural heritage; however, where professional judgement has resulted in a deviation from the thresholds contained in the matrix these are explained within the relevant sections of the chapter and are supported by appropriate evidence and explanation.

6.4.21 The methodology contained in DMRB LA 104 suggests when assigning significance of effects, the following descriptions in Table 6-5 were applied by the assessment.

6.4.22 Significant effects typically comprise residual effects that are within the moderate, large or very large categories.

Table 6-5 Significance categories and typical descriptions

| Significance category | Typical description |
|---|---|
| Very large | Effects at this level are material in the decision-making process. |
| Large | Effects at this level are likely to be material in the decision-making process. |
| Moderate | Effects at this level can be considered to be material decision-making factors. |
| Slight | Effects at this level are not material in the decision-making process. |
| Neutral | No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error. |

*Source: LA 104 Table 3.7.*

### Assessment of Harm to Designated Heritage Assets

6.4.23 The NPPF sets out requirements to consider whether the impacts of a development on a designated heritage asset amounts to substantial harm to or total loss of, or less than substantial harm to its value.

6.4.24 There is no direct correlation between the significance of effect reported in this chapter and the level of harm on the value of designated heritage assets resulting from the Scheme. Notwithstanding this:

- A very large or large (significant) effect on a heritage asset (including total loss of value) would typically form the basis by which to determine that the level of harm to the value of a designated asset would be substantial. However, substantial harm is considered to be a high test (in other words extensive changes to value) and a case-by-case assessment should be made.
- A moderate (significant) effect is unlikely to meet the test of substantial harm and would therefore typically form the basis by which to determine that the level of harm to the value of a designated asset would be less than substantial.
- A minor or negligible (not significant) effect would typically amount to less than substantial harm to the value of a designated asset.
- A neutral effect amounts to no harm on the value of a designated asset.

6.4.25 In all cases, the determination of the level of harm to the value of a designated heritage asset arising from construction or operation of the Scheme has been led by professional judgement.

6.4.26 The assessment of harm on designated heritage assets resulting from the Scheme in respect of the policy requirements of the NPPF are detailed in Section 6.7.

### Assumptions and Limitations

6.4.27 Data was acquired for the study area from the Nottinghamshire HER by Trent and Peak Archaeology in January 2021. Any subsequent additions to the HER after this date have not been included.

## 6.5 Baseline Conditions

6.5.1 There are ten designated assets and 40 non-designated assets recorded within the study area. The designated heritage assets are recorded with their NHLE number and the non-designated assets are recorded with their HER number. The heritage

assets are recorded in Appendix 6-1 in Volume 2D and are shown on the known heritage assets figure (See Figure 6-1 of Volume 2D).

## Designated Assets

6.5.2 The designated assets comprise a scheduled monument, one Grade I listed building, seven Grade II listed buildings and a conservation area.

6.5.3 The scheduled monument is the remains of a motte and bailey castle adjacent to the River Trent (1008568) approximately 500 m north-west of the Scheme.

6.5.4 There are eight listed buildings within 500 m of the Scheme, all located within East Bridgford to the north. The listed buildings comprise the Grade I listed Church of St Peter (1272697) and seven Grade II listed buildings, which include:

- Group of three headstones, seven metres south of the chancel at the Church of St Peter (1272676);
- The Old Rectory (1243712)
- East Bridgford War Memorial Cross (1456217);
- 3, Kirk Hill (1243770);
- The Hill Country House (1045675);
- Garden House, stable and garden wall at The Hill (1272770); and
- Walnut Lodge and adjoining stables (1243773).

6.5.5 The Scheme and the listed buildings to the north also lie within the East Bridgford Conservation Area. The section of the Conservation Area which lies within the assessment boundary consists of an approach to the village, characterised by brick cottages and country houses, separated from the road leading into East Bridgford by long stretches of brick walls.

6.5.6 A Conservation Area Appraisal and Management Plan (RBC, 2008) highlights the features and characteristics of the village that are worthy of protection. Features of note include the ‘strong sylvan setting of the village, with mature trees giving Kirk Hill…a particularly strong character’ and, equally important, ‘the trees and hedgerows surrounding fields and paddocks on the edge of the village’.

6.5.7 The Appraisal includes a sketch plan showing six un-named ‘Character Areas’ with brief descriptions. An area along Kirk Hill is described as a ‘distinctive approach…that contains many buildings that characterise the village’, and also highlights the presence of the long brick wall to then north side. An area to the north-east of the site, including Mill Gate, is noted as having a character defined by the networks of footpaths and sense of enclosure and of drama as views of buildings and open spaces are progressively revealed.

## Non-designated Assets

6.5.8 There are 40 non-designated assets recorded within the study area, one of which lies within the assessment boundary. This is the location of a pinfold between Kirk Hill and the A6097 (MNT13636).

## Archaeological and Historical Background

### Prehistoric (Up to AD43)

6.5.9 The earliest finds are worked flint flakes from the Palaeolithic to the Bronze Age found on Kirk Hill opposite St Peter’s Church (MNT2010).

6.5.10 Evidence of early prehistoric periods are often confined to individual find spots of stone tools, often around river valleys. Correspondingly, within Nottinghamshire evidence of these periods has been found more frequently around the Trent Valley, although finds have been recorded throughout the County (Bishop, 2000a).

6.5.11 Evidence of later prehistoric evidence is more extensive in the wider area. During the Neolithic period (4000-2500BC), the introduction of farming brings a more sedentary way of life, which allows for evidence of permanent settlements. Other features of the later prehistoric include funerary monuments.

6.5.12 Approximately 1.9 km north-west of the site is a Neolithic scheduled henge (1017562), consisting of a sub-circular flat platform measuring approximately 53 m in diameter which is enclosed by a ditch averaging 15 m wide and approximately 1.5 m deep.

6.5.13 The Iron Age (800BC-AD43) evidence within Nottinghamshire has identified a landscape of settlements notably around the Trent Valley, with numerous cropmark remains as well as find spots of metalwork and pottery recorded (Bishop, 2000b).

### Roman (AD43-410)

6.5.14 There are no assets of Roman date recorded within the study area on the HER, although a Roman road is likely located underneath the present A6097 and an excavation in the field to the east of the site recorded Roman made ground. During the Roman period, Nottinghamshire saw a number of settlements established across the County, although more extensively noted within the Trent Valley and southern Nottinghamshire (Bishop, 2000c). Paleoenvironmental evidence, in addition to the extent of settlement evidence, indicates that the landscape was well-cleared of woodland and used for farming during this period (Bishop, 2000c).

6.5.15 While there are no Roman remains recorded in the study area, there is evidence of Roman occupation within the wider landscape. There is a scheduled Roman site to the south-east of the study area; Margidunum Roman Station (1006395) is located approximately 1.4 km to the south-east of the Scheme. Margidunum was a Roman settlement located along Fosse Way, between the Roman towns of Leicester and Lincoln. Remains of at least 22 buildings have been recorded during excavations in the 1920s and 1960s and were dated between the first and fourth centuries AD.

### Early Medieval (410-1066)

6.5.16 There are two non-designated assets of early medieval date within the study area, consisting of Saxon foundations (MNT1880) and a Saxon cross (MNT8187) at St Peter's Church in East Bridgford.

6.5.17 East Bridgford was recorded in the Domesday Book in 1086, indicating a settlement was present from at least the later early medieval period. The settlement is recorded as containing 39 households as well as a church, ploughland and meadow (Open Domesday, 2011).

### Medieval (1066-1540)

6.5.18 There are four medieval assets recorded within the study area, including one scheduled monument, one listed building and two non-designated assets.

6.5.19 The scheduled monument is the motte and bailey castle (1008568). The remains include an elliptical motte, measuring 30 m from east to west by 10 m from north to south and c.5 m high. The motte is surrounded by a ditch measuring up to 2 m deep and between 10 m and 15 m wide, with a small bailey located to the south.

6.5.20 The listed building is the Grade I listed Church of St Peter (1272697). The church comprises several medieval phases, including the Norman chancel, 14th century north aisle, and the 15th century clerestory. Also recorded in the study area are a

find of medieval pottery (MNT8197) and medieval finds from the churchyard (MNT26891).

### Post-Medieval (1540-1900)

6.5.21 There are ten assets of post-medieval date within the study area, comprising six listed buildings and four non-designated assets.

6.5.22 As well as the pinfold located within the assessment boundary (MNT13636), the other post-medieval asset is the 18th century tower of St Peter's Church (MNT9280). There are also two non-registered park and gardens, at East Bridgford Hall and Old Hall.

6.5.23 The earliest historic mapping of the area consists of an estate map of 1614 drawn up for Magdalen College, Oxford, which records the original junction of Bridgford Street and Kirk Hill, in an area of fields with the village to the north. The later enclosure map of 1801 and Sanderson's map of 1835 record the field layout surrounding the road as well as the road layout. The road from East Bridgford to the junction is recorded, which then continues south-west, while the line of the A6097 is represented by a small track (see Appendix 6-2 of Volume 3 for historic maps).

### Modern (1900-present)

6.5.24 There are 18 assets of modern date recorded within the study area, including one listed building and 16 non-designated assets.

6.5.25 The listed building is East Bridgford War Memorial Cross (1456217), located at the corner of Kirk Hill and Trent Lane in the churchyard.

6.5.26 The remaining non-designated buildings are concentrated to the north-east of the site within Bridgford. These are mostly comprised of houses, many along Main Street (MNT24894; MNT24181; MNT24184; MNT24177; MNT24179; MNT24137; MNT24138; MNT24132; MNT24136; MNT23100; MNT24087; MNT24141; MNT24229), as well as a mill (MNT13555), malthouse (MNT13546) and a family vault with the churchyard (MNT26890).

6.5.27 The historic mapping of the area records that the village of East Bridgford continued to expand southwards along Kirk Hill and from Main Street throughout the 20th century. The A6097 is first recorded on the 1952 Ordnance Survey map (Appendix 6-2 of Volume 3).

### Unknown

6.5.28 There are nine assets of unknown date located within the study area. These include an earthwork hollow (MNT7596), boundary bank (MNT10560) and linear feature (MNT8171) as well as fishponds (MNT13644; MNT13643), quarries (MNT17024; MNT13635) and a clay pit (MNT17025).

### Site Visit

6.5.29 The junction is located to the south of East Bridgford, with agricultural fields to the south and west and east, which were in arable cultivation at the time of the site visit. There were no views of the listed buildings from the site due to mature trees and their position set back from the road, or of the scheduled motte and bailey castle to the north of the study area. There is a row of houses located along the northern section of the site, on the road into East Bridgford.

Plate 6-1 Agricultural field to the south-west of the Kirk Hill Junction

Plate 6-2 View north-west along Kirk Hill towards East Bridgford

Plate 6-3 View south along Kirk Hill showing row of post-medieval houses

Plate 6-4 View south-west along Kirk Hill. Brick wall and mature trees mark the boundary of the listed buildings settings along the west side of this road and screen the buildings

## Future Baseline

6.5.30 In the absence of the Scheme, it is considered that the site would remain as

existing. No future baseline developments have been identified within the study area that would affect the future baseline.

## 6.6 Design, Mitigation and Enhancement Measures

6.6.1 The design has retained features which contribute to the special character of the East Bridgford Conservation Area including the stretch of brick wall along the north-west of Kirk Hill.

6.6.2 When developing the detailed design, the character of the East Bridgford Conservation Area should be taken into account. The following measures will be explored and incorporated into the design where possible to further mitigate the Scheme. These considerations include:

- using a grass verge in pace of hard standing bridleway should this be considered suitable for bridleway use;
- minimal extension of any hard kerbing;
- a review of the speed limit reduction point and extent of required signage; and
- consideration of the potential for overhead powerlines to be placed underground where these would be exposed as a result of removal of the mature hedge during construction.

6.6.3 It should be noted that these detailed design considerations have not been considered as part of the Scheme at this stage and so the assessment within this chapter is considered a worst-case scenario.

## 6.7 Assessment of Likely Significant Effects

### Construction

6.7.1 The site of a pinfold (MNT13636) that is located in the assessment boundary, between the two current roads, may be physically impacted during construction. The site of the pinfold possesses archaeological and historical interest, derived from the information it may provide on post-medieval agricultural processes and indicates the former land use. The site is considered to be of negligible heritage value. The asset may be wholly removed by the construction of the Scheme due to its location within the assessment boundary. This would have a major magnitude of impact, resulting in a slight adverse (not significant) effect.

6.7.2 There is also potential for previously unrecorded archaeological remains to survive within the assessment boundary, particularly in agricultural land at the north-eastern side of the site, which may be physically impacted during the construction of the Scheme including remains of a possible Roman road beneath the A6097. While the value of any previously unrecorded remains that may survive within the site cannot be determined at the time of writing, any remains may possess historic and archaeological interest deriving from their potential to contribute to our understanding of past human activity guided by local, regional, and national research priorities. Remains of a Roman road and associated remains may be of medium heritage value.

6.7.3 The widening of the road from the existing carriageway may physically impact upon archaeological remains although sections of the potential Roman road may have been destroyed by the construction of the modern A6097. The construction of the Scheme nevertheless may have a moderate magnitude of impact. On an asset of medium value, this would result in a moderate adverse (significant) effect.

6.7.4 A row of houses on Kirk Hill (ND01) comprises two attached non-designated post-medieval houses, which are recorded on the 1883 OS map. The houses are two storeys high, constructed of red brick and tiled roofs and are located to the south of Kirk Hill. The setting of the houses contributes to their value. The houses possess architectural and historical interest as surviving examples of post-medieval houses. The building is of low heritage value.

6.7.5 The Kirk Hill assessment boundary extends along Kirk Hill directly to the north of the houses. There would be no physical impacts to the houses from the construction of the Scheme, although there would be a temporary change to the setting of the buildings due to increased noise and traffic, as well as the presence of construction equipment. This would have a minor magnitude of impact, resulting in a slight adverse (not significant) effect.

6.7.6 There are several Grade II listed buildings located along Kirk Hill to the north-east of the Scheme, including the Old Rectory (1243712), The Hill (1045675) and associated garden house, stables and walls (1272770). These buildings comprise the late 18th century country house and outbuildings and a mid-18th century rectory, all of brick construction. The buildings are situated within grounds, which are set back from Kirk Hill along a lane with a brick wall and mature trees screening views of the buildings from the road. The setting of the buildings contributes to their value. The buildings possess architectural and historical interest as surviving examples of post-medieval structures. The buildings are of high heritage value.

6.7.7 The north-western side of the Scheme would extend along Kirk Hill, to the south of the listed buildings. There would be no physical impact to the buildings and they would be screened from the road by the mature trees and walls along the road. There may be some increase in noise and traffic along Kirk Hill during construction, although this would not affect the setting of the buildings. This would result in no change and a neutral (not significant) effect.

6.7.8 East Bridgford Conservation Area covers the core of the village including the area of the village within the study area comprising Kirk Hill, St Peter's Church and Main Street. Within the study area, the conservation area consists of an approach to the village, characterised by brick cottages and country houses, separated from the road leading into East Bridgford by long stretches of brick wall. St Peter's Church lies at the junction between Kirk Hill and Main Street, set within a raised churchyard. The conservation area possesses historical and architectural interest for the survival of medieval and post-medieval buildings. The conservation area is of medium heritage value.

6.7.9 The assessment boundary extends into the southern end of the conservation area, as the conservation area runs to the southern end of Kirk Hill. There would be some temporary change to the southern edge of the conservation area during construction due to the presence of construction machinery and increased noise and traffic associated with the construction.

6.7.10 Along Kirk Hill, the construction activity will be widespread although temporary. This section of the conservation area covers the approach along Kirk Hill into East Bridgford, characterised by a long stretch of brick wall and mature trees to the north-west of the road. There will be no change to these key elements of the conservation area from the Scheme and views of the main works at the Kirk Hill junction will be limited to the area directly surrounding the junction.

6.7.11 The noise and vibration data is outlined in Chapter 10 of this report. The assessment within the noise chapter indicates that during construction there is potential for significant adverse effects on noise and vibration sensitive receptors comprising the non-designated houses at the southern end of Kirk Hill, 10-14 Kirk

Hill (ND01) and 8, 8A and 11 Kirk Hill, all of which lie within the conservation area. In terms of heritage, this translates into temporary changes to the setting of the non-designated buildings at the southern end of Kirk Hill within the conservation area during construction of the Scheme.

6.7.12 Precise construction information was not available at this stage and noise predictions were used for various road construction activities.

6.7.13 The increased noise during construction may alter the character of the southern end of the conservation area although this change would be temporary.

6.7.14 These impacts would affect the setting of the non-designated buildings at the southern end of Kirk Hill, although as discussed above, there would be no effect to the listed buildings on Kirk Hill. Similarly, there would be no effect to the buildings further north within the conservation area, such as the church, as there would be no intervisibility between the buildings and the Scheme. Therefore, the changes to the conservation area would be limited to the southern edge and these changes would be temporary, and would have a negligible magnitude of impact, resulting a slight adverse (not significant) effect.

### Operation

6.7.15 In terms of operational effects, these could be associated with changes to lighting and noise to the East Bridgford Conservation Area.

6.7.16 In terms of lighting, there are two proposed 10 m light columns which would lie within the East Bridgford Conservation Area, at the southern end of Kirk Hill (see Figure 8.2 of Volume 2D). These would be located in the position of existing street lighting and therefore would not change the setting during the operation of the Scheme.

6.7.17 The operational noise assessment is outlined in Chapter 10 of this report. During operation of the Scheme there is not expected to be any significant change in noise levels in the noise study area, including within the East Bridgford Conservation Area. There is not predicted to be any adverse impact greater than negligible in the short or long term to any of the receptors within the conservation area.

6.7.18 There are no expected significant operational effects to heritage arising from the Scheme.

## 6.8 Additional Mitigation

6.8.1 As a Roman road is thought to run beneath the existing A6097 and there is potential for associated Roman remains within the assessment boundary as well as the site of the pinfold (MNT13636), a watching brief would be required to identify any surviving archaeological remains within the assessment boundary.

## 6.9 Residual Effects

6.9.1 The residual effects of the Scheme in relation to cultural heritage are outlined in Table 6-6. No significant residual effects are expected.

Table 6-6: Residual Effects

| Description of Effect | Sensitivity of Receptor | Nature of Effect/ Geographic Scale | Magnitude of Impact | Initial Classification of Effect (with embedded mitigation) | Additional Mitigation | Residual Effect Significance |
|---|---|---|---|---|---|---|
| Physical impacts to the site of a pinfold (MNT13636) | Negligible | Local | Major | Slight adverse | Watching brief | Negligible |
| Physical impacts to potential Roman archaeology associated with the possible road | Medium | Regional | Moderate | Moderate adverse | Watching brief | Slight adverse |
| Setting changes to the row of houses on Kirk Hill during construction | Low | Local | Minor | Slight adverse | None proposed | Slight adverse |
| Changes to the East Bridgford Conservation Area | Medium | Regional | Negligible | Slight adverse | None proposed | Slight adverse |

# 7. LANDSCAPE AND VISUAL

## 7.1 Introduction

7.1.1 This chapter reports the findings of an assessment of the likely significant effects on landscape and visual receptors as a result of the Scheme.

7.1.2 Landscape effects relate to changes to the landscape as a 'resource', including physical changes to the fabric or individual elements of the landscape, its aesthetic or perceptual qualities and landscape character. This relates to both rural landscapes and townscapes.

7.1.3 Visual effects relate to changes to existing views of identified visual receptors ('people'), from the loss or addition of features within their view as a result of the Scheme.

7.1.4 This chapter reviews the relevant policies in respect of landscape and visual matters, published landscape character assessments and supporting evidence base documents and the findings from fieldwork.

7.1.5 From this review, a proportionate number of representative landscape and visual receptors are identified for the assessment. The review also enables the landscape and visual work to inform the iterative design process, so that relevant design measures (e.g. new planting) are embedded in the Scheme as primary mitigation.

7.1.6 Following identification of the landscape and visual receptors, likely significant effects on them are assessed through combination of the sensitivity of the receptors and the magnitude of impact (change) from the Scheme during the construction phase (winter), year 1 of operation (winter) and year 15 of operation (winter and summer). This chapter also includes a qualitative night-time lighting assessment to assess the likely impacts and effects from new lighting on the relevant landscape and visual receptors and the character of the night sky.

7.1.7 The LVIA has also been undertaken with reference to the biodiversity assessment (Chapter 8: Biodiversity) and the cultural heritage assessment (Chapter 6: Cultural Heritage). These should be read in combination with this ES chapter.

## 7.2 Legislation and Policy

7.2.1 Information relating to relevant landscape and visual legislation and policy can be viewed in Volume 1, Chapter 7.

## 7.3 Consultation

7.3.1 Table 7-1 sets out specific landscape related consultation responses received from stakeholders.

Table 7-1: Consultation Response re Landscape or Visual Matters

| Stakeholder | Stakeholder Comments | Scheme Response |
|---|---|---|
| RBC Planning | It would appear that the various environmental constraints have been identified including heritage assets including various listed buildings and the East Bridgford Conservation Area in close proximity to the site. The importance of mature landscaping including trees and landscaping to the entrance to the village of East Bridgford and its Conservation Area should be clearly acknowledged and considered in the preparation of any scheme. | The existing vegetation, entrance to East Bridgford and the East Bridgford Conservation Area are considered within the assessment reported in this chapter. |

## 7.4 Assessment Methodology

7.4.1 This assessment has been prepared with reference to DMRB LA 107 Landscape and visual effects (Revision 2) (Highways England, 2020d) and, where appropriate, the Guidelines for Landscape and Visual Impact Assessment 3rd Edition (GLVIA3), (Landscape Institute, 2013). DMRB LA 107 indicates that assessment should identify likely significant landscape and visual effects.

7.4.2 The detailed plans and elevations that define the Scheme have been reviewed and form the basis of the assessment of likely significant effects on landscape and visual receptors.

7.4.3 Information sources for the LVIA are:

- OS and aerial on-line mapping;
- Published landscape character assessments, associated studies and relevant policy as set out in the respective sections of the LVIA; and
- Fieldwork, to verify the desk-based reviews and identify representative views from publicly accessible locations, as set out in the LVIA.

### Methodology for Determining Baseline Conditions and Sensitive Receptors

7.4.4 With reference to the assessment of landscape effects, DMRB LA 107 states that the study area should be proportionate in relation to the project boundary, wider landscape setting, extent of the area visible and the full extent of adjacent or affected landscape receptors of special value.

7.4.5 With reference to the assessment of landscape effects, DMRB LA 107 states that the study area should be proportionate in relation to the project boundary, wider landscape setting, extent of the area visible and the full extent of adjacent or affected landscape receptors of special value.

7.4.6 In relation to the assessment of visual effects, DMRB LA 107 states that the study area should be proportionate in terms of the visual footprint, wider visual envelope, the extent of representative viewpoints visible and the extent of adjacent or affected visual receptors and the visual amenity of the area.

7.4.7 Further to the above, GLVIA3 states that the assessment area should include the full extent of the wider landscape that the development may influence in a significant manner. This is usually based on the extent of Landscape Character Areas likely to be significantly affected, directly or indirectly; but also may be based on the extent of the area where the development may be visible, defined as the Zone of Theoretical Visibility (ZTV); or a combination of the two.

7.4.8 Both guidance documents advocate a proportionate approach to the LVIA process, with emphasis placed on the potential for significant effects.

### Study Area

7.4.9 A 2 km study area was initially defined at the Scoping stage, determined by desk-based reviews of landform and vegetation patterns, the generation of a ZTV and fieldwork.

7.4.10 Following site surveys and reviews of the revised design, it was considered appropriate to reduce the study area to 750 m. The relatively small scale of the Scheme, combined with screening provided by a combination of existing landform

and built form, are considered to negate the potential for significant landscape and visual effects beyond this range.

7.4.11 The baseline scenario for the assessment is the 'present-day' landscape character and features across the site and study area and the existing 'present day' visibility as recorded by the fieldwork. This landscape and visual baseline is described in the following sections of this chapter.

7.4.12 The landscape receptors were determined through reviewing published landscape character assessments and undertaking fieldwork to verify the published studies and identify local landscape character areas where relevant to add a further level of detail.

7.4.13 The visual receptors were also identified from a review of mapping, ZTVs, fieldwork from publicly accessible locations and professional judgement, to establish a representative range of people's views.

7.4.14 The methodology for the presentation of the Type 1 viewpoint photography and the Type 4 photomontages has been undertaken in accordance with Technical Guidance Note 06/19: Visual Representation of Development Proposals (Landscape Institute, 2019).

### Methodology for Determining Construction Effects

7.4.15 The assessment of the construction impacts is based upon the assumption that all of the construction activity occurs across the site at the same time, to represent a worst-case scenario of peak activity.

7.4.16 The construction assessment is based on winter conditions when existing deciduous vegetation is not in leaf and therefore the extent of visibility and perception of the Scheme is greater in comparison to summer conditions.

- the potential construction impacts in relation to the LVIA are:
- removal of vegetation, both inside and outside the highway boundary;
- re-grading of landform, including top-soil strips and storage;
- main and satellite compounds consisting of offices, welfare facilities, materials storage, machinery, car-parking, security fencing, fuel storage and lighting;
- barriers and hoardings across the site as required for security and standard construction operating practices;
- temporary access routes between the site, construction areas and compounds;
- temporary traffic management measures; and
- machinery (diggers, excavators).

### Methodology for Determining Operational Effects

7.4.17 The assessment of the operation impacts is undertaken at two stages.

7.4.18 The first stage is the 'year 1' assessment, which assumes that the Scheme is built in its entirety and operational. The year 1 assessment is considered for both winter and summer conditions but in particular highlights winter, when existing deciduous vegetation is not in leaf and therefore the extent of visibility and perception of the Scheme is greater in comparison to summer conditions. It represents the worst-case scenario where visibility is greater.

7.4.19 The year 1 assessment also assumes that new planting is immature and at the

planted height specified in the landscape mitigation proposals, typically ranging between 0.5 m and 3 m in height.

7.4.20 The potential year 1 impacts in relation to the LVIA are:

- change in land use;
- alteration to vegetation cover; and
- additional highways infrastructure, including shared cycle/footways, lighting, traffic signals and signage.

7.4.21 The potential year 15 impacts in relation to the LVIA would reflect those stated above. The difference from the year 1 assessment is that the year 15 assessment assumes the successful establishment of the proposed planting, such that the planting would be taller in height, ranging between 1 m and 8 m in height.

7.4.22 The year 15 assessment is considered for both winter and summer conditions, informed by whether deciduous vegetation is in leaf or not.

## Significance Criteria

7.4.23 The significant effects are identified for both landscape and visual effects through a combination of sensitivity and magnitude, based on the criteria presented in DMRB LA 104, together with professional judgment. The approach to assigning significance of effect relies on reasoned argument, the professional judgement of competent experts and using effective consultation to ensure the advice and views of relevant stakeholders are taken into account.

### Landscape Sensitivity

7.4.24 Landscape sensitivity has been determined in accordance with DMRB LA 107.

7.4.25 Relevant tables from the above guidance clarifying the terms used to describe landscape sensitivity and the corresponding typical landscape descriptions are set out in Table 7-2.

Table 7-2 Landscape Sensitivity (Susceptibility and Value) and Typical Descriptions

| Landscape sensitivity (susceptibility and value) of receptor/resource | Typical description |
|---|---|
| Very high | Landscapes of very high international/national importance and rarity or value with no or very limited ability to accommodate change without substantial loss/gain (i.e. national parks, internationally acclaimed landscapes - UNESCO World Heritage Sites). |
| High | Landscapes of high national importance containing distinctive features/elements with limited ability to accommodate change without incurring substantial loss/gain (i.e. designated areas, areas of strong sense of place - registered parks and gardens, country parks). |
| Medium | Landscapes of local or regional recognition of importance able to accommodate some change (i.e. features worthy of conservation, some sense of place or value through use/perception). |
| Low | Local landscape areas or receptors of low to medium importance with ability to accommodate change (i.e. non- |

| Landscape sensitivity (susceptibility and value) of receptor/resource | Typical description |
|---|---|
| | designated or designated areas of local recognition or areas of little sense of place). |
| Negligible | Landscapes of very low importance and rarity able to accommodate change. |

*Source: DMRB LA 107 Table 3.22*

### Visual Sensitivity

7.4.26 Visual sensitivity has been determined in accordance with DMRB LA 107.

7.4.27 Relevant tables from the above guidance clarifying the terms used to describe visual sensitivity and the corresponding typical receptor descriptions are set out in Table 7-3.

Table 7-3 Visual Sensitivity (Susceptibility and Value) and Typical Descriptions

| Sensitivity (susceptibility and value) | Typical descriptions |
|---|---|
| Very high | 1) Static views from and of major tourist attractions:<br>2) Views from and of very important national/international landscapes, cultural/historical sites (e.g. National Parks, UNESCO World Heritage sites);<br>3) Receptors engaged in specific activities for enjoyment of dark skies. |
| High | 1) Views by users of nationally important PRoW / recreational trails (e.g. national trails, long distance footpaths);<br>2) Views by users of public open spaces for enjoyment of the countryside (e.g. country parks);<br>3) Static views from dense residential areas, longer transient views from designated public open space, recreational areas;<br>4) Views from and of rare designated landscapes of national importance. |
| Moderate | 1) Static views from less populated residential areas, schools and other institutional buildings and their outdoor areas;<br>2) Views by outdoor workers;<br>3) Transient views from local/regional areas such as public open space, scenic roads, railways or waterways, users of local/regional designated tourist routes of moderate importance;<br>4) Views from and of landscapes of regional importance. |
| Low | 1) Views by users of main roads or passengers in public transport on main arterial routes;<br>2) Views by indoor workers;<br>3) Views by users of recreational/formal sports facilities where the landscape is secondary to enjoyment of the sport; |

| Sensitivity (susceptibility and value) | Typical descriptions |
|---|---|
| | 4) Views by users of local public open spaces of limited importance with limited variety or distinctiveness. |
| Negligible | 1) Quick transient views such as from fast moving vehicles;<br>1) Views from industrial area, land awaiting re-development;<br>2) Views from landscapes of no importance with no variety or distinctiveness. |

*Source: DMRB LA 107 Table 3.41*

### Landscape Impacts

7.4.28 The magnitude and nature of impacts on the Landscape has been determined in accordance DMRB LA 107.

7.4.29 Relevant criteria from the above guidance clarify the terms which are used to describe the magnitude of change (the impact) and the corresponding typical descriptions as set out in Table 7-4.

Table 7-4 Magnitude of Impact on Landscape and Typical Descriptions

| Magnitude of impact (change) | | Typical descriptions |
|---|---|---|
| Major | Adverse | Total loss or large-scale damage to existing landscape character or distinctive features or elements; and/or addition of new uncharacteristic, conspicuous features or elements (i.e. road infrastructure). |
| | Beneficial | Large scale improvement of landscape character to features and elements; and/or addition of new<br>distinctive features or elements, or removal of conspicuous road infrastructure elements. |
| Moderate | Adverse | Partial loss or noticeable damage to existing landscape character or distinctive features or elements; and/or<br>addition of new uncharacteristic, noticeable features or elements (i.e. road infrastructure). |
| | Beneficial | Partial or noticeable improvement of landscape character by restoration of existing features or elements; or<br>addition of new characteristic features or elements or removal of noticeable features or elements |
| Minor | Adverse | Slight loss or damage to existing landscape character of one (maybe more) key features and elements;<br>and/or addition of new uncharacteristic features and elements. |
| | Beneficial | Slight improvement of landscape character by the restoration of one (maybe more) key existing features<br>and elements; and/or the addition of new characteristic features. |

| | | |
|---|---|---|
| Negligible | Adverse | Very minor loss, damage or alteration to existing landscape character of one or more features and elements. |

### Visual Impacts

7.4.30 The magnitude of visual impacts on the landscape has been determined in accordance DMRB LA 107.

7.4.31 Relevant criteria from the above guidance clarify the terms which are used to describe the magnitude of change (the impact) and the corresponding typical descriptions as set out in Table 7-5.

Table 7-5 Magnitude of Impact on Visual Receptors and Typical Descriptions

| Magnitude of impact (Change) | Typical descriptions |
|---|---|
| Major | The Scheme, or a part of it, would become the dominant feature or focal point of the view. |
| Moderate | The Scheme, or a part of it, would form a noticeable feature or element of the view which is readily apparent to the receptor. |
| Minor | The Scheme, or a part of it, would be perceptible but not alter the overall balance of features and elements that comprise the existing view. |
| Negligible | Only a very small part of the Scheme would be discernible or being at such a distance it would form a barely noticeable feature or element of the view. |
| No change | No part of the Scheme would be discernible. |

### Assumptions and Limitations

7.4.32 A site visit was undertaken by Landscape Architects from Via during February and September 2021 and by Landscape Architects from AECOM in October and November 2021 to assess the existing character of the landscape and record views from representative photoviewpoints covering winter and summer periods. These views were identified and recorded at locations within the study area (refer to Figure 7-1 of Volume 2D).

7.4.33 No major technical difficulties or practical problems were encountered in carrying out the LVIA. Potentially significant differences between seasonal views have been outlined where relevant within the assessment and taken into consideration in assessing the impacts and reaching conclusions. The site visit was undertaken in good weather visibility of at least 5 km.

## 7.5 Landscape Baseline Conditions

### The Site

7.5.1 The site, including any areas required for temporary construction works, consists of a signal-controlled crossroads and adjacent sections of road between the A6097 East Bridgford bypass and the unclassified road Kirk Hill and East Bridgford Road. It is located around 400 m south-west of the historic centre of East Bridgford village.

7.5.2 The A6097 is a two-lane single carriageway, widening for a short distance either

side of the junction to accommodate a turning filter lane and traffic islands. The road was constructed at the same time as the Gunthorpe Bridge over the River Trent, which opened in 1927. It provided a bypass to the village and follows the alignment of the former Roman Road 'Bridgford Street', now demarcated by the parallel bridleway that still bears the same name.

7.5.3 Prior to the opening of the A6097, Kirk Hill and East Bridgford road was a single route, with a short dog-leg that now runs parallel to the bypass. Both routes are single carriageway, two-lane unclassified roads.

7.5.4 The north side of the A6097 is characterised by a largely continuous belt of vegetation, including mature trees and dense, tall hedge line that is probably a relic of a former field boundary along Bridgford Street. This provides an effective screen that limits views between the A6097 and the main built-up area of East Bridgford, as well as intervening Public Rights of Way.

7.5.5 The south side of the A6097 includes a mown grass verge, which widens in the form of a visibility splay around the junction, with field boundary hedges beyond. Historic Ordnance Survey mapping indicates a roundabout in place during the late 1970s/1980s, with the junction being widened prior to this during the 1970s. The hedge planting appears to be reflective of this period and does not suggest a historic origin.

7.5.6 The A6097 descends through the ridge line as a straight, engineered gradient via a slight cutting through deciduous woodland. This woodland was historically part of the grounds of The Hill, a Georgian Grade II listed country house around 300 m to the north-east. The woodland extends west along the steeper section of the distinct Mercian Mudstone escarpment that runs parallel to the River Trent.

7.5.7 A small number of semi-mature trees are clustered either side of East Bridgford Road. Beyond this, both sides of the road are bounded by low, managed hawthorn hedges.

7.5.8 A pair of brick two-storey c.19$^{th}$ century cottages (No.s 12 and 14) and a relatively new build detached property (No. 10) are located between Kirk Hill and the A6097, with gardens backing onto the woodland belt parallel to the latter. The garden to No. 10 extends along a narrow strip which is screened from Kirk Hill by a tall hedge. A dense hedge with semi-mature trees runs along the eastern boundary, screening views into adjacent paddocks.

7.5.9 Immediately east of the junction is a small area of dense mixed woodland planted as a community project, which aerial mapping suggests took place between 2007 and 2010.

7.5.10 Lighting columns are present along the A6097 junction approaches, with only single columns along Kirk Hill and East Bridgford Road. Signage traffic signals, some with repeaters mounted on tall poles, contributes to a more urban, functional character which is at odds with the wider rural quality. Moving and queuing traffic limits tranquillity; particularly queues along the narrow Kirk Hill approach.

7.5.11 To the north-east of the A6097 and separating the road from East Bridgford is a field subdivided into horse paddocks. A public footpath runs along the eastern boundary, alongside a small pasture. These fields are bounded by dense hedges and occasional mature trees. Further east is a large, arable field.

7.5.12 Kirk Hill presents an attractive entrance to the village, with a high red brick wall and mature trees on the north side representing the former boundary to the parkland estate associated with The Hill. Outbuildings at the former Hill Farm have been converted into a number of detached residential properties.

7.5.13 To the south-west of the A6097 the character is much more open, with the exception of the small woodland area noted above. Expansive arable fields with low hawthorn hedges allow open views towards the hamlet of Newton and, more notably, glimpses across the Trent Valley towards high ground beyond.

7.5.14 The latter views are more easily appreciated from a public footpath that crosses the A6097 within the woodland and runs along the top of the ridge. This forms part of the long distance, waymarked Trent Valley Way, which runs from Stoke on Trent to the River Humber.

7.5.15 Overall, the junction is well-screened from nearby East Bridgford by woodland and tree belts to the east. This reduces the wider influence of traffic and highways infrastructure that otherwise feels incongruous in what is superficially a rural context.

### Landform and Hydrology

7.5.16 The site and study area lie near the top of the Mercia Mudstone escarpment, which is locally a relatively prominent landform that runs north-east to south-west, parallel to the River Trent. To the south-east, the land dips gently in the direction of the dip slope towards the Vale of Belvoir.

7.5.17 The junction lies at 47 m above Ordnance Datum (aOD). The land rises slightly towards the north-east (50 m aOD in East Bridgford (50 m aOD) and south-west (along East Bridgford road, 49 m aOD), but otherwise falls in all direction, with an overall 25 m difference between the site and the Trent floodplain, around 800 m to the north-west. The A6097 runs through a slight cutting, built to accommodate the gradient along the 1920s alignment, which means it lies slightly below the level of adjacent properties and fields.

7.5.18 An un-named watercourse runs from a point north of the site, adjacent to the A6097 Bridgford Street at the top of the scarp slope. This flows through woodland to a sewage works and then into the River Trent, downstream from Gunthorpe Bridge. Old Ordnance Survey maps indicate historic ponds along the watercourse as part of the former estate to The Hill. There are no visible watercourses within the site itself.

### Vegetation and Land Cover

7.5.19 Vegetation within the assessment boundary includes mown grass to verges on the A6097 and hedgerows of varied height and width along all the approach roads. Mature trees are scattered within sections of the hedgerows, merging into mixed deciduous woodland along the scarp slope to the north-west.

7.5.20 Gardens associated with residential properties adjacent to the site are largely screened from view. The wider landscape comprises arable fields and paddocks.

7.5.21 The combination of the slight cutting, woodland and dense, tall hedge boundaries create a relatively enclosed character that limits visual influence of the site beyond the immediately surrounding of the junction and A6097.

### Land Use, Infrastructure and Settlement Pattern

7.5.22 East Bridgford is the main settlement, with the old centre of the village located around the Kirk Hill/Main Street crossroads around 400 m east. Historic development included agricultural holdings with associated farmsteads and cottages along Kneeton Road and College Street respectively, further to the north-east. Many of these plots have been developed during the post-war years through infill housing, with further housing estates to the east and south.

7.5.23 Kirk Hill, between the site and the old centre, retains the historic character and provides an attractive entrance to the village, including the Grade I Church of St Peter. This contrasts with the more suburban character of the later residential estates to the east.

## Public Rights of Way (PRoW)

7.5.24 With reference to third-party online PRoW mapping Rowmaps (Rowmaps, 2021) there are a number of PRoW across the study area. Those relevant to the site are as follows:

- PRoW East Bridgford BW28 (bridleway), named Bridgford Street and running parallel to the A6097 along the course of the Roman Road;
- PRoW East Bridgford FP26 (footpath) along the south-eastern edge of the village, between Kirk Hill and Walnut Tree Lane;
- PRoW East Bridgford FP27 (footpath) linking Kirk Hill at the A6097 at the junction with Mill Gate on the south-west edge of the village;
- PRoW East Bridgford BW36 (bridleway), along Mill Gate within the village; and
- PRoW Shelford FP9 (footpath), from the A6097 and Bridgford Street towards Shelford Road along the edge of the scarp slope and forming part of the Trent Valley Way.

## Designations

### International and National Designations

7.5.25 The site is not covered by any statutory landscape designations (e.g. National Park or Area of Outstanding Natural Beauty), and there are no statutory designated landscapes within the study area.

### Local Landscape Designations

7.5.26 The site and study area are not covered by any local landscape designations, such as those supported by Local Plan policies, that relate to landscapes with special qualities or value, historic landscapes or protected views.

### Cultural Heritage Designations

7.5.27 Scheduled monuments, listed buildings and conservation areas, whilst not specific landscape designations, may reflect landscape and architectural quality or value and are relevant to development proposals that may impact upon them.

7.5.28 With reference to the Chapter 6: Cultural Heritage, there are several listed structures within the study area. All are located along Kirk Hill and include the Church of St. Peter (Grade I) and The Old Rectory; The Hill; and the Garden House, Stable and Wall at The Hill (Grade II). The last noted is the nearest to the site, at around 230 m.

7.5.29 A scheduled monument, a motte and bailey castle, lies around 500 m north of the site, commanding a view of a historic crossing point to the River Trent.

7.5.30 The boundary to the East Bridgford Conservation Area (see Figure 7-3 of Volume 2D) runs along the east side of the A6097 between Kirk Hill and to a point just beyond the crossing point of the Trent Valley Way. The designation includes Kirk Hill, land around the residential properties next to the A6097; and land associated with Hill Farm, The Hill and St. Peter's Church. The East Bridgford Conservation Area also encompasses a large area to the east of the village centre, including Mill Gate.

7.5.31 A Conservation Area Appraisal and Management Plan (RBC, 2008) highlights the features and characteristics of the village that are worthy of protection. Of note include the 'strong sylvan setting of the village, with mature trees giving Kirk Hill…a particularly strong character' and, equally important, 'the trees and hedgerows surrounding fields and paddocks on the edge of the village'.

7.5.32 The Appraisal includes a sketch plan showing six un-named 'Character Areas' with brief descriptions. An area along Kirk Hill is described as a 'distinctive approach…that contains many buildings that characterise the village', and also highlights the presence of the long brick wall to then north side. An area to the north-east of the site, including Mill Gate, is noted as having a character defined by the networks of footpaths and sense of enclosure and of drama as views of buildings and open spaces are progressively revealed.

7.5.33 Through a SWOT (strengths, weakness, opportunities and threats) analysis, weakness include fast-moving traffic and roads that are difficult to cross, with opportunities noted to reduce the negative impacts of both. The loss of important vegetation such as mature hedgerows, grass verges and trees is described as a threat, which would have a major impact.

7.5.34 The short (approximately 100 m) section of Kirk Hill nearest the junction is described as a Quality Rural Street. The remainder of Kirk Hill is a Quality Mixed Street. Such streets are deemed to be of high quality and the majority of boundary features such as hedges and walls are important to the character of the East Bridgford Conservation Area. These should be retained and maintained wherever possible.

7.5.35 A Townscape Appraisal Plan accompanies the report. It highlights the following that have relevance to the site and study area:

- "*significant trees"* along the eastern boundary to the A6097;
- "*significant hedges"* along both sides of Kirk Hill, close to the A6097 junction;
- Nos. 10, 12 and 14 Kirk Hill as *"positive buildings"* with special architectural or historic character;
- fields and paddocks west of the A6097 and Kirk Hill as "*positive open spaces"*;
- a panoramic/wide (medium to long distance) from the junction of the footpath East Bridgford FP27 and bridleway BW28 (Bridgford Street), across fields towards the village; and
- Kirk Hill, looking towards the village from near Hill Farm, is noted as a "*view of [a] positive building or landscape; the brick walls are described as 'a feature that is strongly associated with the village*".

### Green Belt

7.5.36 The site and adjacent agricultural land outside the settlement boundary to East Bridgford is within the Nottingham Green Belt.

7.5.37 The Green Belt is protected through both national and local planning policy with purposes that include the prevention of sprawl; merging of towns; encroachment of the countryside; and preservation of the setting and special character of historic towns. The essential characteristics of the Green Belt are their openness and their permanence.

7.5.38 Unlike other designations and character assessments, the Green Belt designation is not informed by any moderated, evidence-based evaluation of landscape character, quality, condition or value. Some areas designated as Green Belt are of distinctly poor landscape and visual quality. There is no legal definition of 'openness', a

concept which continues to be the subject of planning case law and High Court challenges.

7.5.39 For these reasons, the Green Belt designation is not considered as part of the evaluation of landscape sensitivity, nor are landscape and visual impacts upon it assessed in their own right.

## Tranquillity

7.5.40 Tranquillity at the site within the immediately area is low, being reduced by heavy traffic, both queuing and moving. Queuing traffic also frequently extends a short distance along Kirk Hill. The enclosure of the junction by vegetation and - to a lesser extent - landform means that tranquillity increases rapidly with distance, with a much more rural character more prevalent in the wider study area. Influence of the A46 dual carriageway, which runs around 1.2k m south-east of the site, was not noted during the site visit.

## Published Landscape Character Assessments

7.5.41 The site and study area are covered by several published landscape character assessments. Local planning authorities use their published landscape character assessments as part of their planning policy evidence base and the published assessments often provide specific guidance or recommendations on managing landscape change.

7.5.42 The following section summarises those aspects of the published studies that are relevant to the study area and the site and should be read in combination with Figure 7-2 of Volume 2D, which illustrate the published landscape character assessment boundaries.

### National: Natural England, National Character Area 48 (NCA 48): Trent and Belvoir Vales

7.5.43 The site and study area are within NCA 48: Trent and Belvoir Vales (Natural England, 2013), which is characterised by undulating, strongly rural and predominantly arable farmland, with stated key characteristics relevant to the site and study area as follows:

- *"A gently undulating and low-lying landform in the main, with low ridges dividing shallow, broad river valleys, vales and flood plains. …*
- *The bedrock geology of Triassic and Jurassic mudstones has given rise to fertile clayey soils across much of the area…*
- *Agriculture is the dominant land use, with most farmland being used for growing cereals, oilseeds and other arable crops. While much pasture has been converted to arable use over the years, grazing is still significant in places, such as along the Trent and around settlements."*
- *A regular pattern of medium to large fields enclosed by hawthorn hedgerows, and ditches in low-lying areas, dominates the landscape*
- *Very little semi-natural habitat remains across the area...*
- *Extensive use of red bricks and pantiles in the 19th century has contributed to the consistent character of traditional architecture within villages and farmsteads across the area. Stone hewn from harder courses within the mudstones, along with stone from neighbouring areas, also feature as building materials, especially in the churches*

- *A predominantly rural and sparsely settled area with small villages and dispersed farms linked by quiet lanes, contrasting with the busy market towns of Newark and Grantham, the cities of Nottingham and Lincoln, the major roads connecting them and the cross-country dual carriageways of the A1 and A46*."

7.5.44 Relevant Statements of Environmental Opportunity (SEO) include:

- "*Enhance the woodland and hedgerow network through the planting of small woodlands, tree belts, hedgerow trees and new hedgerows to benefit landscape character, habitat connectivity and a range of ecosystem services, including the regulation of soil erosion, water quality and flow*"
- *Maintain and enhance the character of this gently undulating, rural landscape. Promote and carefully manage the many distinctive elements that contribute to the overarching sense of place and history of the Trent and Belvoir Vales.*"

7.5.45 Relevant stated landscape attributes are:

- *"A strong sense of history and time depth through-out the landscape;*
- *The overall rural character and undisturbed pockets of tranquillity in the landscape;*
- *Hedgerows and field patterns; and*
- *The traditionally farmed, managed landscape."*

7.5.46 Landscape opportunities include:

- "*Conserve the rural settlement pattern by ensuring that new development is complementary to intrinsic local character …;*
- *Ensure new developments are integrated well with adequate, well designed, green infrastructure. Resist new road development which threatens tranquillity; and*
- *Restore and manage hedgerows, where they have been lost, to strengthen the historical field patterns, improve wildlife networks and enhance landscape character.*
- *Enhance tree cover throughout the NCA following the recommendations of the East Midlands Woodland Opportunity Mapping Guidance for each of the sub areas within the NCA through, for example, extensive planting of hedgerow trees. This is particularly important in view of the threat from ash dieback disease as ash is a characteristic species in the NCA*."

### County: Greater Nottingham Landscape Character Assessment (GNLCA), 2009

7.5.47 With reference to Figure 7-2 of Volume 2D, the site is covered by a single GN LCA (NCC, 2009) Regional Landscape Character Areas (RLCA) and Policy Zone (PZ):

- South Nottinghamshire Farmlands RLCA, which extends from the area to the south of Nottingham east to the County border, including the Vale of Belvoir.

7.5.48 Within the assessment boundary the Policy Zone directly affected is:

- PZ SN05 East Bridgford Escarpment Farmlands, which encompasses a north-east to south-west band from Newark to Radcliffe on Trent, including the steep scarp slope parallel to the Trent and the gently sloping dip slope to the south-east.

7.5.49 Table 7-6 summarises the key characteristics within the published landscape character assessments.

Table 7-6: Summary of published Landscape Character Assessments

| RLCA | Key Characteristics |
|---|---|
| **South Nottinghamshire Farmlands RLCA** | A rural agricultural region characterised by small nucleated red brick villages on the high mudstone ridge within uniform and sometimes monotonous tracts of arable farmland, and pasture around villages. Hedgerows are of a varied condition and woodland is limited, allowing open views. |
| **PZ SN05 East Bridgford Escarpment Farmlands** | |
| **Key Characteristics** | |
| PZ SN05 includes the steeply sloping northern edge of the escarpment above the River Trent and more gentle slopes to the south, towards the A46. It has a rural character which is largely arable and comprises fields of medium to large size and as modern field patterns, with smaller areas of pasture around the edges of East Bridgford and Kneeton. Field boundaries are almost all hedgerows of variable condition, with some fragmentation around fields. Woodland cover is limited and, where present, is prominent and often as irregular blocks.<br>Settlement is limited, the largest being Radcliffe on Trent, with East Bridgford being nestled into the landscape with mature boundaries that helps to reduce prominence. Hedgerow trees are limited and where present are often in small groups along field boundaries, often close to woodland. The prominent red brick wall along Kirk Hill is noted, adding a formality to the approach to the village.<br>Extensive and distinctive views are possible across low-lying farmland along the Trent and to the village of Shelford.<br>Landscape condition is described as ‘moderate’, character is described as ‘moderate’ and the overall landscape strategy is ‘enhance’.<br>Relevant Landscape Actions are:<br>Enhance field boundaries through augmentation of hedgerows to reinforce field pattern<br>Enhance the distribution of hedgerow trees by encouraging planting of trees within hedgerows. Species used should be mostly ash with some oak. These should be carefully located to ensure that an open character is retained<br>Conserve the small pockets of permanent pasture around village fringes | |
| **Value** | |
| No landscape designations<br>Green Belt – planning designation<br>Heritage features include Conservation Area at East Bridgford and Kneeton, with the former extending along Kirk Hill to the site. Listed Buildings include the Grade 1 listed Church of St. Peter in East Bridgford and Grade II listed buildings such as The Hill and associated Garden House, Stable and Wall; and East Bridgford windmill.<br>Open views across the Trent valley<br>Recreational interest is demonstrated by the many PRoWs in the area, including the Trent Valley Way.<br><br>Overall: Taking the key characteristics and indicators of value into account PZ SN05 is assessed as medium landscape value. | |

## Future Baseline

7.5.50 In the absence of the Scheme, it is considered that the site would remain as existing. No future baseline developments have been identified within the study area that would affect the future baseline.

## 7.6 Design, Mitigation and Enhancement Measures

7.6.1 The landscape design proposals are shown in Appendix 2-2 in Volume 3D. The objectives of the landscape design are to:

- mitigate unavoidable loss of landscape elements by the replication of characteristic features within the landscape design proposals;
- reduce or mitigate effects on landscape character and visual amenity by the use of planting and seeding to integrate the junction as far as possible, given the nature of the Scheme;
- achieve and maximise biodiversity opportunities within land taken for the Scheme; and
- provide a long-term appropriate setting for the junction which is functional but also appropriate for the context.

7.6.2 Elements which achieve these objectives at the Kirk Hill Junction include:

- use of species rich hedgerow of native trees and shrubs to establish new highway boundaries and integrate the junction into the landscape context, including a new well defined boundary to replace that lost on Kneeton Road; and
- wildflower and wetland areas to provide biodiversity value and extend the habitat range adjacent to the junction.

## 7.7 Assessment of Landscape Effects

7.7.1 Effects on the landscape character of the South Nottinghamshire Farmlands RLCA would be of a scale and extent, within the context of an existing junction that they would effectively be of neutral significance at the scale of the regional landscape character area at all stages.

7.7.2 Effects at the Policy Zone scale are assessed in Table 7-7.

Table 7-7: Assessment of Landscape Effects in Construction

**PZ SN05 East Bridgford Escarpment Farmlands**

**Susceptibility**

The pattern of elements in SN05 comprises a balance of open, large-scale expansive views, with more intimate, wooded settlement and the prominent escarpment above the River Trent. Elements of value, such as mature trees and historic built form, are notable within the immediate site area. Human influence is concentrated along the main transport routes of the A46 and A6097. Construction would increase human activity and directly impact landscape character and appear incongruous in a largely rural landscape dominated by natural elements. However, given the context of a busy highway, susceptibility to this Scheme is assessed as low.

**Sensitivity**

Taking medium value and low susceptibility into account PZ SN05 is assessed as medium sensitivity to the Scheme in construction.

**Nature of Effect: Size/Scale, Geographical Extent, Duration and Reversibility**

Changes in construction would include removal of around 270 m of dense, outgrown hedge along Kirk Hill. This feature is described within the Conservation Area Appraisal as making a significant contribution to the character of Kirk Hill and the approach to the village. The adjacent open paddocks are also noted as being of value. Changes at this stage will also include removal of hedges, around 11 trees and a section of mown amenity grass along the west side of the A6097; and a small area of recently planted community woodland east of the junction.

There would be an increase in the amount of activity and human influence at the junction, as a result of the presence of machinery, traffic management and loss of key characteristics of the PZ. However, changes would be short-term, and temporary and in most respects reversible on removal of the construction activity.

Loss or damage to existing landscape character would be of small scale and extent around the junction. The loss of the hedge along Kirk Hill will temporarily alter one of the key elements that define this route into the village, increasing the perception of the minor road from adjacent footpaths and fields; and similarly increasing the perception of the village from the road.

The geographical extent of direct change within the PZ as a whole would be localised and indirect effects on the PZ would be of very limited geographical extent. Overall, there would be a minor magnitude of effect on PZ SN05 during construction.

**Significance of Effect**

Overall, taking the medium sensitivity and minor magnitude of effect into account there would be an **adverse effect of slight significance** on PZ SN05 during construction.

## Table 7-8: Assessment of Landscape Effects in Operation Year 1/Operation Year 15

**PZ SN05 East Bridgford Escarpment Farmlands**

**Susceptibility**

Influence of transport routes on landscape character occurs in the baseline from the A46 and A6097. The Scheme would not increase traffic or introduce new uncharacteristic elements but there would be some intensification of highway elements such as signage and lighting. Given the context, susceptibility to this particular Scheme within the PZ during operation is assessed as low both in Year 1 and Year 15.

**Sensitivity**

Taking medium value and low susceptibility into account PZ SN05 is assessed as low sensitivity to the Scheme in operation in Year 1 and Year 15.

**Nature of Effect: Size/Scale, Geographical Extent, Duration and Reversibility**

Changes in operation Year 1 would include highway intensification derived from the slightly wider footprint of the A6097 and presence of slightly increased lighting along East Bridgford Road. Changes would be long-term and permanent. However, the addition of highway infrastructure would be of negligible scale and extent within the PZ.
The Scheme would include addition of vegetation to replace that lost in construction, including new hedgerows along Kirk Hill and the east side of the A6097. Both include a large number of hedgerow trees. Areas of species-rich grassland will also be included along road verges, outside of visibility splays.
The provision of a new footway/horse riding route along a section of Kirk Hill will result in a wider corridor and reduce the dominance of traffic along what the alignment of what is currently a relatively constricted road.

In year 1 the new planting will remain immature, contribute little to landscape character, and not reduce the wider influence of traffic adjacent to Kirk Hill. Overall, there would be a minor magnitude of effect on PZ SN05 during Year 1.

At Year 15, the landscape mitigation elements of hedgerow species characteristic of the landscape character area, tree planting and species-rich verges will have matured in such that they contribute positively to the landscape context of the junction within PZ SN05. Effects from the highway elements would remain as described for Year 1 with some benefit derived from greater integration within the baseline and less dominance of traffic along the wider corridor of Kirk Hill where near the junction. Balancing these factors, there would be a negligible magnitude of effect on PZ SN05 at Year 15.

**Significance of Effect**

Overall, taking the medium sensitivity and negligible magnitude of effect into account there would be a **slight adverse effect** on PZ SN05 in operation Year 1 and a **neutral effect** at Year 15.

## 7.8 Visual Baseline Conditions

7.8.1 Figure 7-1 of Volume 2D illustrates a range of representative viewpoints which form the basis of the LVIA.

7.8.2 There are several potential visual receptors in and around the study area (all distances are approximate and taken from the assessment boundary). These include:

- residents at properties along Kirk Hill, close to the junction and within the East Bridgford conservation area (2-10 m);
- residents at properties in other locations along Kirk Hill, behind the wall running along the north side, within the East Bridgford conservation area (40-100 m);
- residents at properties in the wider village of East Bridgford, within the conservation area (275 m and beyond);
- pedestrians, cyclists and horse riders using local rights of way, including the bridleway Bridgford Street (0 m); and
- users of vehicle along the A6097, Kirk Hill and East Bridgford Road.

7.8.3 Following production of a ZTV of the Scheme, photoviewpoints were recorded from a total of seven locations within the study area (see Volume 2D Figure 7-1 for locations, Figures 7-4 for viewpoints and Figure 7-5 for photomontages for viewpoint 1) and were selected to represent a range of location types and viewing distances. The photoviewpoints are displayed at a viewing distance of a comfortable arm's length within in accordance with the Landscape Institute's Technical Guidance Note 06/19: Visual Representation of Development Proposals. The photoviewpoint are Type 1 viewpoint photography and the photomontages are Type 4 visualisations.

7.8.4 As the ZTV was based on a bare earth survey, some photoviewpoints have not been taken forward due to the limited nature of views in these locations, when visited on site. Assessment of baseline characteristics of the representative viewpoints is set out in Table 7-9.

Table 7-9: Representative Viewpoints Baseline Characteristics

**Photoviewpoint 1: A6075, Kirk Hill junction (looking east)**

| Grid reference | Elevation (m aOD) | Receptor type | Approx. distance | Photoplan | Date of Visit |
|---|---|---|---|---|---|
| 468901, 342759 | 50 | Highway | 0 m | Figure 7-5-1 | July-Nov 2021 |

**Description of the baseline view**

View looking east across the A6097, with the junction to East Bridgford Road (in the foreground) and Kirk Hill (in the background).

This viewpoint reflects the views available to users of East Bridgford Road, as well as a representative view of receptors using the A6097.

The outlook is enclosed by dense, outgrown hedgerows and associated trees, resulting in the view being dominated by highways infrastructure such as lighting and signage, along with stationary or moving traffic associated with the junction. Areas of mown amenity grass in the foreground provide a limited sense of space. The screening by vegetation is such that no views of housing in East Bridgford, both along Kirk Hill and within the wider village, are available.

Degree of filtering: views beyond 50-100 m are screened by vegetation. There is no foreground filtering of views of the existing junction by hedgerows. Detractors in the view include lamp columns, highway signage, and moving traffic.

**Value of the View** **Value**

| | |
|---|---|
| The viewpoint is not located within an area subject to any landscape designations, but the whole study area is within the Green Belt. The East Bridgford Conservation Area extends beyond the A6097, extending away from the view along Kirk Hill and including the boundary hedgerow. The hedgerows along Kirk Hill are noted as contributing to the character of the conservation area, although in this location the dominant elements are associated with the A6097 and highways infrastructure. Despite the presence of the designation in the view, the location is not expected to be visited to experience the view and visual value is assessed as low. | **Low** |

## Photoviewpoint 2: Footpath FP26, rear of Walnut Grove, East Bridgford

| Grid reference | Elevation (m aOD) | Receptor type | Approx. distance | Photoplan | Date of Visit |
|---|---|---|---|---|---|
| 469336, 342863 | 52 | Recreational/ Residential | 345 m | Figure 7-4-1 | July-Nov 2021 |

**Description of the baseline view**

View looking west across an open field towards the A6097, with housing on the western edge of East Bridgford to the right of the view.

This viewpoint reflects the views available to users of the PRoW FP26, as well being representative of receptors in residential properties and gardens along the western edge of East Bridgford, including those adjacent on Walnut Tree Grove.

Range of view: The view is open towards the north-east, extending across an arable field as far as the distant boundary which comprises an outgrown hedge with trees along the A6097. Further boundaries of hedges and trees screen paddocks and fields to the west, although mature trees in the grounds of Hill Farm can be glimpsed beyond. The A6097 and Kirk Hill are almost completely screened by intervening vegetation, although lighting columns are just perceptible in some locations. This vegetation largely prevents onwards views, although the roofs of buildings at the former RAF Newton and distant housing around Radcliffe on Trent can be seen. The open view is framed to the west the garden and mature trees to Walnut Lodge (a Grade II listed building); and to the right by boundary vegetation to gardens along the western edge of the village. The latter screens the village, although a single property at the end of Mill Gate is visible.

Views within this direction are generally constrained to within 300-350 m, although glimpses of higher ground up to around 5 km are possible. Other than the glimpsed lighting columns, there are no detractors in the view.

| Value of the View | Value |
|---|---|
| The viewpoint is not located within an area subject to any landscape designations, but the whole study area is within the Green Belt. The East Bridgford Conservation Area extends to the edge gardens that adjoin the field, although does not include the footpath itself. The Conservation Area appraisal plan highlights both this view and the field as providing a positive contribution to the character of the village. The view is in the context of the listed building, although the building itself is not visible. The footpath is well-used and provides amenity value to residents through easily accessible views of the countryside. It is also available from a number of properties, the majority of which are oriented take advantage of the rural aspect. Value is assessed as medium, due to the absence of detractors and pleasing composition, such that the location may be visited on account of the view. | **Medium** |

## Photoviewpoint 3: Brunt's Lane, East Bridgford

| Grid reference | Elevation (m aOD) | Receptor type | Approx. distance | Photoplan | Date of Visit |
|---|---|---|---|---|---|
| 469406, 342670 | 47 | Residential/ highway | 256m | Figure 7-4-2 | July-Nov 2021 |

**Description of the baseline view**

View looking north-west across an open field, through a gap in vegetation and adjacent to houses along the north side of Brunt's Lane.

This viewpoint reflects the views available to users of the Brunt's Lane, a Restricted Byway (East Bridgford RB34), as well being representative of receptors in four residential properties with rear gardens along the unsurfaced track.

Range of view: The view is restricted by a hedgerow and vegetation in the garden to The Egg Farm to the right (north); and outbuildings and garden boundary vegetation to No. 8 Brunt's Lane to the left (west). As such, the view from the Restricted Byway is very limited and glimpsed, being largely focused along the length of the route. The available view is across an arable field as far as a boundary hedgerow, with mature trees within the curtilage to properties at Hill Farm and the former estate of The Hill visible beyond. To right of these are houses at the end of Mill Gate, including the distinctive former windmill, now a private residence. The left of the view is dominated by the four brick properties of No.s 8-12 Brunt's Lane, including gravel parking areas and front gardens.

Views within this direction are limited. Those available across the field extend to around 500 m, although the majority is constrained by adjacent housing and vegetation. There are no notable detractors in the wider view, although the immediate context of car parking is functional and domestic.

| Value of the View | Value |
|---|---|
| The viewpoint is not located within an area subject to any landscape designations, but the whole study area is within the Green Belt. The East Bridgford Conservation area extends to include the garden of the Egg Farm to the right of the view (around 25 m distant) but does not include the field or this section of Brunt's Lane itself. The Conservation Area Appraisal and Management Plan highlights both this view and the field as providing a positive contribution to the character of the village. Brunt's Lane is well-used and provides amenity value to residents through accessibility to the wider rural PRoW network. It is described in the Conservation Area Appraisal and Management Plan as a 'quality rural street'. Although noted on the appraisal plan, this view is glimpsed and largely dominated by adjacent domestic elements. Value overall is assessed as low. | **Low** |

## Photoviewpoint 4: East Bridgford Road, near Newton

| Grid reference | Elevation (m aOD) | Receptor type | Approx. distance | Photoplan | Date of Visit |
|---|---|---|---|---|---|
| 468554, 342099 | 47 | Recreational/ highway | 586m | Figure 7-4-3 | July-Nov 2021 |

**Description of the baseline view**

View looking north-east along East Bridgford Road and across adjacent fields.

This viewpoint reflects the views available to users of East Bridgford Road, an unclassified road between the hamlet of Newton (with an industrial estate on the former RAF base) and the junction with the A6097. It is also representative of users of a PRoW, footpath Newton FP2, which runs across the field in the foreground, but then terminating with no onward PRoW connections. No signage or evidence of use for this PRoW was noted in the field and the nearby field entrance was marked as 'no access'.

The view largely encompasses intensive farmland as arable fields either side of the road, bounded by hawthorn hedgerows. It is curtailed to the left (north-west) and right (north-east) by woodland blocks and hedgerow trees around 300 m distant, although the main extent of the view extends to towards the Kirk Hill junction and the village of East Bridgford beyond, around 1.1 km distant. Lighting columns along the A6097 can be glimpsed, but otherwise traffic and much of the village are screened by trees within hedgerows and the grounds of Hill Farm, The Hill and the along the settlement edge. More distant views are limited to high ground above Burton Joyce on the far side of the Trent Valley, including Bulcote Woods, to the left (north) of the view.

Views within this direction are across open field, although locally filtered by hedges. There are no notable detractors in the wider view, although the context is one of functional farmland. East Bridgford Road is relatively wide and straight for an unclassified route, such that it does not exhibit qualities associated with a rural lane.

| Value of the View | Value |
|---|---|
| The viewpoint is not located within an area subject to any landscape designations, but the whole study area is within the Green Belt. The view is largely one of functional farmland where the adjacent PRoW does not appear to be well-used. The location is unlikely to be visited to experience the view and visual value is assessed as low. | **Low** |

## Photoviewpoint 5: PRoW Shelford Footpath FP9, Trent Valley Way

| Grid reference | Elevation (m aOD) | Receptor type | Approx. distance | Photoplan | Date of Visit |
|---|---|---|---|---|---|
| 468554, 342099 | 47 | Recreational | 130 m | Figure 7-4-4 | July-Nov 2021 |

**Description of the baseline view**

View looking north-east from a public footpath that runs along the top of the Trent Valley escarpment.

This viewpoint reflects the views available to users of a public footpath (Shelford FP9) that runs between Shelford Road and Kirk Hill on the edge of East Bridgford, crossing with the A6097 within woodland on the relatively steep slopes of the Trent Valley escarpment. The route forms part of the Trent Valley Way, a waymarked long-distance walking trail between Nottingham and the River Humber.

The view is predominantly focused to the north and north-east, where this location offers an expansive panorama across open arable fields of the Trent Valley towards Burton Joyce, Gunthorpe and Lowdham, with higher ground beyond. The Trent can be glimpsed through riverside trees, with longer-distance views towards Nottingham, upstream and away from the field of view shown. Views to the north-east and east, including towards the site, are much more constrained, being largely screened by field hedgerows and an area of woodland that extends towards the A6097. A glimpse through the adjacent hedge of site is available, across an open field, with signage and lighting columns associated with the junction.

Views vary with direction; those away from the site area open and extend up to around 10 km, whilst those towards the site are largely screened. There are no notable detractors in the wider view, although the immediate context is one of functional farmland. The wider prospect across the Trent Valley is attractive and provides an opportunity to appreciate the relationship of the escarpment and floodplain.

| Value of the View | Value |
|---|---|
| The viewpoint is not located within an area subject to any landscape designations, but the whole study area is within the Green Belt. The view is located on what appears to be a well-used footpath that also forms part of a waymarked long-distance trail. It offers an open, attractive, elevated panorama across the Trent Valley in an area that is otherwise dominated by gently undulating farmland. The footpath is relatively accessible to residents in East Bridgford. Value is assessed to be medium. | **Medium** |

## Photoviewpoint 6: PRoW (footpath) FP27, rear of Mill Gate, East Bridgford

| Grid reference | Elevation (m aOD) | Receptor type | Approx. distance | Photoplan | Date of Visit |
|---|---|---|---|---|---|
| 469037, 342870 | 50 | Recreational/ Residential | 102 m | Figure 7-4-5 | July-Nov 2021 |

**Description of the baseline view**

View looking west from a public footpath, across a small field and paddocks towards the A6097.

This viewpoint reflects the views available to users of the PRoW FP27. It is also, in part, representative of a small number of receptors in residential properties and gardens along the western edge of East Bridgford, at the western end of Mill Gate.

Range of view: The view extends across a small pasture, with a larger field subdivided into paddocks to the right (north). A mature oak tree dominates the foreground, with more recent planting of a variety of standard trees present along the line of the footpath. Views to towards the site are screened by a variety of vegetation in the middle distance, including a tall hedgerow with trees along the A6097, and an intervening small coppice in the field; an area of young, dense woodland near the junction with Kirk Hill; and an outgrown hedgerow along Kirk Hill itself.

This vegetation serves to create a small-scale, intimate rural character on the village edge. Mature trees in the grounds to properties at Hill Farm are visible as prominent, attractive elements to the north. Built form is almost completely screened, other than the rooftops of the cottages near the Kirk Hill junction. Glimpses of lighting columns are the only visual indication of the A6097, although traffic noise is noticeable.

Views within this direction are generally constrained to within 150-200 m, Other than the glimpsed lighting columns, there are no detractors in the view.

| Value of the View | Value |
|---|---|
| The viewpoint is not located within an area subject to any landscape designations, but the whole study area is within the Green Belt. The East Bridgford Conservation Area includes parts of the paddock and the hedgerow that adjoins Kirk Hill, although does not include the footpath and viewpoint itself. The Conservation Area Appraisal and Management Plan highlights the field, alongside mature trees and the hedgerow along Kirk Hill as providing a positive contribution to the character of the village. The footpath is well-used and provides amenity value to residents through easily accessible views of the countryside. Value is assessed as medium, due to the absence of detractors and pleasing composition, such that the location may be visited on account of the rural qualities and view. | **Medium** |

### Photoviewpoint 7: Kirk Hill, East Bridgford

| Grid reference | Elevation (m aOD) | Receptor type | Approx. distance | Photoplan | Date of Visit |
|---|---|---|---|---|---|
| 468825, 342911 | 49 | Residential/ highway | 0 m | Figure 7-4-6 | July-Nov 2021 |

**Description of the baseline view**

View looking east from Kirk Hill, at a point where it curves sharply towards East Bridgford, alongside the wall to Hill Farm.

This viewpoint reflects the views available to users of the unclassified road Kirk Hill, the main vehicle access to East Bridgford from the A6097, along with the adjacent footway. The road forms part of the Trent Valley Way, a waymarked long-distance walking trail between Nottingham and the River Humber.

The view is relatively constrained by the tall, outgrown deciduous edge on the far side of Kirk Hill, which largely screens views into the adjacent paddocks and towards the edge of the village beyond. To the left (north-east) is a prominent brick boundary wall to the former Hill Farm and The Hill, the latter encompassing three Grade II listed buildings. Mature trees within the grounds to these properties contribute a strong presence to this entrance to the village, which includes the Grade I listed Church of St. Peter, slightly out of the view beyond.

To the right, the view includes the pair of 19th century brick cottages, and a more recent residential property. These, along with mature trees and garden vegetation, screen the A6097 beyond.

Views extend up to around 300 m along Kirk Hill, although are much more enclosed in most other directions. There are no notable detractors in the wider view; overall the appearance is one of an attractive, well-kept entrance to the village.

| Value of the View | Value |
|---|---|
| The full extent of the viewpoint is within the East Bridgford Conservation area. The hedgerows, mature trees, 19th century cottages and brick walls are all noted as contributing to the character of the conservation area. The walls are described as being strongly associated with the village and Kirk Hill is identified in the Conservation Area Appraisal and Management Plan as a 'quality mixed street'. The road itself is likely to be well-used by residents accessing the wider PRoW network, including the waymarked Trent Valley Way. Overall, the value of the view is assessed to be medium. | **Low** |

## 7.9 Assessment of Visual Effects

Table 7-10: Assessment of Visual Effects at Representative Viewpoints

### Photoviewpoint 1: Kirk Hill junction, looking east. See Photomontage 7-5-1

| Susceptibility of Receptor to Specific Change | Susceptibility |
|---|---|
| **All stages:** This view represents the view available to vehicle drivers/other road users approaching the junction and traffic signals with the A6097, travelling north-eastwards. Users of highways are at the lower range of susceptibility to visual intrusion from construction or highway infrastructure, as their primary focus is likely to be on travel/the highway rather than appreciation of views. | **Low** |

## Photoviewpoint 1: Kirk Hill junction, looking east. See Photomontage 7-5-1

| Sensitivity | Sensitivity |
|---|---|
| Taking the low value of the view with the low susceptibility to visual intrusion of construction and highway infrastructure into account, viewers are assessed as being of low sensitivity. | **Low** |
| **Nature of Effect: Size/Scale, Geographical Extent, Duration and Reversibility** | |
| **During construction:** Construction activity will be openly visible within much of the view. This will include widening of the carriageway in the foreground, through the removal of an area of mown amenity grass either side of East Bridgford Road. Mature trees to both sides of East Bridgford Road will be removed, along with a small area of woodland adjacent to Kirk Hill, beyond the A6097. The introduction of traffic management/construction activity and machinery will also be prominent. Construction activity for road users will be widespread in the view but will be relatively short-term and reversible. Overall, taking the short-term nature of the construction into account there will be a moderate adverse magnitude of change in construction vehicle users. | **Moderate** |
| **Year 1 of operation:** The Scheme will be visible within the same portion of the view as the baseline. Impacts will be derived from views of the increased footprint of the A6097, to accommodate widening north of the junction. New replacement planting of the woodland beyond the junction will be in place, but at a height of around 1 m maximum which will allow an open view of the paddocks beyond. The presence of highways lighting and signage will be largely unchanged; the view will be broadly similar to the existing outlook, dominantly one of a road junction. The perceptible increase in the scale and extent of the highway will result in a minor adverse magnitude of change for both receptor groups at this location in Year 1. Refer to Photomontage 7-4-1. | **Minor** |
| **Year 15 of operation:** By year 15, planting will replace that lost during construction, with additional hedgerow trees in the wider view to provide localised benefits to visual amenity. The inclusion of species-rich grassland, in place of existing amenity grass, may also provide some benefit to receptors waiting at traffic signals. Overall, adverse effects from the increased highway footprint and lighting columns will be of negligible magnitude. Refer to Photomontage 7-4-1. | **Negligible** |

| Significance of Effect | Significance |
|---|---|
| During construction: | **Slight adverse** |
| Year 1 of operation: | **Slight adverse** |
| Year 15 of operation: | **Neutral** |

## Photoviewpoint 2: PRoW Footpath FP26, rear of Walnut Grove, East Bridgford

| Significance of Effect | Significance |
|---|---|
| **All stages:** Lighting columns will extend further within the arc of view from this location, comprising 6 columns along the southern section of the A614. Overall, the use of low light spill LED will result in a neutral effect on visual amenity as a result of replacement of intrusive sodium lighting with LED lighting. Intervening vegetation along boundaries to fields and paddocks are such that the construction or operational Scheme will be indiscernible within the panorama, or of such short duration, that the effects on visual amenity would be effectively be neutral at all stages. | **Neutral** |

## Photoviewpoint 3: Brunt's Lane, East Bridgford

| Significance of Effect | Significance |
|---|---|
| **All stages:** Lighting columns will extend further within the arc of view from this location, comprising six columns along the southern section of the A6097. Overall, the use of low light spill LED will result in a neutral effect on visual amenity as a result of replacement of intrusive sodium lighting with LED lighting. In addition, in the daytime, intervening vegetation along boundaries to fields and paddocks are such that the construction or operational Scheme will be indiscernible within the panorama, or of such short duration, that the effects on visual amenity would be neutral at all stages. Effects from the residential properties are expected to be equivalent to those described for Viewpoint 2 (to the rear of Walnut Grove) above. Those for users of Brunt's Lane will be subject to much greater levels of foreground screening from the houses and adjacent vegetation. | **Neutral** |

## Photoviewpoint 4: East Bridgford Road, near Newton

| Significance of Effect | Significance |
|---|---|
| **All stages:** Lighting columns will extend further towards the viewpoint at this location, comprising three additional columns up to around 100 m distance from the junction along East Bridgford Road. Overall, the use of low light spill LED will result in a neutral effect on visual amenity as a result of replacement of intrusive sodium lighting with LED lighting. Intervening vegetation along fields, combined with the distance to the site and context of the expansive view, are such that the construction or operational Scheme will be indiscernible within the panorama, or of such short duration, that the effects on visual amenity would effectively be neutral at all stages. | **Neutral** |

## Photoviewpoint 5: PROW Shelford Footpath FP9, Trent Valley Way

| Significance of Effect | Significance |
|---|---|
| **All stages:** The temporary construction compound will be located at the far side of the field, close to the junction where moving and queuing traffic is currently visible. During operation, lighting columns will extend further across the view at this location, comprising three additional columns up to around 100 m distance from the junction along East Bridgford Road. Overall, the use of low light spill LED will result in a neutral effect on visual amenity as a result of replacement of intrusive sodium lighting with LED lighting. The limited visibility through the adjacent hedgerow, coupled with the main focus of the view being across the Trent and away from the site (to the left of the view shown in the figure), is such that the construction or operational Scheme will be indiscernible within the panorama, or of such short duration, that the effects on visual amenity would be neutral at all stages. | **Neutral** |

## Photoviewpoint 6: PRoW (footpath) FP27, rear of Mill Gate, East Bridgford

| Susceptibility of Receptor to Specific Change | Susceptibility |
|---|---|
| **All stages:** Receptors at this location comprise PRoW users. It is also partly representative of views from residential properties from properties to the edge of the East Bridgford Conservation Area (predominantly from upper floors). Both are at the higher range of susceptibility to visual intrusion from construction as a result of the expectation of appreciation of views and being typically engaged in active enjoyment of the view.<br><br>The A6097 highway forms a very minor element in the existing view. Receptors at this location are assessed as being of moderate susceptibility to change arising from construction activity within a highway context, given an expectation of enjoyment of views and the absence of similar activity in the baseline. Taking the medium value of the view with the moderate susceptibility to visual intrusion of construction into account, receptors are assessed as being of moderate sensitivity.<br><br>Views of the Scheme in operation (Years 1 and 15) would potentially be incongruous in the context of this view in which the A6097 highway forms only a minor part of the baseline, and users of PRoWs have any expectation of enjoyment of the view in this context. Receptors are therefore of medium susceptibility to the operational highway. Considering the medium value of the view against the medium susceptibility to views of the Scheme in year 1, PRoW users and residential receptors are assessed as being of moderate sensitivity to the operational Scheme. | **Moderate** |
| **Sensitivity** | **Sensitivity** |
| **All stages:** | **Moderate** |
| **Nature of Effect: Size/Scale, Geographical Extent, Duration and Reversibility** | |
| **During construction:** Construction activity visible within this view will comprise removal of the outgrown hedge along Kirk Hill, which forms the middle distance of the centre of the panorama. Sufficient depth of young woodland close to the junction will remain in order that views towards construction activity at the junction itself, as well as the compound on the far | **Minor** |

## Photoviewpoint 5: PROW Shelford Footpath FP9, Trent Valley Way

side of the A6097, will be screened. Minor construction activity will be visible along Kirk Hill. Queuing traffic, that was previously screened by the outgrown hedgerow, will be intermittently visible, along with the brick 19th century cottages and more modern house beyond. The latter will introduce built form. The introduction of these would add to adverse elements within the view. For residents near to the viewpoint, views would be largely from upper floors and for both residents and users of the PRoW, the construction activity would be viewed as a localised element within a wide panorama. The geographical extent of the view would be localised and be experienced from a small number of houses and as a minor element for PRoW users. Given the relatively short duration and reversibility of construction activity and the nature of the view there would be minor adverse magnitude of change during construction of the Scheme.

**Minor**

**Year 1 of operation:** The Scheme would be predominantly screened by existing, retained vegetation. New planting along Kirk Hill will be yet to mature, and introduction of increased highway infrastructure and intermittent queuing traffic (albeit along the unclassified Kirk Hill) more apparent in a part of middle-ground views. The majority of the view will remain unchanged, including key elements such as mature trees on the wider skyline. Screening will also prevent views of the additional lighting columns along the A6097 to the south of the junction. At night there will a localised increase in visual intrusion from the additional lighting within the periphery of the view, but partially offset by the use of LED low light spill lighting, including for the replacement of existing columns. Overall, at night therefore the perception of lighting will extend further within the view but the intensity of lighting/extraneous light spill will be similar to or less than in the baseline. The lighting design and lux plans for the Scheme (Figure 8-2 in Volume 2B) indicate that lighting will not illuminate, to any significant extent, beyond the immediate highway corridor. Overall, both in daytime and at night the geographical extent of the change in views from this location, including from along the PRoW and from within the East Bridgford Conservation Area would be limited. The perceptible increase in the scale and extent of the highway would result in a minor adverse magnitude of change for both receptor groups at this location in Year 1.

**Year 15 of operation:** Landscape mitigation planting, including hedges and trees, within the footprint of the Scheme would be substantially mature (in the case of hedgerows) and partially nature (in the case of trees) by year 15 and contribute to reduction in effects on visual amenity, compared to Year 1, and integration into the view. The mitigation within the highway boundary would substantially create landscape elements in the view which replicate the baseline (replacement hedgeline along Kirk Hill, with additional trees). Effects from lighting columns and lighting at night would remain. Overall, changes in visual amenity for residents and highway users as a result of modification of the view the negligible increase in highway dominance within a localised section of a wide panorama during the day and effects of negligible magnitude at night. The overall magnitude of the impact would be negligible adverse.

**Negligible**

| **Significance of Effect** | **Significance** |
|---|---|
| During construction: | **Slight adverse** |
| Year 1 of operation: | **Slight adverse** |
| Year 15 of operation: | **Neutral** |

## Photoviewpoint 7: Kirk Hill, East Bridgford

| **Susceptibility of Receptor to Specific Change** | **Susceptibility** |
|---|---|
| **All stages:** Receptors at this location comprise road users and pedestrians, many of which will access the adjacent PRoW. It is also partly representative of views from residential properties on Kirk Hill, with the East Bridgford Conservation Area.<br><br>Use of roads is not primarily associated with appreciation of the view and hence the majority of users at this location are at the lower range of susceptibility to visual intrusion from | **Moderate** |

construction or highway operation. Views from adjacent properties in this direction include the road and traffic in close proximity. However, it is acknowledged that some users in this location may be engaged in active enjoyment of the view that is noted in the Conservation Area Appraisal, for example pedestrians using the footway and accessing the wider path network. Taking the medium value of the view with the moderate susceptibility to visual intrusion into account, viewers at this location are assessed as being of moderate sensitivity to the construction and operation of the Scheme.

| **Sensitivity** | **Sensitivity** |
|---|---|
| **All stages:** | **Moderate** |
| **Nature of Effect: Size/Scale, Geographical Extent, Duration and Reversibility** | |
| **During construction:**<br>Construction activity will be openly visible within much of the view. This will include removal of the outgrown hedgerow in the foreground along Kirk Hill and exposure of cut material along the bank to accommodate a new multi-user path and footway. There will be a loss of enclosure that informs the character of this route, with more open views into the paddock beyond. The introduction of traffic management/construction activity and machinery will also be prominent. Construction activity for road users will be widespread in the view but will be relatively short-term and reversible. The hedgerow, when viewed from this location, is gappy and poorly managed. The open views will be of paddocks on the village fringe and there will be no change to key elements such as the brick wall and mature trees that contribute to the wider view. There will be no views of the main works at the Kirk Hill junction. Overall, taking the short-term nature of the construction into account there will be a minor adverse magnitude of change to receptors during construction. | **Minor** |
| **Year 1 of operation:** In operation, the Scheme will be visible within the same portion of the view as the baseline. Impacts will be derived from views of the increased footprint of Kirk Hill, to accommodate the new footway and multi-user path. New replacement planting of hedge and trees to the far side of Kirk Hill will be in place, but at a height of around 1 m maximum which will allow an open view of the paddocks beyond. The presence of highways lighting and signage will be largely unchanged. The open views, immature hedge and increase in the extent of the highway will result in a minor adverse magnitude of change for receptors at this location in Year 1. | **Minor** |
| **Year 15 of operation:** By year 15, planting will replace that lost during construction, with additional hedgerow trees in the wider view to provide localised benefits to visual amenity. Subject to management of the hedge, view may remain slightly more open than is currently the case. The inclusion of species-rich grassland along Kirk Hill may also provide some benefit to receptors. Overall, adverse effects at this stage will be of negligible magnitude. | **Negligible** |

| **Significance of Effect** | **Significance** |
|---|---|
| During construction: | **Slight adverse** |
| Year 1 of operation: | **Slight adverse** |
| Year 15 of operation: | **Neutral** |

## 7.10 Additional Mitigation

7.10.1 No additional mitigation is considered to be required.

## 7.11 Residual Effects

7.11.1 The residual effects of the Scheme in relation to landscape and visual effects are outlined in Table 7-11, Table 7-12 and Table 7-13 below. No significant residual effects are expected.

## Table 7-11: Residual Effects: Construction

| Receptor | Sensitivity of Receptor | Magnitude of Impact | Initial Classification of Effect (with embedded mitigation) | Additional Mitigation | Residual Effect Significance |
|---|---|---|---|---|---|
| **SN05 East Bridgford Escarpment Farmlands** | Medium | Minor | Slight | n/a | **Slight adverse** |
| **Photoviewpoint 1: Kirk Hill junction, looking east** | Low | Minor | Slight | n/a | **Slight adverse** |
| **Photoviewpoint 2: PROW Footpath FP26, rear of Walnut Grove, East Bridgford** | Moderate | Negligible | Neutral | n/a | **Neutral** |
| **Photoviewpoint 3: Brunt's Lane, East Bridgford** | Moderate | Negligible | Neutral | n/a | **Neutral** |
| **Photoviewpoint 4: East Bridgford Road, near Newton** | Moderate | Minor | Neutral | n/a | **Neutral** |
| **Photoviewpoint 5: PROW Shelford Footpath FP26, rear of Walnut Grove, East Bridgford** | Low | Minor | Neutral | n/a | **Neutral** |
| **Photoviewpoint 6: PRoW (footpath) FP27, rear of Mill Gate, East Bridgford** | Moderate | Minor | Slight | n/a | **Slight adverse** |
| **Photoviewpoint 7: Kirk Hill, East Bridgford** | Moderate | Minor | Slight | n/a | **Slight adverse** |

## Table 7-12: Residual Effects: Year 1

| Receptor | Sensitivity of Receptor | Magnitude of Impact | Initial Classification of Effect (with embedded mitigation) | Additional Mitigation | Residual Effect Significance |
|---|---|---|---|---|---|
| **SN05 East Bridgford Escarpment Farmlands** | Medium | Minor | Slight | n/a | **Slight adverse** |
| **Photoviewpoint 1: Kirk Hill junction, looking east** | Moderate | Minor | Slight | n/a | **Slight adverse** |
| **Photoviewpoint 2: PROW Footpath FP26, rear of Walnut Grove, East Bridgford** | n/a | Neutral | Neutral | n/a | **Neutral** |

| Receptor | Sensitivity of Receptor | Magnitude of Impact | Initial Classification of Effect (with embedded mitigation) | Additional Mitigation | Residual Effect Significance |
|---|---|---|---|---|---|
| **Photoviewpoint 3: Brunt's Lane, East Bridgford** | Moderate | Negligible | Neutral | n/a | **Neutral** |
| **Photoviewpoint 4: East Bridgford Road, near Newton** | Moderate | Negligible | Neutral | n/a | **Neutral** |
| **Photoviewpoint 5: PROW Shelford Footpath FP26, rear of Walnut Grove, East Bridgford** | Low | Negligible | Neutral | n/a | **Neutral** |
| **Photoviewpoint 6: PRoW (footpath) FP27, rear of Mill Gate, East Bridgford** | Moderate | Minor | Slight | n/a | **Slight adverse** |
| **Photoviewpoint 7: Kirk Hill, East Bridgford** | Moderate | Minor | Slight | n/a | **Slight adverse** |

## Table 7-13: Residual Effects: Year 15

| Receptor | Sensitivity of Receptor | Magnitude of Impact | Initial Classification of Effect (with embedded mitigation) | Additional Mitigation | Residual Effect Significance |
|---|---|---|---|---|---|
| **SN05 East Bridgford Escarpment Farmlands** | Medium | Negligible | Neutral | n/a | **Neutral** |
| **Photoviewpoint 1: Kirk Hill junction, looking east** | Moderate | Minor | Slight | n/a | **Slight adverse** |
| **Photoviewpoint 2: PROW Footpath FP26, rear of Walnut Grove, East Bridgford** | n/a | Negligible | Neutral | n/a | **Neutral** |
| **Photoviewpoint 3: Brunt's Lane, East Bridgford** | Moderate | Negligible | Neutral | n/a | **Neutral** |
| **Photoviewpoint 4: East Bridgford Road, near Newton** | Moderate | Negligible | Neutral | n/a | **Neutral** |
| **Photoviewpoint 5: PROW Shelford Footpath FP26, rear of Walnut Grove, East Bridgford** | Low | Negligible | Neutral | n/a | **Neutral** |

| Receptor | Sensitivity of Receptor | Magnitude of Impact | Initial Classification of Effect (with embedded mitigation) | Additional Mitigation | Residual Effect Significance |
|---|---|---|---|---|---|
| **Photoviewpoint 6: PRoW (footpath) FP27, rear of Mill Gate, East Bridgford** | Moderate | Negligible | Neutral | n/a | **Neutral** |
| **Photoviewpoint 7: Kirk Hill, East Bridgford** | Moderate | Negligible | Neutral | n/a | **Neutral** |

# 8. BIODIVERSITY

## 8.1 Introduction

8.1.1 This chapter considers the biodiversity impacts as a consequence of the construction and operation of the Scheme by using the assessment methodology described in the DMRB LA 108 Biodiversity Revision 1 (Highways England, 2020e).

8.1.2 A number of ecological surveys and assessments have been undertaken in support of the biodiversity assessment of this Scheme, and as such this Chapter is supported by the following documents:

- Ecological Appraisal (Via, 2021) – found in Appendix 8-1 Volume 2D;
- Biodiversity Net Gain (BNG) Assessment (Baker Consultants, 2021) – found in Appendix 4-2 of Volume 3; and
- Shadow Habitats Regulations Assessment (sHRA) (Baker Consultants, 2021) – found in Appendix 4-4 of Volume 3.

## 8.2 Legislation and Policy

8.2.1 Information relating to relevant biodiversity legislation and policy can be viewed in Volume 1, Chapter 8: Biodiversity.

## 8.3 Consultation

8.3.1 A summary of the biodiversity related responses from the Scoping Opinion, which relate to the Scheme at Kirk Hill Junction, is included in Table 8-1. A full set of responses to all comments received during the scoping process is provided within Appendix 4-1 of Volume 3.

Table 8-1: Scoping Response Summary

| Stakeholder | Comment made | Response and where addressed in the ES |
|---|---|---|
| Nottinghamshire County Council (Scoping Opinion) | Noise change impacts on sensitive species (roosting and foraging bats and nesting birds) will need to be assessed. | The methodology for the assessment of the impact of artificial lighting and noise can be found in Section 8.4. Lux diagrams and noise contour plans are provided (see Figures 8-2, 8-3 and 8-4 in Volume 2D). Embedded and additional mitigation, and the assessment are reported in Sections 8.6 and 8.7. |
| | Biodiversity Net Gain, funding and management which should be addressed in the submission. | The Project has been developed with consideration for BNG requirements, and is predicted to achieve a net gain in all three metrics (see Appendix 4-3 of Volume 3). All net gain requirements will be within the revised highway boundary. Funding and management will be the responsibility for NCC. |
| NCC Ecology<br>Natural Environment Manager | In relation to bats and potential roost sites, it is noted that in some cases buildings adjacent to the proposed works areas were not surveyed, therefore, it will need to be demonstrated through the assessment process that there will not be significant indirect impacts on potential roost locations as a result of noise, lighting or general disturbance. | The methodology for the assessment of the impact of artificial lighting and noise can be found in Section 8.4. Lux diagrams and noise contour plans are provided (see Figures 8-2, 8-3 and 8-4 in Volume 2D). Embedded and additional mitigation, and the assessment are reported in Sections 8.6 and 8.7. |
| | The creation of habitat should be delivered at each location, as far as possible. | The design has sought to maximise habitat creation at each Scheme location as noted in the BNG Assessment (Baker Consultants Ltd, 2021a) located in Appendix 4-2 of Volume 3. |
| Nottinghamshire Wildlife Trust | No methodology is proposed for how the impacts of changes to noise, light and disturbance will be assessed. For example:<br>Bat activity surveys will be required in order to be able to assess the predicted noise changes on bat foraging activity.<br>The Noise chapter does not describe how the impacts of changes in noise will be assessed for sensitive species. | The methodology for the assessment of the impact of artificial lighting and noise can be found in Section 8.4. Lux diagrams and noise contour plans are provided (see Figures 8-2, 8-3 and 8-4 in Volume 2D). Embedded and additional mitigation, and the assessment are reported in Sections 8.6 and 8.7. |

| Stakeholder | Comment made | Response and where addressed in the ES |
|---|---|---|
| | Further monitoring undertaken in a key protected habitats site such as the SAC or a heathland SSSI required, to ensure that the modelling is correct for the areas of potential greatest irreversible habitat impact. | This is not applicable to the Kirk Hill Junction as there are no SAC or SSSI within the Zone of Influence for Air Quality– refer to Chapter 5: Air Quality. |
| | Impacts of dust on some SSSIs and LWS in close proximity to the junctions, should be closely monitored, with a plan in place for how it could be rectified if a problem is shown to have arisen. | The impacts of dust would be mitigated through BPM to be included within the CEMP. |
| | The ppSPA should be included in the HRA, and the likely in-combination effects should be assessed. | A sHRA (Baker Consultants Ltd, 2021b) has been undertaken (see Appendix 4-4 in Volume 3). |
| | Further surveys in the field are required as follows, to supplement those already undertaken for Phase 1 habitats, reptiles, HSI and eDNA: | |
| | Bats - survey of all possible structures that may support roosts, including both daytime visual inspections and evening emergence surveys undertaken at the correct times of year by suitably licensed persons. | Daytime visual inspections of any trees to be removed was included within the Preliminary Ecological Appraisal (Via East Midlands, 2021) (Appendix 8-1 of Volume 2D). |
| | Badgers - surveys of the whole site and adjacent land (up to 250 m) for field signs and setts. | Surveys for badgers were undertaken in September 2020 as part of the phase 1 habitat survey (Via East Midlands, 2021) – refer to Appendix 8-1 of Volume 2D.<br>Further details found within Section 8.5, 8.6 and 8.7. |
| | Birds - breeding bird surveys to standard methodologies for at least 100 m around the periphery of the sites, where there may be noise impacts. | There are likely to be negligible noise impacts as detailed within Section 8.7, therefore no breeding bird surveys have been undertaken. |
| | Water voles and other riparian mammals – Searches for water vole and other riparian mammal field signs to standard methodologies should be undertaken on any potentially affected watercourses. | There is no impact to watercourses within the assessment boundary. |
| | Particular consideration should be given to the potential direct and indirect impacts of:<br>▪ Habitat loss or degradation<br>▪ Noise<br>▪ Hydrological/hydrogeological changes | Noted, refer to Section 8.7 for the assessment considering these aspects where relevant. |

| Stakeholder | Comment made | Response and where addressed in the ES |
|---|---|---|
| | ▪ Dust, $NO_x$, GHG<br>▪ Vibration<br>▪ Disturbance to sensitive species | |
| | BNG calculation for the Scheme should be undertaken with the aim of delivering at least 20% BNG. There should be an assurance of long-term funding for management of the habitats, so that they can be retained in perpetuity. | A BNG metric assessment has been undertaken for the Project (as can be found in Appendix 4-2 of Volume 3). Post-development, the Project is expected to deliver an 18.07% gain in habitat units, a 71.75% gain in hedgerow units and a 67.14% gain in river units.<br>All net gain requirements will be within the revised highway boundary. Funding and management will be the responsibility for NCC. |

# 8.4 Assessment Methodology

## Baseline Conditions

8.4.1 Baseline information associated with the Scheme has been gathered between 2020 and 2021 and has informed the Scheme design and assessment process. Baseline ecological conditions associated with the Scheme are described in Section 8.5. A combination of desk study and field surveys has been used to adequately define bassline conditions for assessment purposes.

### Desk Study

8.4.2 The following organisations were contacted to obtain information on existing ecological information (i.e. information on statutory and non-statutory designated sites and records of protected and notable species and habitats) up to 2 km from the Scheme:

- Nottinghamshire Biological and Geological Records Centre (NBGRC) (Nottingham City Council, 2021);
- Multi-Agency Geographic Information Centre (MAGIC) (Defra, 2021); and
- Spectrum Spatial Analyst – internal mapping system.

### Field Surveys

8.4.3 The field surveys and associated reports, related to the Kirk Hill Junction Scheme, are outlined in Table 8-2.

8.4.4 Via undertook the following works in relation to the Scheme:

- a desk-based study using the organisations detailed above;
- a Phase 1 habitat survey; and
- appraisals and targeted surveys for protected and/or notable flora and fauna.

Table 8-2: Baseline Field Surveys and Associated Methodology

| Survey Target | Survey Type and Survey Area | Date Undertaken and Consultancy | Description of Assessment Undertaken | Methodology |
|---|---|---|---|---|
| Habitats, botany and suitability for protected and notable species | Extended Phase 1 Habitat Survey, within and up to 50 m from the assessment boundary. | 29th September 2020, Via | Vegetation and habitats present were described and mapped during a walkover of the site. Habitats within the site and surrounding land were appraised for their suitability to support protected and notable species. | Joint Nature Conservation Committee (JNCC) (2010)<br>Full details can be found in Ecological Appraisal (Via, 2021) – Appendix 8-1 of Volume 2D. |
| Great Crested Newt (GCN) | HSI Assessment | 29th October 2020, Via | All waterbodies within 500 m of the Scheme were evaluated against the GCN Habitat Suitability Index | Oldham *et al.* (2000)<br>Full details can be found in Ecological Appraisal (Via, 2021) – Appendix 8-1 of Volume 2D |

| Survey Target | Survey Type and Survey Area | Date Undertaken and Consultancy | Description of Assessment Undertaken | Methodology |
|---|---|---|---|---|
| Bats | Bat Roost/Habitat Survey, within the Scheme boundaries. | 18th March 2021, Via | Habitats within the survey area were assessed for their potential to support roosting, commuting and foraging bats | Collins, J. (ed.) (2016)<br>Full details can be found in Ecological Appraisal (Via, 2021) – Appendix 8-1 of Volume 2D |

8.4.5 The ecological assessment undertaken takes into account standard guidance from a variety of sources including the:

- Guidelines for Ecological Impact Assessment in The UK and Ireland: Terrestrial, Freshwater, Coastal and Marine (CIEEM 2018);
- Guidelines of Ecological Report Writing (CIEEM, 2015);
- Guidelines for Preliminary Ecological Appraisal (CIEEM, 2017);
- BS42020:2013 Biodiversity – Code of Practise for Planning and Development (British Standards Institute, 2013); and
- Protected species and development: advice for local planning authorities (GOV.UK, 2021).

## Study Area

8.4.6 To define the total extent of the study area for ecological assessment, the Scheme has been reviewed in order to identify the spatial scale at which ecological features could be affected. In accordance with the DMRB LA 108 and the 'Guidelines for Ecological Impact Assessment in the UK and Ireland' issued by the Chartered Institute of Ecology and Environmental Management (CIEEM, 2018), the study area has been defined by determining a Zone of Influence (ZoI) encompassing all likely biophysical changes that would occur as a result of the Scheme. This will include direct effects and indirect effects.

8.4.7 Differing ZoI have been used to collate desk study data for designated sites and protected and/or notable habitat and species as follows:

- statutory and non-statutory designated sites within 2 km of each Scheme;
- ancient woodlands and notable habitats (outside of designated sites) within 1 km of each Scheme; and
- protected and/or notable species recorded within 1 km of each Scheme (unless stated otherwise); and
- ancient / veteran Trees within 50 m of the Scheme.

8.4.8 Notable habitats and species are those considered as being of principal importance in England, as listed under Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006 (HM Government, 2006).

8.4.9 In accordance with DMRB LA 115 Habitat Regulations Assessment (Highways England, 2020f), desk study information has been collated for sites designated at an International/ European level, including Special Protection Areas (SPAs), potential SPAs (pSPAs); Special Areas of Conservation (SACs), candidate or possible (cSAC/pSAC) sites and Ramsar sites (wetlands of international

importance) using the following criteria:

- the European Site or its functionally linked land are located within 2 km from the Scheme;
- the European Site is designated for bats and is located within 30 km of the Scheme;
- the Scheme crosses or lies adjacent to, upstream of, or downstream of, a watercourse which is designated part or wholly as a European Site;
- there is potential for hydrological or hydrogeological linkages to a European Site that may require further assessment in accordance with DMRB LA 113 Road Drainage and the Water Environment (Highways England, 2020i); and/ or
- there is the possibility that the affected road network will require assessment for effects on a European Site in accordance with DMRB LA 105 Air Quality.

## Methodology for Determining Construction and Operational Effects

8.4.10 The assessment of impacts and effects and their significance follows the guidance set out in DMRB LA 108, and CIEEM best practice guidance (CIEEM, 2018). This outlines the process for the reporting of baseline information, evaluation of features and the assessment of impacts and effects.

8.4.11 In accordance with this guidance the assessment of construction and operational effects on biodiversity is informed by collection of relevant baseline information as described within earlier sections of this chapter. Baseline conditions are described, including a summary of legislation/ policy relevant to the baseline conditions. The assessment covers both the current baseline, as determined by the desk study and ecological field surveys, and the future baseline. Environmental factors from other assessments including air quality; noise and vibration; and road drainage and the water environment are also considered. Separate methodologies for determining light and noise impacts have been used and are detailed in the following paragraphs.

### Lighting

8.4.12 The operational lighting scheme has been designed to the ‘5 second rule’ which forms part of the Institution of Lighting Professionals document PLG02 (ILP, 2013) and DMRB TD 501 Road lighting design (Highways England, 2020a). The Scheme design has been modelled using data provided by the manufacturer, and Lighting Reality software (Lighting Reality Ltd, 2021) to provide lux contour plans showing the spill to 1 lux. The data has been modelled to 1 lux as it is considered that natural conditions, such as a twilight, or full moon can result in this lux level (ILP and BCT, 2018). Any suitable roosting, commuting or foraging habitat subject to an increase in lighting levels above that of the baseline, has been subject to further assessment, where applicable

### Noise

8.4.13 Noise modelling data was obtained for the Scheme to determine the changes in noise levels during the Operational phase. A total of 33 ecological receptors were used, up to 600 m from the Scheme. The modelling followed the methodology in DMRB LA 111 Noise and Vibration (Highways England, 2020h). This number of receptors was considered necessary to assess the surrounding areas, in particular those that were considered to be ecologically valuable, such as the broadleaved woodland. The change in noise levels between the current baseline, and the predicted changed post-development were then compared and reviewed using relevant literature. Behavioural patterns / stress responses and fitness (feather development and body size) were assessed, where applicable, to determine the impacts of increase in noise levels.

8.4.14 Anthropogenic disturbance is known to alter animal behavioural patterns. Physiological responses to noise exposure in animals include hearing loss, elevated stress hormone levels and hypertension. These responses begin to appear at exposure levels of 55-60 dB (Barber, Crooks, Fristrup, 2009). The effects of noise on fitness levels (feather development and body size) are considered to have a positive impact to bird species with noise levels up to 70 dB (Kleist et al., 2017). Examples of perceived sound intensity determine that 20 dB sound levels are just audible to a bat, owl or fox. With 10 dB being the sound of leaves rustling. Analysis of transportation noise impacts based on perceived loudness often assert that increases of up to 3 dB have negligible effects (Barber, Crooks, Fristrup, 2009).

8.4.15 The changes in noise levels have been compared in relation to the studies undertaken above in the assessment in Section 8.7.

8.4.16 The level of impact upon ecological features as a result of the Scheme and the associated effects takes into consideration the following characteristics based upon the CIEEM best practice guidance (CIEEM, 2018) and DMRB LA 108:

- positive or negative – whether the impact will result in loss or degradation of an important ecological feature or whether it would improve or enhance it;
- magnitude – the size and intensity of the impact measured in relevant terms, e.g. number of individuals lost or gained, area of habitat lost or created, the degree of change to existing conditions;
- extent – the spatial scope of the impact;
- reversibility – the extent to which impacts are reversible, either spontaneously or through mitigation;
- duration – the length of time over which the impact occurred; and
- timing and frequency – consideration of the timing of events in relation to ecological change; some effects might be of greater significance if they took place at certain times of year.

8.4.17 Subsequently the impact assessment considers embedded avoidance and mitigation measures that are inherent to the design (e.g. the retention of a hedgerow), including the use of best practice construction methods (e.g. implementation of methods to supress dust generation or avoid pollution of water courses).

8.4.18 Additional (essential) mitigation, compensation and enhancement measures are described in Section 8.8, followed by the impact after mitigation and significance of residual effects in Section 8.9. A summary of the assessment is presented together with relevant conclusions.

8.4.19 For each phase of the Scheme (e.g. construction, operation), the assessment is structured and reported by ecological receptor with relevant potential impacts on that feature described in turn, and then the overall effect arising from those impacts reported. For example, any impacts on bat roosting habitat and light disturbance on retained roosts are documented, before a conclusion is reached on the overall effect on the conservation status of the of the local bat population concerned.

## Significance Criteria

8.4.20 The relative importance of the biodiversity resources has been established using the guidance provided in Table 8-3 as based upon DMRB LA 108.

## Table 8-3: Biodiversity Resource Importance

| | |
|---|---|
| **International or European importance** | |
| Sites | Sites including:<br>▪ European sites:<br>• Sites of Community Importance (SCIs);<br>• Special Protection Areas (SPAs);<br>• Potential SPAs (pSPAs);<br>• Special Areas of Conservation (SACs);<br>• Candidate or possible SACs (cSACs or pSACs); and<br>• Wetlands of International Importance (Ramsar sites).<br>▪ Biogenetic Reserves, World Heritage Sites (where recognised specifically for their biodiversity value) and Biosphere Reserves.<br>▪ Areas which meet the published selection criteria for those sites listed above but which are not themselves designated as such. |
| Habitats | N/A |
| Species | Resident, or regularly occurring, populations of species which can be considered at an international or European level where:<br>▪ The loss of these populations would adversely affect the conservation status or distribution of the species at an international or European scale; or<br>▪ The population forms a critical part of a wider population at this scale; or<br>▪ The species is at a critical phase of its life cycle at an international or European scale. |
| **UK or national importance** | |
| Sites | Sites including:<br>▪ Sites of Special Scientific Interest (SSSIs) or Areas of Special Scientific Interest (ASSIs);<br>▪ National Nature Reserves (NNRs);<br>▪ National Parks;<br>▪ Marine Protected Areas (MPAs) including Marine Conservation Zones (MCZs); or<br>▪ Areas which meet the published selection criteria for those sites listed above but which are not themselves designated as such. |
| Habitats | Habitats including:<br>▪ areas of UK BAP priority habitats;<br>▪ habitats included in the relevant statutory list of priority species and habitats; and<br>▪ areas of irreplaceable habitats including:<br>▪ ancient woodland;<br>▪ ancient or veteran trees;<br>▪ blanket bog;<br>▪ limestone pavement;<br>▪ sand dunes;<br>▪ salt marsh;<br>▪ lowland fen.<br>▪ areas of habitat which meet the definition for habitats listed above but which are not themselves designated or listed as such. |
| Species | Resident, or regularly occurring, populations of species which can be considered at an international, European, UK or national level where: |

| | |
|---|---|
| | ▪ the loss of these populations would adversely affect the conservation status or distribution of the species at a UK or national scale; or<br>▪ the population forms a critical part of a wider population at this scale; or<br>▪ the species is at a critical phase of its life cycle at a UK or national scale. |
| **Regional importance** | |
| Sites | Designated sites (non-statutory) including heritage coasts. |
| Habitats | Areas of habitats identified (including for restoration) in regional plans or strategies (where applicable). |
| Species | Species including:<br>▪ resident, or regularly occurring, populations of species which can be considered at an international, European, UK or national level where:<br>▪ the loss of these populations would adversely affect the conservation status or distribution of the species at a regional scale; or<br>▪ the population forms a critical part of a wider regional population; or<br>▪ the species is at a critical phase of its life cycle;<br>▪ Species identified in regional plans or strategies. |
| **County or equivalent authority importance** | |
| Sites | Wildlife / nature conservation sites designated at a County (e.g. Nottinghamshire) level including:<br>▪ Local Wildlife Sites (LWS);<br>▪ Local Nature Conservation Sites (LNCS);<br>▪ Local Nature Reserves (LNRs);<br>▪ Sites of Importance for Nature Conservation (SINCs);<br>▪ Sites of Nature Conservation Importance (SNCIs);<br>▪ County Wildlife Sites (CWSs). |
| Habitats | Areas of habitats identified within the Nottinghamshire Local Biodiversity Action Plan. |
| Species | Species including:<br>▪ resident, or regularly occurring, populations of species which can be considered at an international, European, UK or national level where:<br>▪ the loss of these populations would adversely affect the conservation status or distribution of the species at a County or unitary authority scale; or<br>▪ the population forms a critical part of a wider County or equivalent authority area population, e.g. metapopulations; or<br>▪ the species is at a critical phase of its life cycle.<br>▪ Species identified in a County or equivalent authority area plans or strategies. |
| **Local importance** | |
| Sites | Wildlife / nature conservation sites designated at a local level including:<br>▪ Local Wildlife Sites (LWS);<br>▪ Local Nature Conservation Sites (LNCS);<br>▪ Local Nature Reserves (LNRs);<br>▪ Sites of Importance for Nature Conservation (SINCs);<br>▪ Sites of Nature Conservation Importance (SNCIs);<br>▪ Sites of Local Nature Conservation Importance (SLNCIs). |

| | |
|---|---|
| Habitats | Areas of habitat considered to appreciably enrich the habitat resource within the local context including features of importance for migration, dispersal, or genetic exchange. |
| Species | Populations / communities of species considered to appreciably enrich the habitat resource within the local context including features of importance for migration, dispersal or genetic exchange. |

8.4.21 When determining the level of impacts on biodiversity resources are reported in accordance with the criteria in Table 8-4, based upon DMRB LA 108.

Table 8-4: Level of Impact and Typical Descriptions

| Level of Impact (change) | | Typical Description |
|---|---|---|
| Major | Adverse | Permanent/irreversible damage to a biodiversity resource; and<br>the extent, magnitude, frequency, and/or timing of an impact negatively affects the integrity or key characteristics of the resource. |
| | Beneficial | Permanent addition of, improvement to, or restoration of a biodiversity resource; and<br>the extent, magnitude, frequency, and/or timing of an impact positively affects the integrity or key characteristics of the resource. |
| Moderate | Adverse | Temporary/reversible damage to a biodiversity resource; and<br>the extent, magnitude, frequency, and/or timing of an impact negatively affects the integrity or key characteristics of the resource. |
| | Beneficial | Temporary addition of, improvement to, or restoration of a biodiversity resource; and<br>the extent, magnitude, frequency, and/or timing of an impact positively affects the integrity or key characteristics of the resource. |
| Minor | Adverse | Permanent/irreversible damage to a biodiversity resource; and<br>the extent, magnitude, frequency, and/or timing of an impact does not affect the integrity or key characteristics of the resource. |
| | Beneficial | Permanent addition of, improvement to, or restoration of a biodiversity resource; and<br>the extent, magnitude, frequency, and/or timing of an impact does not affect the integrity or key characteristics of the resource. |

8.4.22 The importance of the resource, and level of impact is used to determine the significance of effect based on Table 8-5 and the principles of DMRB LA 104 Environmental assessment and monitoring (Highways England, 2020b). Significant effects typically comprise effects that remain within the moderate, large or very large categories once mitigation has been taken into account.

Table 8-5: Significance Matrix

| Resource importance | Level of impact | | | | |
|---|---|---|---|---|---|
| | No change | Negligible | Minor | Moderate | Major |
| International or European importance | Neutral | Slight | Moderate or large | Large or very large | Very large |

| Resource importance | Level of impact | | | | |
|---|---|---|---|---|---|
| | No change | Negligible | Minor | Moderate | Major |
| UK or national importance | Neutral | Slight | Slight or moderate | Moderate or large | Large or very large |
| Regional importance | Neutral | Neutral or slight | Slight | Moderate | Moderate or large |
| County or equivalent authority importance | Neutral | Neutral or slight | Neutral or slight | Slight | Slight or moderate |
| Local importance | Neutral | Neutral | Neutral or slight | Neutral or slight | Slight |

8.4.23 The level of impact is informed by the outcomes of the modelling and assessment of other environmental factors, where relevant.

### Assumptions and Limitations

8.4.24 The information presented in this chapter reflects that obtained and evaluated at the time of reporting.

8.4.25 This assessment is based upon the design and detail regarding construction and operation as provided in Chapter 2: The Scheme.

8.4.26 It is important to note that even where data is returned for a desk study, a lack of records for a defined geographical area does not necessarily mean that there is a lack of ecological interest since the area may be under-recorded.

8.4.27 Whilst every effort was made in the field surveys to provide a comprehensive description of the site, no investigation can ensure the complete characterisation and prediction of the natural environment. Also, natural and semi-natural habitats are subject to change, species may colonise the site after the surveys have taken place and results included within the baseline data may become less reliant over time.

8.4.28 The timescale used to assume the period for the created habitat to reach maturity and desired condition are based on the BNG report (Baker Consultants, 2021) in Appendix 4-2 in Volume 3.

## 8.5 Baseline Conditions

### Statutory and Non-Statutory Designated Sites and Ancient Woodland

8.5.1 Designated sites identified within the study area are detailed in Table 8-6. Some additional information is provided in the subsequent text. The location of designated sites can be viewed on Figure 8-1 of Volume 2D.

Table 8-6: Non-Statutory Sites located within the Kirk Hill Junction Study Area

| Name | Status | Location/distance | Interest |
|---|---|---|---|
| Trent Hills Wood | Local Wildlife Site (LWS) | 600 m to the north-east | Botanical – Wooded cliff stretched along a section of the southern bank of the River Trent. |

| Name | Status | Location/distance | Interest |
|---|---|---|---|
| River Trent (Gunthorpe to Fiskerton) | LWS | 750 m to the north | A representative length of the River Trent, of high wildlife value. |
| River Trent: Burton Joyce to Lowdham | LWS | 1 km to the west | Stretch of the River Trent that has notable marginal and inundation plant communities. Species include Reed sweet-grass *Glyceria maxima,* hemlock water-dropwort *Oenanthe crocata* and branched bur-reed *Sparganium erectum.* |
| Gunthorpe Riverside Gravel Pits | LWS | 1.1 km to the north-west | Comprises a large flooded gravel pits, used for angling, with some islands and a well indented shoreline. |
| Shelford Carr | LWS | 1.4 km to the west | Site is situated next to the River Trent and comprises mostly improved cattle-grazed grassland with seasonally wet depressions, to the south-east are areas of wet woodland with swamp and open water. |
| Shelford Manor Pond | LWS | 1.4 km to the west | Large rectangular pond within the ground of a farm and equestrian centre. |
| Gunthorpe Lakes | LWS | 1.5 km to the north-west | Comprise a series of flooded gravel pits, used for anglings, situated next to the River Trent. |
| High Westings Farm Marsh | LWS | 1.7 km to the east | A species rich area of marsh and tall grassland. |
| East Bridgford Bank Pasture | LWS | 2 km to the north-east | The site comprises a steep scrub covered river cliff above the River Trent, with a grassland community below it. |

8.5.2 There were no European protected sites within 30 km of the Scheme for which bats were listed as a qualifying feature.

8.5.3 No records of ancient woodland were identified within the study area.

8.5.4 No records for ancient/ veteran trees were identified within the study area.

## Habitats

8.5.5 The following habitats were recorded within and up to 50 m of the assessment boundary during the extended Phase 1 Habitat Survey undertaken in September 2020 by Via.

### Broadleaved woodland

8.5.6 Three areas of broad-leaved woodland are located within the survey boundary, along the A6097. Species comprise blackthorn *Prunus spinosa*, sycamore *Acer pseudoplatanus*, ash *Fraxinus excelsior*, wych elm *Ulmus glabra*, crab apple *Malus sylvestris* and English oak *Quercus robur*. The understory was dominated by ivy *Hedera helix*.

### Neutral grassland

8.5.7 Neutral grassland verges are present along both sides of the A6097 and Kirk Hill which are then flanked by broad-leaved woodland, or hedgerows.

8.5.8 The verges along the A6097 are heavily managed in areas. At the time of the Phase 1 habitat survey, the verge was recently mown to a very short sward, approximately 2-8 m from the roadside dependent on location along the road. An earth bank is present along the A6097, on the north-western aspect, creating a change in topography. Species comprise false oat grass *Arrhenatherum elatius*, perennial rye grass *Lolium perenne*, Yorkshire fog *Holcus lanatus*, broadleaved dock *Rumex obtusifolius*., cinquefoil *Potentilla sp* spear thistle *Cirsium vulgare* and ribwort plantain *Plantago lanceolata*.

8.5.9 The road verges along Kirk Hill are sensitively managed allowing grasses and ruderal species to grow along parts of the verge. Species comprise dandelion *Taraxacum officinale*, nettle *Urtica dioica*, broadleaved dock, field bindweed *Convolvulus pluricaulis*, false oat grass, ivy, cow parsley *Anthriscus sylvestris*, cocksfoot *Dactylis glomerata*, creeping thistle *Cirsium arvense*, red campion *Silene dioica*, perennial rye grass, yarrow *Achillea millefolium*, cinquefoil *Potentilla sp*., ribwort plantain, creeping buttercup *Ranunculus repens*, white clover *Trifolium repens*, tansy *Tanacetum vulgare*, Yorkshire fog and red fescue *Festuca rubra* and comfrey.

#### Improved grassland

8.5.10 An area of improved grassland is present to the north-east of Kirk Hill. The grassland is rotationally grazed horse paddock, that extended beyond the survey boundary. A post and wire fence separates each horse paddock, which would be permeable to other mammals. The habitat is dominated by perennial rye grass and comprises cocksfoot, broadleaved plantain, ribwort plantain, dock *Rumex sp.* white clover and bristly ox tongue *Helminthotheca echioides.*

#### Hardstanding

8.5.11 Kirk Hill, East Bridgford road and the A6097 are all hard standing, tarmac roads.

#### Hedgerows

8.5.12 Two sections of intact, species poor hedgerow are located along East Bridgford road, to the south of the assessment boundary. The hedgerows are dominated by hawthorn *Crataegus monogyna*.

8.5.13 A hedgerow with trees creates a boundary between the improved grassland field and Kirk Hill to the north of the site. The hedgerow is species rich and comprises hawthorn, bramble *Rubus sp*., ash *Fraxinus excelsior*, sycamore *Acer pseudoplatanus*, dog-rose *Rosa canina*, oak *Quercus sp*. and horse chestnut *Aesculus hippocastanum*. The hedgerow is approximately 15 m tall, and 3 m wide. It is continuous from the entrance of the farm along Kirk Hill, to the junction point.

### Protected and Notable Species

8.5.14 Table 8-7 presents the protected and notable species, including invasive non-native species, that have been identified as present or potential present within the assessment boundary and relevant ZoI.

Table 8-7: Summary of Baseline Details for Protected and Notable Species

| Species | Baseline Detail |
|---|---|
| Bats | Desk Study:<br>The desk study returned multiple bat records of ten bat species including soprano pipistrelle, common pipistrelle, noctule, an unknown Myotis bat species, Daubenton's bat, Brandt's *Myotis brandti,* Whiskered *Myotis mystacinus* and Natterer's bat, the nearest records being 60 m from the assessment boundary.<br>Field Study: |

| Species | Baseline Detail |
|---|---|
| | To facilitate the carriage way widening, several trees along the edge of the broadleaved woodland will be removed. A ground level tree assessment was undertaken 18th March 2021 to assess the trees suitability to support roosting bats.<br>All the trees assessed were considered to provide negligible or low suitability to support roosting bats. |
| Badger | Desk Study:<br>The desk study returned roadkill records for badger within 300 m of the assessment boundary.<br>The desk study returned sensitive records for badger within 500 m of the assessment boundary indicating that setts are located within 500 m to the Scheme.<br>Field Study:<br>No badger setts, or signs of badgers were noted within the assessment boundary, or within 30 m of the assessment boundary, at the time of the survey. |
| Other mammals | Desk Study:<br>The desk study returned 14 hedgehog records, the nearest being 260 m distance from the site.<br>The desk study returned four brown hare records the nearest being 650 m distance from the site.<br>The desk study returned two Reeves Muntjac *Muntiacus reevesi* records the nearest being 1 km distance from the site.<br>Field Study:<br>The hedgerows, woodland edges, grassland verges and wider arable habitat were considered to provide a range of suitable habitat for both hedgehog and brown hare.<br>The habitats within the assessment boundary were considered sub-optimal for Reeves Muntjac. |
| Amphibians | Desk Study:<br>No records for great crested newts *Triturus cristatus*, or other common amphibians were returned within the desk study.<br>Field Study:<br>No waterbodies were located within the assessment boundary. Eight waterbodies were located within 500 m of the assessment boundary. Five out of the eight ponds were dry at the time of the survey, one pond had been infilled and one pond was subject to HSI assessment and considered to have 'below average' suitability for GCN. The remaining pond is separated from the Scheme by dispersal barriers.<br>Suitable breeding habitat for GCN is not present within the assessment boundary. The hedgerows within the assessment boundary may provide some suitable terrestrial habitat but are separated from suitable breeding habitat by main roads. |
| Reptiles | Desk Study:<br>The desk study returned one record for grass snake within 700 m of the site.<br>Field Study:<br>Due to the high level of disturbance across the site, from both the road junction and the horse grazed fields, the habitat is considered sub-optimal for reptiles. In addition, the habitats within the assessment boundary are considered to provide limited opportunity for basking, foraging and hibernating reptiles. |
| Birds | Desk Study:<br>The desk study returned multiple records for bird species within the search area.<br>Field Study:<br>The presence of hedgerows, trees and scrub on site are likely to provide potential nesting habitat for a range of bird species. |

| Species | Baseline Detail |
|---|---|
| Invasive non-native plant species | Desk Study:<br>The desk study returned no records of invasive non-native plant species.<br>Field Study:<br>No protected or invasive plants were recorded within the assessment boundary at the time of the survey. |
| Invertebrates | No records of invertebrates were noted in the desk study or during the Phase 1 Habitat Survey. |

## Importance of Ecological Features

8.5.15 The importance of ecological features within the study area that are scoping into the assessment have been assessed in accordance with the guidance detailed in Section 8.4.

8.5.16 Table 8-8 summarises the ecological features identified in the study area and, along with rationale, detailed the ecological importance assigned to each.

Table 8-8: Summary of Ecological Importance

| Designated / non-designated site/ habitat/ species | Ecological Feature | Rationale | Importance |
|---|---|---|---|
| **Non-Statutory Designated Sites** | | | |
| Local Wildlife Site | Details on all LWS can be found in table 8-6. | Areas of land that are especially important for their wildlife. | County |
| **Habitats** | | | |
| Woodland | Broadleaved woodland | Does not meet LWS selection criteria for woodland that would indicate County importance or demonstrate ancient woodland indicators.<br>Habitat may be of value to local wildlife including nesting birds and bats. | Local |
| Grassland | Unimproved neutral grassland | LBAP habitat | County |
| | Improved grassland | LBAP habitat<br>Common habitats found within the surrounding area, of limited / negligible ecological interest. | County |
| Hedgerow | Species-poor hedgerow | Habitat of Principal Importance in England<br>Hedgerows provide wildlife dispersal corridors and provide connectivity to the wider landscape beneficial for fauna. | Local |
| | Species-rich hedgerow with trees | Habitat of Principal Importance in England<br>LBAP habitat<br>This habitat supports butterflies, moths and other invertebrates, birds, bats, hedgehog, hares, reptiles, amphibians and other mammals. | County |
| **Legally Protected and Notable Species** | | | |
| Badger | | Suitable habitat present within assessment boundary for sett building and commuting / foraging. | Local |
| Bats | Roosting<br>Foraging and Commuting bats | Seven species of bat are Species of ‘Principal Importance’ in England.<br>Five species of bat including within Nottinghamshire LBAP | Up to County |

| Designated / non-designated site/ habitat/ species | Ecological Feature | Rationale | Importance |
|---|---|---|---|
| | | Trees present within assessment boundary with low suitability to support roosting bats<br>Linear features present within assessment boundary that will be subject to localised losses | |
| Birds | Common nesting bird species across the Scheme | 49 species of bird are Species of 'Principal Importance' in England<br>88 species of birds included within Nottinghamshire LBAP<br>All nesting birds are protected under the Wildlife and Countryside Act 1981 (as amended)<br>Hedgerows have the potential to support nesting birds | Up to County |
| Hedgehog & brown hare | Suitable habitat for hedgehog within the assessment boundary | Hedgehogs and Brown Hare are both Species of Principal Importance in England.<br>Hedgehog and brown hare are LBAP species within Nottinghamshire | County |

### Future Baseline

8.5.17 In the absence of the Scheme, it is considered that the site would remain as existing. No future baseline developments have been identified within the study area that would affect the future baseline.

## 8.6 Design, Mitigation and Enhancement Measures

8.6.1 Environmental elements have been considered during the development of the Scheme design, to avoid and reduce potential impacts on biodiversity. This approach has led to a range of mitigation measures capable of reducing the magnitude of impacts being embedded within the Scheme design or captured within the proposed construction and operational practices. Measures specifically related to the protection of ecological sites and habitats, and protected species are detailed in the following sections.

### Scheme Design

8.6.2 The following mitigation measures have been incorporated into the Scheme design.

#### Habitats

8.6.3 The following mitigation measures have been incorporated into the Scheme design:

- **Loss and replacement of species-poor hedgerow:** the loss of hedgerow will be replaced and further enhanced with a species-rich hedgerow, comprising of common hazel *Corylus avellana*, hawthorn *Crataegus monogyna*, dogwood *Cornus sanguinea*, holly *Ilex aquifolium*, privet, *Ligustrum vulgare*, blackthorn *Prunus spinosa* and dog rose *Rosa canina*. All species selected are in keeping with the landscape character area.
- **Loss of grassland verges**: the loss of grassland verges will be reinstated on a like-for-like basis incorporating flowering native dry meadow grassland species which will be sensitively managed and cut twice per year.
- **Loss of species rich hedgerow with trees**: will be replaced on a like-for-like basis, further enhancing by incorporating more woody species in line with the character assessment of the area.
- **Loss of broadleaved woodland**: Replacement tree planting with associated sub-shrub and herbaceous woodland understory will mitigated the loss of woodland during the construction phase of the Scheme. Proposed species include field maple *Acer campestre*, common alder *Alnus glutinosa*, hawthorn, holly, crab apple *Malus sylvestris*, wild cherry *Prunus avium*, blackthorn, English oak *Quercus robur* and white willow *Salix alba* all which are in keeping with the local character area.

8.6.4 Further detail can be found within the landscape proposals in Appendix 2-2 in Volume 3D.

#### Species

- **Birds:** To mitigate the unavoidable loss of habitat of value to foraging and nesting birds across the Scheme, trees and hedgerows, in keeping with the character assessment of the area, will be planted as part of the landscape design.
- **Bats (roosting, foraging and commuting):** The Scheme lighting has been designed to minimise impacts to bats. This includes the use of light emitting diodes (LEDs) to ensure more directional and controlled light source. In

addition, the LED lanterns will have rear shielding, to reduce the amount of light spill and lower the lux levels into surrounding habitat.

## Essential Mitigation – Construction

8.6.5 Construction of the Scheme would be subject to measures and procedures as defined within a CEMP for the Scheme. The CEMP will be produced by the Principal Contractor prior to construction commencement. The CEMP will include a range of measures to mitigate potential impacts on ecological habitats, protected species and the water environment, which accord with legal compliance and good practice guidance. The CEMP would include measures to minimise dust deposition, air pollution, pollution incidents, light spillage and noise and vibration which would all assist in minimising impacts upon biodiversity receptors.

### Non-Statutory Designated Sites and Habitats

8.6.6 The following mitigation measures would be put in place to reduce the effects of potential significant Scheme construction phase impacts on non-statutory designated sites (where applicable) and habitats:

- **Pollution prevention control measures:** Water pollution prevention control measures and standard best practice measures to control construction dust, noise and lighting would be implemented during the construction phase via the CEMP (refer to Chapter 5: Air Quality and Chapter 10: Noise and Vibration, plus good practice recommended in Volumes 1A, 1B and 1D for pollution prevention).

### Species

8.6.7 The following mitigation measures would be in place to reduce the effect of potentially significant Scheme construction impacts on ecological species.

8.6.8 **Badger:** Precautionary methods of working will be detailed within the CEMP which will detail measures to reduce the potential impact to badger during the construction phase. These measures will include:

- Works should be carried out during daylight hours, where possible.
- Any open excavations should be covered at night. Or alternatively, before dusk, backfilled or ramped (no steeper than 45°) to prevent badgers becoming entrapped.
- Any pipes over 200 mm in diameter should be capped off at night to prevent animals becoming entrapped.
- Any chemicals required for the works should be stored either away from the site or in a secure compound overnight.

8.6.9 Pre-construction badger surveys will be undertaken to determine baseline conditions remain the same as currently recorded.

8.6.10 **Bats (roosting):** The felling of trees with low bat roost suitability will be undertaken using precautionary methods of workings. The following methodology will be incorporated into the CEMP for any trees with low bat roost suitability:

- The felling work will be undertaken during weather conditions suitable for bats to be active, avoiding the main hibernation period, to minimise the risk of significant disturbance.
- An ECoW with appropriate experience will be present on site to advise on felling methods and what to do in the even bats are encountered.

- Sections of the tree containing feature suitable for roosting bats, will be softly lowered to the ground, and subject to a more detailed inspection by the ECoW to confirm absence of bats.
- After felling the section of the tree supporting suitable features will be retained in a suitable location overnight allowing bats to disperse, in the unlikely event that any are present but undetectable.

8.6.11 **Bats (roosting, foraging and commuting):** Measures would be implemented during the construction phase to minimise impacts on foraging and commuting bats – this includes keeping lighting to a minimum by limited night-time working, where possible, and reducing lighting within habitat of value to bats. Any lighting used would be directional and positioned sympathetically to minimise light spill.

8.6.12 **Birds:** Vegetation clearance during the core bird breeding season (March to August, inclusive) should be avoided. Where this is not possible, nesting bird checks will be carried out by the ECoW to determine whether there are any active nests.

8.6.13 **Hedgehogs and Brown Hare**: The removal of dense vegetation will be carried out under the supervision of the ECoW. Suitable habitat will be identified in advance of any clearance works in the local area (see Chapter 7: Landscape and Visual) to release any captured hedgehogs. If clearance work is carried out during winter months, provision will be made for captured hedgehogs to be overwintered in captivity.

8.6.14 **ECoW:** ECoW will be required for nesting birds (if clearance works are undertaken during the breeding bird season) and hedgehogs.

## Essential Mitigation - Operation

### Habitats

8.6.15 Landscape design plans illustrate the essential biodiversity mitigation and compensation that have been incorporated into the Scheme design to meet specific species and habitat requirements within the wider framework of other environmental measures for landscape and visual.

8.6.16 Ongoing 5-year management to ensure that the habitat implemented as part of the Scheme design, within the highway boundary, will be undertaken by NCC to ensure that the habitats are maintained to their desired condition and habitat type.

8.6.17 Ongoing 30-year management to ensure that the habitats implemented as part of the Scheme design directly related to the BNG will be undertaken by NCC to ensure that the habitats are maintained to their desired condition. Further detail is provided within the BNG Assessment in Appendix 4-2 of Volume 3.

8.6.18 The responsibility for funding both that habitat creation/ enhancement within the highway boundary, and as part of the scheme design and BNG requirements will be NCC.

### Species

8.6.19 Bats (roosting, foraging and commuting): The Scheme lighting has been designed to minimise the impacts to bats.

## Enhancements

8.6.20 As detailed within the Scheme design, the landscape design has incorporated enhancements to ensure net gain is achieved, where possible, within the assessment boundary. This includes incorporating:

- Species-rich hedgerows with species in line with the character assessment of the area;
- Species-rich flowering native dry meadow grassland; and
- Additional scattered trees with species in line with the character assessment of the area.

8.6.21 Further detail can be found within the landscape proposals – see Appendix 2-2 in Volume 3D.

8.6.22 Additionally, BNG calculations have been undertaken across the wider project, incorporating all Schemes associated within the Major Network Junction Improvement project. On-site mitigation has been calculated and it is considered that the project achieves the following net gains:

- 18.07% increase in habitat units;
- 71.75% increase in hedgerow units; and
- 67.14% increase river units.

8.6.23 More information regarding the requirements to achieve these gains can be found within the BNG Assessment in Appendix 4-2 of Volume 3.

## 8.7 Assessment of Likely Significant Effects

8.7.1 The prediction of impacts and the assessment of effects has taken account of the mitigation measures and the compensation measures identified within Section 8.6.

8.7.2 Impacts and effects on biodiversity are reported for both the construction and operational phases of the Scheme and are presented first under the headings of designated sites (international, national and other), then habitats, and finally species. The effects of all of the impacts are considered individually and then collectively for each of the biodiversity features assessed.

### Construction

#### Non-Statutory Designated Sites

8.7.3 A total of ten LWSs are located within the search area. The LWSs are separated from the Scheme by a large arable field and a main road. Given the geographical separation of farmland, urban areas and roads between the sites and the junction, and the localised development footprint, an adverse impact on the scientific interest of the LWSs, during the construction phase, is not anticipated.

#### Habitats

Direct effects – habitat loss from vegetation clearance

8.7.4 The construction of the Scheme would result in both losses and gains of habitat. The permanent habitat gains are those classified as habitats created as part of the Scheme. Table 8.9 provides a summary of all habitat losses and gains within the assessment boundary. It does not correspond to the total area of land required for the Scheme because it does not include highway or other built infrastructure.

Table 8-9: Habitat losses and gains

| Existing habitat | Habitat loss (ha) / (m) | Importance | New habitat | Habitat gains (ha) / (m) | Net permanent gains |
|---|---|---|---|---|---|
| Broadleaved woodland | 0.12 ha | Local | Broadleaved woodland | 0.061 ha | -0.059 ha |

| Existing habitat | Habitat loss (ha) / (m) | Importance | New habitat | Habitat gains (ha) / (m) | Net permanent gains |
|---|---|---|---|---|---|
| Neutral grassland verges | 0.67 ha | County | Neutral grassland verges | 0.411 ha | -0.259 ha |
| | | | Amenity grassland (visibility splays) | 0.211 ha | +0.211 ha |
| Improved neutral grassland parcel | 0.18 ha | County | No replacement habitat | 0.0 ha | -0.18 ha |
| Arable land | 0.07 ha | County | No replacement habitat | 0.0 ha | -0.07 |
| Species-poor hedgerow | 200 m | Local | Replaced and enhanced to species-rich hedgerow with trees | 239 m | +39 m |
| Species-rich hedgerow with trees | 240 m | County | Species rich hedgerow with trees | 474 m | +234 m |

*Broadleaved woodland*

8.7.5 The construction of the Scheme will result in the loss of 0.12 ha of broadleaved woodland, excluding trees as part of the hedgerow. As detailed within Section 8.6, the loss of broadleaved woodland will be mitigation for with the creation of 0.061 ha of broadleaved woodland, resulting in a permanent loss of 0.059 ha. The woodland species proposed include field maple *Acer camestre*, common alder *Alnys glutinosa*, hawthorn *Crategus monogyna*, holly *ilex aquilofium*, crab apple *Malus sylvestris*, wild cherry *Prunus avium*, blackthorn *Prunis spinosa*, English oak *Quercus robur* and white willow *Salix alba*. All tree species chosen are in keeping with the local character assessment. It is considered that due to the small area of permanent loss of woodland habitat the construction of the Scheme, in the long-term, will result in a minor adverse impact on a receptor of local value, resulting in a slight adverse (not significant) effect.

8.7.6 It will take approximately 15 years for the replacement / created habitat to mature and reach its desired condition. Therefore, it is considered that in the short-term, there will be a moderate adverse impact on a receptor of local value, resulting in a slight adverse (not significant) effect.

*Neutral grassland verges*

8.7.7 The Scheme would result in a loss of 0.67 ha neutral grassland associated with the highway verge. Due to the highway design, the alignment of the road will alter, changing the current sizes of the highway verges. This loss of grassland would be mitigated for through the creation of 0.411 ha of species-rich flowering native meadow grassland, which will be sensitively managed with two cuts per year to achieve a diverse, species rich sward. Additionally, 0.211 ha of amenity managed grassland will also be created to mitigate this loss. It is essential that these areas

are amenity managed to allow for visibility splays along the highway. The construction of the Scheme, with the mitigation measures embedded, will therefore result in the permanent loss of 0.048 ha of neutral grassland verges.

8.7.8 Therefore, given the habitat to be created, once established, up to 10 years post construction, the new grassland will result in a minor adverse impact on a receptor of County value, resulting in a neutral effect (not significant). During the construction of the Scheme, it is considered that the loss of the grassland verges will result in a moderate adverse impact on a receptor of County value, resulting in a slight adverse (not significant) effect.

*Improved neutral grassland*

8.7.9 An area of approximately 0.18 ha of improved grassland will be permanently lost to the Scheme. The improved grassland that will be affected are not considered to be notable due to their low ecological interest and lack of notable species in associated with this habitat. Therefore, it is considered that the construction of the scheme will constitute a minor adverse impact on a receptor of County value, resulting in a neutral effect (not significant).

*Arable land*

8.7.10 An area of approximately 0.07 ha of arable land will be permanently lost to the Scheme. The arable field margins or arable field that would be affected are not considered to be notable due to its low ecological interest and lack of notable species in associated with this habitat. Therefore, it is considered that the small loss of this habitat would constitute a minor adverse impact on a receptor of County value, resulting in a neutral effect (not significant).

*Hedgerows*

8.7.11 Approximately 200 m of species-poor hedgerow and 240 m of species-rich hedgerow with trees will be lost as part of the Scheme. The landscape design includes approximately 713 m of hedgerow to be planted to compensate and enhance for the loss of the habitat. Resulting in the permanent gain of 273 m of species-rich hedgerow with trees. Each new hedgerow planted will comprise of common hazel *Corylus avellana*, hawthorn *Crataegus monogyna*, dogwood *Cornus sanguinea*, holly *Ilex aquifolium*, privet *Ligustrum vulgare*, blackthorn *Prunus spinosa* and dog rose *Rosa canina*. All species selected are in keeping with the landscape character area, further details can be found within the landscape design Appendix 2-2 in Volume 3D. It is considered that once established, this would constitute a moderate beneficial impact on a receptor of up to County value, resulting in a slight beneficial (not significant) effect.

8.7.12 It will take up to approximately 20 years for the replacement / created habitat to mature and reach its desired condition. Therefore, it is considered that in the short-term there will be a moderate adverse impact on a receptor of up to County value, resulting in a slight adverse (not significant) effect.

### Species

Badger

8.7.13 Given the presence of suitable habitat within and adjacent to the Scheme, it is possible that badgers may excavate new setts prior to works commencing, and, in the absence of mitigation, site clearance works could result in the damage or destruction of a badger sett or the killing or injury of badgers. However, subject to the completion of a pre-construction survey to assess the current status of badgers on site prior to the works commencing, as detailed within Section 8.6, and the implementation of further mitigation or licencing if required, the impacts on badger can be avoided.

8.7.14 General construction activities during the Scheme construction phase are likely to include ground works, excavations and storage of materials including pipes which, left uncovered, could trap or injure badgers which may utilise the site for foraging and commuting purposes. Given the mitigation provisions detailed in Section 8.6 above, it is considered that the Scheme will result in no change for badgers, giving a neutral (not significant) effect of local value.

Bats

*Direct effect – habitat loss*

8.7.15 The trees associated with the broadleaved woodland subject to removal were assessed for their suitability to support roosting bats. It is considered that of the 13 trees to be removed, two are assessed as having low suitability for roosting bats, with the others having negligible suitability. Further detail regarding these trees can be found within Appendix 8-1 of Volume 2D – Preliminary Ecological Appraisal.

8.7.16 Taking into account the mitigation measures detailed in Section 8.6, it is considered that there would be a negligible impact on a receptor of local value, resulting in a neutral effect (not significant).

8.7.17 There will be a loss of hedgerows across the assessment boundary which have the potential to interfere with bat foraging and dispersal. However, the majority of the hedgerows and woodland edge that will be lost are subject to existing high levels of artificial lighting from both street lighting and residential housing. Additionally, the landscape design mitigates the loss of these hedgerows by reinstating new hedgerows post development, along a similar alignment. Therefore, it is considered that the removal of suitable foraging and commuting habitat as part of the Scheme would be temporary and therefore would have a negligible impact on a receptor of up to County value, resulting in a neutral effect (not significant).

*Indirect effect – lighting and noise impacts*

8.7.18 As detailed in Section 8.6, best practice construction measures would be implemented during the construction phase to minimise disturbance to bats through minimising night-time working and avoiding any direct illumination of habitats of value to bats. With the implementation of such measures, it is considered that there would be a negligible impact on a receptor of local value, resulting in a neutral effect (not significant).

8.7.19 At this stage, precise information on the construction works is not available, therefore the noise assessment has been based on the likely road construction activities. It is anticipated that the contractor will employ standard best practice controls to manage noise and vibration levels during the construction phase and such measures would be detailed within the CEMP. The construction of the Scheme would result in temporary fluctuation in noise, which will be managed via the CEMP such that the impacts would be a negligible impact on a receptor of up to County value, resulting in a neutral effect (not significant).

Birds

*Direct effect – habitat loss*

8.7.20 Site clearance during the construction phase of the proposed development will result in the loss of hedgerows and trees, habitats which are likely to provide nesting opportunities for a variety of bird species during the breeding season. The loss is considered to be temporary as new suitable habitats, provided in the landscape proposals will provide replacement nesting opportunities for those lost. Furthermore, suitable nesting habitat is present within the wider area.

8.7.21 Provided the mitigation measures detailed within the CEMP are followed during the clearance works, and the suitable habitat is replaced and further enhanced as detailed within the landscape plan, it is considered that the works would have a

negligible impact on a receptor of up to County value, resulting in a neutral effect (not significant).

*Indirect effect –noise impacts*

8.7.22 Precise information on the construction works is not available at the time of writing this chapter. However, given the mitigation measures detailed, and the temporary nature of the construction, it is considered that the noise impacts would have a negligible impact on a receptor of up to County value, resulting in a neutral effect (not significant).

Hedgehog and Brown Hare

*Direct effect – habitat loss*

8.7.23 The hedgerows and grassland within the assessment boundary provide potential habitat for hedgehog and brown hare. Best practice measures for habitat clearance will be detailed within the CEMP. Ensuring this is followed during the clearance works, it is considered that the works would have a negligible impact on a receptor of County value, resulting in a neutral effect (not significant).

*Indirect effect – construction activities*

8.7.24 General construction activities within the Scheme development are likely to include ground works, excavations and storage of materials, including pipes which, if left uncovered, could trap, injure or kill individual hedgehogs moving through the site. These effects could increase hedgehog mortality within the sites, leading to reduced breeding success and recruitment into the local population. Provided the mitigation measures, detailed within the CEMP are followed during the construction phase, it is considered that the works would have a negligible impact on a receptor of County value, resulting in a neutral effect (not significant).

## Operation

### Non-Statutory Designated Sites

8.7.25 Ten LWS are located within the ZoI. Given the geographical separation of arable fields the River Trent and main roads, an adverse impact on the LWS, during the operational phase, is not anticipated.

### Species

Bats

8.7.26 The potential operational impacts upon bats relate to direct mortality and reduction of habitat quality due to artificial light.

8.7.27 The severance of flight lines has the potential to increase levels of bat mortality through accidental collision with vehicles. Direct collision resulting in mortality of bats occurs in areas where bats would attempt to cross the highway when following existing or new linear features (hedgerows, tree lines, woodland edge, linear riparian habitat and other features). Mitigation measures include the replacement and further enhancement of linear features that may be used by foraging and commuting bats, additionally the Scheme does not result in the severance of any new habitat but is restricted to widening along the existing carriageway, reducing the impacts to commuting and foraging bats as a result of direct mortality. Therefore, taking into account the mitigation proposed, it is considered that the Scheme operation will constitute a negligible impact on a receptor of up to County value, resulting in a neutral effect (not significant).

8.7.28 Artificial lighting has the potential to impact upon bats, causing them to avoid otherwise suitable areas of habitat.

8.7.29 The operational lighting scheme, presented in Figure 8-2 in Volume 2D has been designed to the ‘5 second rule’ which forms part of the Institution of Lighting

Professionals document PLG02 (ILP, 2013) and DMRB TD 501 Road lighting design (Highways England, 2020a). This lighting extent is greater than the current lighting in place at Kirk Hill Junction, and therefore the lighting levels extend further south-east along the A6097 and south-west along East Bridgford Road. The increase in lighting levels causes neutral grassland, species-poor hedgerow and broadleaved woodland to be lit to levels greater that 1 lux. It is considered that these habitats provide some low quality, isolated habitat that may be utilised by foraging and commuting bats, however, the surrounding habitat for habitat is sub-optimal and lit by artificial lighting further along the A6097 reducing the likelihood of that bats using the verges, hedgerows or woodland edges as commuting habitat. It is considered that due to the small area and habitat types that are to be impacted by the lighting scheme, and the surrounding area being of sub-optimal bat habitat, that the increase in lighting levels will constitute a negligible impact on a receptor of up to County value, resulting in a neutral effect (not significant).

8.7.30 Traffic noise can affect bat activity at least 20 m away from the noise source (Finch, Schofield and Mathews, 2020). Noise modelling data was obtained for the Scheme both during the daytime and night-time, detailed in Figures 8-3 and 8-4 in Volume 2D to determine the changes in noise levels during the operational phase. A total of 33 ecological receptors were used, up to 600 m from the Scheme. This number of receptors was considered necessary to assess the surrounding areas, in particular those that were considered to be ecologically valuable, such as habitats that provide value to species sensitive to an increase in noise levels. The noise data modelling determined the majority of receptors have an overall negligible beneficial impact with the introduction of the Scheme, and eight receptors where a negligible adverse impact is expected, due to an increase in noise levels by a maximum of 0.1 dB. Due to the negligible impact on a receptor of up to County value, this results in a neutral effect (not significant).

Birds

8.7.31 The operation of the Scheme has the potential to affect birds through direct mortality and habitat degradation, behavioural patterns, stress response and fitness levels, as a result of increased noise and lighting levels.

8.7.32 Certain birds, for example thrush species and game birds, are at a higher risk of collision as they fly at low height. Collisions occur where hedgerows and other woodland habitat directly adjoin the carriageway. The Scheme incorporates wide verges and/ or a footpath directly adjacent to the carriageway offsetting any suitable habitat directly adjoining the carriageway, which will reduce the risk of direct mortality.

8.7.33 The artificial lighting scheme has been designed to minimise light-spill onto adjacent habitats and is largely concentrated to the carriageway boundary which is considered to minimise any effects on birds.

8.7.34 Noise modelling data was obtained for the Scheme to determine the changes in noise levels during the Operational phase. A total of 33 ecological receptors were used, up to 600 m from the Scheme. This number of receptors was considered necessary to assess the surrounding areas, in particular those that were considered to be ecologically valuable, such as habitats that provide value to species sensitive to an increase in noise levels. Eight of these receptors had an increase in noise level of between 0.1 dB from the existing baseline, with the remaining 25 receptors resulting in either no change, or a decrease in noise levels up to 0.2 dB. These results are presented in Figures 8-3 and 8-4 in Volume 2D. As the increase in overall noise levels does not exceed 3 dB, it is considered that the increase in noise level will constitute a negligible impact on a receptor of up to County value, resulting in a neutral effect (not significant).

Hedgehog and Brown Hare

8.7.35 Britain's hedgehog numbers are in severe decline, with a possible reason for this being increased deaths caused by road collisions (Mammal Society, 2020).

8.7.36 Studies have also shown that brown hare populations have been in decline throughout Europe since the 1960s with the impact of roads being a potential factor in this decline (Roedenbeck, I., Voser, p., 2008).

8.7.37 The speed at which a vehicle is travelling has the potential to impact the number of road traffic accidents. According to the road traffic data obtained for the Scheme, for the opening year (2023) and for 2037 there is limited change in speed bands between the Do Minimum and the Do Something. Additionally, changes to speed limits are proposed with the speed limit being reduced from de-restricted to 50 mph. Therefore, it is considered that the introduction of the Scheme will constitute a moderate beneficial impact on a receptor of County value, resulting in a slight beneficial (not significant) effect.

## 8.8 Additional Mitigation

### Construction Phase

8.8.1 Providing the design and mitigation measures outlined in Section 8.6 are undertaken, significance of effect in the short-term ranges from neutral to slight adverse and in the long-term (once habitats have established) from neutral to slight adverse. Therefore, no further additional mitigation measures have been identified.

### Operation Phase

8.8.2 No mitigation measures are considered to be required for the operational phase of the Scheme as no significant effects are predicted.

## 8.9 Residual Effects

8.9.1 The residual effects of the Scheme are considered to be 'not significant' for biodiversity for both the construction and operational phases as noted in Table 8-10.

Table 8-10 Residual Effects

| Description of Effect | Sensitivity of Receptor | Nature of Effect/ Geographic Scale | Magnitude of Impact | Initial Classification of Effect (with embedded mitigation) | Additional Mitigation | Residual Effect Significance |
|---|---|---|---|---|---|---|
| **Construction** | | | | | | |
| Loss broadleaved woodland | Local | Permanent loss of 0.059 ha of woodland | Moderate adverse | Slight adverse (not significant) | No additional mitigation required | Slight adverse |
| Loss of neutral grassland verge | County | Permanent loss of 0.048 ha of grassland verge | Moderate adverse | Slight adverse (not significant) | No additional mitigation required | Slight adverse |
| Loss of improved grassland | County | Permanent loss of 0.18 ha of improved grassland | Minor adverse | Neutral effect (not significant) | No additional mitigation required | Neutral effect (not significant) |
| Arable land | County | Permanent loss of 0.07 ha of arable land | Minor adverse | Neutral effect (not significant) | No additional mitigation required | Neutral effect (not significant) |
| Loss of species-poor hedgerow | Local | Temporary loss of 200 m of hedgerow, 239 m hedgerow reinstated / created and further enhanced to species-rich hedgerow with trees | Moderate adverse | Slight adverse (not significant) | No additional mitigation required | Slight adverse (not significant) |
| Loss of species-rich hedgerow with trees | County | Temporary loss of 240 m hedgerow, 474 m created to replace lost hedgerow and further enhance | Moderate adverse | Slight adverse (not significant) | No additional mitigation required | Slight adverse (not significant) |
| Loss of suitable badger habitat | Local | Entrapment and injury during construction activities | No change | Neutral effect (not significant) | No additional mitigation required | Neutral effect (not significant) |
| Loss of suitable bat habitat | Up to County | Loss of suitable roosting / foraging / dispersal habitat | Negligible | Neutral effect (not significant) | No additional mitigation required | Neutral effect (not significant) |

| Description of Effect | Sensitivity of Receptor | Nature of Effect/ Geographic Scale | Magnitude of Impact | Initial Classification of Effect (with embedded mitigation) | Additional Mitigation | Residual Effect Significance |
|---|---|---|---|---|---|---|
| Lighting and noise impact on bats | Up to County | Destruction / disturbance to bat roosts and / or dispersal corridors | Negligible | Neutral effect (not significant) | No additional mitigation required | Neutral effect (not significant) |
| Loss of suitable bird nesting habitat | Up to County | Destruction / disturbance to nesting birds | Negligible | Neutral effect (not significant) | No additional mitigation required | Neutral effect (not significant) |
| Noise impacts on birds | Up to County | Destruction / disturbance to nesting birds | Negligible | Neutral effect (not significant) | No additional mitigation required | Neutral effect (not significant) |
| Loss of suitable hedgehog and brown hare habitat | County | Injury / mortality during habitat clearance | Negligible | Neutral effect (not significant) | No additional mitigation required | Neutral effect (not significant) |
| Effect of construction activities on hedgehog and brown hare | County | Injury / mortality during construction activities | Negligible | Neutral effect (not significant) | No additional mitigation required | Neutral effect (not significant) |
| **Operation** | | | | | | |
| Increase levels of bat mortality / injury | Up to County | Injury / mortality during operation | Negligible | Neutral effect (not significant) | No additional mitigation required | Neutral effect (not significant) |
| Changes in artificial lighting levels (bats) | Up to County | Habitat degradation / behavioural patterns | Negligible | Neutral effect (not significant) | No additional mitigation required | Neutral effect (not significant) |
| Changes in noise levels (bats) | Up to County | Habitat degradation / behavioural patterns | Negligible | Neutral effect (not significant) | No additional mitigation required | Neutral effect (not significant) |

| Description of Effect | Sensitivity of Receptor | Nature of Effect/ Geographic Scale | Magnitude of Impact | Initial Classification of Effect (with embedded mitigation) | Additional Mitigation | Residual Effect Significance |
|---|---|---|---|---|---|---|
| Increase levels of bird mortality / injury | Up to County | Injury / mortality during operation | Negligible | Neutral effect (not significant) | No additional mitigation required | Neutral effect (not significant) |
| Changes to artificial lighting levels (birds) | Up to County | Habitat degradation / behavioural patterns / stress response / fitness | Negligible | Neutral effect (not significant) | No additional mitigation required | Neutral effect (not significant) |
| Changes in noise levels (birds) | County | Habitat degradation / behavioural patterns / stress response / fitness | Negligible | Neutral effect (not significant) | No additional mitigation required | Neutral effect (not significant) |
| Hedgehog | County | Mortality / injury due to road collisions | Minor beneficial | Slight beneficial (not significant) | No additional mitigation required | Slight beneficial |

# 9. GEOLOGY AND SOILS

## 9.1 Introduction

9.1.1 This chapter discusses the potential geology and soils effects of the proposed Scheme and the likely significance of such impacts during the construction and operational phases.

9.1.2 This chapter should be read in conjunction with Figure 9-1 within Volume 2D, and Appendices 9-1 and 9-2 of Volume 2D. This assessment has followed the methodology within DMRB LA 109 Geology and Soils Revision 0 (Highways England, 2019).

## 9.2 Legislation and Policy

9.2.1 Information relating to relevant geology and soils legislation and policy can be viewed in Chapter 9 of Volume 1.

## 9.3 Consultation

9.3.1 None of the consultation responses received to date are considered to be relevant to the geology and soils assessment for this Scheme. However, the assessment is consistent with the assessments undertaken for the other Schemes and the consultation responses received in relation to those assessments (see Volume 1).

## 9.4 Assessment Methodology

### Baseline Conditions

9.4.1 To determine the baseline conditions, a Phase 1 geo-environmental desk study was prepared for the site by Via between November 2020 and October 2021, taking into account changes to the assessment boundary over that period of time. The desk study gathered information from historical mapping and environmental data searches provided in a site-specific Envirocheck report. A site walkover survey was also carried out for the site to identify any potential sources of contamination and potential receptors. The information obtained in the desk study was used to develop a preliminary conceptual site model (CSM) for the site. The desk study report is included in Volume 2D, Appendix 9-1.

9.4.2 In addition, a Phase 2 geo-environmental ground investigation was carried out in February 2021, to establish the ground conditions at the site. The ground investigation comprised excavation of four window sampler boreholes, one rotary borehole, eight in-situ DCP tests, two trial pits and one infiltration test pit. Three soil samples were tested for potential contaminants of concern. The ground investigation results are presented in the factual ground investigation report, which is included in Volume 2D, Appendix 9-2.

9.4.3 The reports are referenced as follows:

- Via East Midlands Ltd (2021). Kirk Hill, East Bridgford, Nottinghamshire. Phase 1 – Geo-Environmental Desk Study; and
- Nicholls Colton Group (2021). Factual Report on a Ground Investigation for Kirk Hill, East Bridgford, Nottinghamshire. Ref. G21008-FR.

9.4.4 Supplementary ground investigation works are planned for the site, including areas not previously investigated. The results of the existing and additional testing will be

used to carry out quantitative environmental risk assessments and update the conceptual site model.

9.4.5 A soil resources and agricultural land quality survey has been carried out by Land Research Associates Ltd for the site (30th September – 1st October 2021). The results of the survey have been used to determine the agricultural land classification (ALC) for the agricultural land. The final report was not available at the time of writing; however, the initial findings of the survey have been used to inform the geology and soils assessment.

9.4.6 To further inform the baseline conditions, additional consultation has been carried out with stakeholders, agencies and on-line resources as per Table 9-1.

Table 9-1: External Sources of Information

| Stakeholder / Agency | Details |
|---|---|
| British Geological Survey (BGS) | GeoIndex Onshore (BGS, 2021) – information on 1:50,000 geology, faults and artificial ground.<br>1:50,000 geological map series (BGS, 1996). 113 Ollerton. Solid and Drift (British Geological Survey, 1996). |
| Cranfield Soil and Agrifood Institute (2020) | Soilscapes – information on soil types across England and Wales. |
| Defra (Defra,2021) | Multi-Agencies Geographic Information for Countryside (MAGIC) – information on local geological sites. |
| Environment Agency | Information requested on groundwater and surface water abstractions, pollution incidents within the last five years and waste sites. Response received: 25th January 2021.<br>Information on historic landfill sites (EA, 2021a).<br>Information on authorised landfill site boundaries, (EA, 2021b). |
| Natural England (NE) | Information requested on sensitive geological sites within the study area. Response received: 2nd February 2021. |
| Newark and Sherwood District Council | Information requested on private water supply abstractions. Response received: 26th October 2020. |
| Nottinghamshire Biological and Geological Records Centre (NBGRC) | Information requested on sensitive geological sites within the study area. Response received: 19th January 2021. |

## Study Area

9.4.7 For the purposes of the geology and soils assessment, the study area includes the main extents of the Scheme construction, as defined by the geology and soils assessment boundary (“the site”) and a buffer of 250 m from the assessment boundary. The site excludes areas of the Scheme that are limited to proposed street lighting or signage installation on existing highway land. Any baseline information related to soil geochemistry has been limited to the site area only.

9.4.8 In the case of controlled waters receptors, the study area is extended to include relevant features within 1 km of the assessment boundary. This includes any significant groundwater Source Protection Zones (SPZ), water abstractions, discharge consents, surface water receptors and pollution incidents to controlled waters. It is noted that surface water receptors could potentially be impacted by the

Scheme over greater distances than 1 km downstream. This will be taken into account in the assessment, where relevant.

9.4.9 The study area is shown in Volume 2D, Figure 9-1.

## Methodology for Determining Construction Effects

9.4.10 The construction effects are determined by considering how the construction works could affect the environmental receptors identified in the baseline assessment, compared with the existing baseline conditions. The effects are generally considered to be short-term / temporary during the construction phase. However, the assessment includes permanent effects related to loss of or damage to soil resources and to changes in ground contamination conditions during the construction of the Scheme.

9.4.11 Potential geology and soils effects related to the construction of a road scheme can be both adverse and beneficial.

9.4.12 Examples of potential adverse effects are:

- increased mobilisation of contaminants during construction as dust, which could be inhaled or ingested by human receptors or deposited onto surrounding land;
- increased mobilisation of contaminants through leaching of contaminated materials exposed or disturbed during construction, which could impact groundwater and surface water receptors;
- mobilisation of ground gas or vapours during construction, which could impact off-site receptors;
- soil or groundwater contamination from hazardous materials or substances used during construction (e.g. fuel spills, air borne contaminants and spray);
- accidental release of contaminated materials onto surrounding transport routes during transport of contaminated materials from a construction site;
- loss of best and most versatile (BMV) agricultural land or important soil resources;
- damage to BMV agricultural land or important soil resources;
- loss of important geological features, or permanently reduced access; and
- damage to important geological features.

9.4.13 Examples of potential beneficial effects are:

- removal of older road surfacing materials, which may contain contaminants, such as coal tar;
- removal or stabilisation of contaminated soils and other materials in the ground during the construction works; and
- removal or remediation of contaminated groundwater during the construction works.

## Methodology for Determining Operational Effects

9.4.14 The operational effects are determined by considering how the future use of the site, following completion of the Project, could affect the environmental receptors identified in the baseline, compared with the existing baseline conditions. The effects are generally considered to be long-term / permanent.

9.4.15 The potential geology and soils effects during operation of a road scheme can be both adverse and beneficial.

9.4.16 Examples of potential adverse effects are:

- Increased release of soil contaminants into the environment due to inappropriate placement of contaminated materials, for example, within new embankments. This could have an impact on human receptors, through inhalation, ingestion or dermal contact.
- Increased leaching of soil contaminants into the environment, due to inappropriate placement of contaminated materials. This could have an impact on controlled waters receptors, through vertical and lateral migration in groundwater.
- Release of highways related contaminants into the environment, for example in spray or spills. This could occur as a result of general traffic movements over time, routine road maintenance activities and road traffic accidents or other incidents.
- Increased soil erosion impacts, for example within cuttings and embankments.

9.4.17 Examples of potential beneficial effects are:

- Reduced future risks from soil and groundwater contaminants due to ground improvements. For example, removal or treatment of contaminated soils and groundwater, or appropriate placement of potentially contaminated materials in low risk areas.
- Reduced future risks from highways related contaminants due to improved design and materials. For example, improved drainage, improved hardstanding materials and better traffic management and flow.
- Improved access to designated sites or potential to uncover new features of interest. For example, new geological exposures in road cuttings.
- Mitigation of existing adverse soil erosion effects through improved drainage.

## Significance Criteria

9.4.18 Qualitative environmental assessments have been carried out to determine the significance of potential geology and soils effects on potential environmental receptors. The general methodology, based on DMRB LA 104, is described in Chapter 4 of Volume 1.

9.4.19 The significance of the effects (described as adverse, neutral or beneficial) have been determined using the significance matrix taken from DMRB LA 104, which has been reproduced in Table 4-3 in Volume 1. This is based on the environmental value (sensitivity) versus the magnitude of impact (degree of change).

9.4.20 The criteria used to determine the receptor sensitivity and magnitude of impact for geology and soils are presented in Table 9-2 and Table 9-3, respectively.

9.4.21 Very large, large and moderate effects are considered to be significant, while slight and neutral effects are considered to be manageable and not significant.

9.4.22 In some cases the significance falls between two levels, e.g. a minor impact on a high sensitivity receptor gives a “slight or moderate” effect. In these cases, one level of significance has been selected, with justification for that decision included in the assessment.

### Receptor Sensitivity

9.4.23 The receptor sensitivity has been assessed using the criteria in Table 9-2. This is based on Table 3.11 of DMRB LA 109 for geology, soils and human health receptors and Table 3.70 of DMRB LA 113 for surface water and groundwater receptors.

Table 9-2 Environmental Value (sensitivity) and Descriptions (based on DMRB LA 109 and LA 113)

| Receptor value (sensitivity) | Description | Typical examples |
|---|---|---|
| Very high | Geology | Very rare and of international importance with no potential for replacement (e.g. UNESCO World Heritage Sites, UNESCO Global Geoparks, SSSIs and GCR sites where citations indicate features of international importance).<br>Geology meeting international designation citation criteria which is not designated as such. |
| | Soils | Soils directly supporting an EU designated site (e.g. SAC, SPA, Ramsar).<br>Agricultural land classification (ALC) grade 1 & 2 or Land Capability for Agricultural Classification (LCAc) grade 1 & 2. |
| | Contamination – human health | Very high sensitivity land use such as residential or allotments. |
| | Contamination – surface water | Watercourse having a WFD classification shown in a RBMP and Q95[3] ≥1.0 $m^3/s$.<br>Site protected under EC or UK legislation (SAC, SPA, SSSI, Ramsar site, salmonid water).<br>Species protected by EC legislation. |
| | Contamination – groundwater | Principal Aquifer providing a regionally important resource and / or supporting a site protected under EC and UK legislation.<br>Groundwater that locally supports GWDTE.<br>SPZ 1. |
| High | Geology | Rare and national importance with little potential for replacement (e.g. geological SSSI, ASSI, NNR). Geology meeting national designation citation criteria which is not designated as such. |
| | Soils | Soils directly supporting a UK designated site (e.g. SSSI).<br>ALC grade 3a or LCAc grade 3.1. |
| | Contamination – human health | High sensitivity land use such as public open space. |
| | Contamination – surface water | Watercourse having a WFD classification shown in a RBMP and Q95 <1.0 $m^3/s$.<br>Species protected under EC or UK legislation. |
| | Contamination – groundwater | Principal Aquifer providing locally important resource or supporting a river ecosystem.<br>Groundwater that supports a GWDTE |

[3] Q95: The flow in cubic metres per second which was equalled or exceeded for 95% of the flow record. The Q95 flow is a significant low flow parameter particularly relevant in the assessment of river water quality consent conditions.

| Receptor value (sensitivity) | Description | Typical examples |
|---|---|---|
| | | SPZ 2. |
| Medium | Geology | Geology of regional importance with limited potential for replacement (e.g. RIGS). Geology meeting regional designation citation criteria which is not designated as such. |
| | Soils | Soils supporting non-statutory designated sites (e.g. LNRs, LGSs, SNCIs).<br>ALC grade 3b or LCAc grade 3.2. |
| | Contamination – human health | Medium sensitivity land use such as commercial or industrial. |
| | Contamination – surface water | Watercourses not having a WFD classification shown in a RBMP and Q95 >0.001 $m^3/s$. |
| | Contamination – groundwater | Aquifer providing water for agricultural or industrial use with limited connection to surface water.<br>SPZ 3. |
| Low | Geology | Geology of local importance / interest with potential for replacement (e.g. non-designated geological exposures, former quarries / mining sites). |
| | Soils | ALC grade 4 & 5 or LCAc grade 4.1 to 7.<br>Soils supporting non-designated notable or priority habitats. |
| | Contamination – human health | Low sensitivity land use such as highways and rail. |
| | Contamination – surface water | Watercourses not having a WFD classification shown in a RBMP and Q95 ≤0.001$m^3/s$. |
| | Contamination – groundwater | Unproductive strata. |
| Negligible | Geology | No geological exposures, little / no local interest. |
| | Soils | Previously developed land formerly in ‘hard uses’ with little potential to return to agriculture. |
| | Contamination – human health | Undeveloped surplus land / no sensitive land use proposed. |
| | Contamination – surface water | N/A |
| | Contamination – groundwater | N/A |

9.4.24 DMRB LA 109 also notes that soils not categorised as BMV (land in grades 1, 2 and 3a of the ALC) or prime land (land in grades 1, 2 and 3.1 of the LCAc) can be

allocated in a higher sensitivity category where particular agricultural practices contribute to the quality and character of the environment or local economy (e.g. in upland areas where lower quality agricultural land is integral to agricultural practices).

### Magnitude of Change

9.4.25 The magnitude of change on the receptors has been determined using the criteria in Table 9-3. This is based on Table 3.12 and Table E/2.1 of DMRB LA 109 for geology, soils and human health receptors. The relevant sensitivity criteria in Table 3.71 of DMRB LA 113 have been used for surface water and groundwater receptors.

Table 9-3 Magnitude of Impact (based on DMRB LA 109 and LA 113)

| Magnitude of impact (change) | Description | Typical examples |
|---|---|---|
| Major | Geology | Loss of geological feature / designation and / or quality and integrity.<br>Severe damage to key characteristics, features or elements. |
| | Soils | Physical removal or permanent sealing of >20 ha of agricultural land. |
| | Contamination – human health | Significant contamination identified.<br>Contamination levels significantly exceed background levels and relevant screening criteria (e.g. category 4 screening levels (CL:AIRE, 2014)) with potential for significant harm to human health.<br>Contamination heavily restricts future use of land. |
| | Contamination – surface water | Failure of both acute-soluble and chronic-sediment related pollutants in HEWRAT and compliance failure with EQS values.<br>Calculated risk of pollution from a spillage ≥2% annually (spillage assessment).<br>Loss or extensive change to a fishery.<br>Loss of regionally important public water supply.<br>Loss or extensive change to a designated nature conservation site.<br>Reduction in water body WFD classification. |
| | Contamination – groundwater | Loss or, or extensive change to, an aquifer.<br>Loss of regionally important water supply.<br>Potential high risk of pollution to groundwater from routine runoff – risk score >250 (Groundwater quality and runoff assessment).<br>Calculated risk of pollution from spillages ≥2 % annually (Spillage assessment).<br>Loss of, or extensive change to GWDTE or baseflow contribution to protected surface water bodies.<br>Reduction in water body WFD classification. |
| Moderate | Geology | Partial loss of geological feature / designation, potentially adversely affecting the integrity.<br>Partial loss of / damage to key characteristics, features or elements. |
| | Soils | Physical removal or permanent sealing of 1 ha – 20 ha of agricultural land.<br>Permanent loss / reduction of one or more soil function(s) and restriction to current or approved future use (e.g. through degradation, compaction, erosion of soil resource). |

| Magnitude of impact (change) | Description | Typical examples |
|---|---|---|
| | Contamination – human health | Contaminant concentrations exceed background levels and are in line with limits of relevant screening criteria (e.g. category 4 screening levels (CL:AIRE, 2014)).<br>Significant contamination can be present. Control / remediation measures are required to reduce risks to human health / make land suitable for intended use. |
| | Contamination – surface water | Failure of both acute-soluble and chronic-sediment related pollutants in HEWRAT but compliance with EQS values.<br>Calculated risk of pollution from spillages ≥1 % annually and <2 % annually.<br>Partial loss in productivity of a fishery.<br>Degradation of regionally important public water supply or loss of major commercial / industrial / agricultural supplies.<br>Contribution to reduction in water body WFD classification. |
| | Contamination – groundwater | Partial loss or change to an aquifer.<br>Degradation of regionally important public water supply or loss of significant commercial / industrial / agricultural supplies.<br>Potential medium risk of pollution to groundwater from routine runoff – risk score 150-250.<br>Calculated risk of pollutant from spillages ≥1 % annually and <2 % annually.<br>Partial loss of the integrity of GWDTE.<br>Contribution to reduction in water body WFD classification. |
| Minor | Geology | Minor measurable change in geological feature / designation attributes, quality or vulnerability.<br>Minor loss of, or alteration to, one (maybe more) key characteristics, features or elements. |
| | Soils | Temporary loss / reduction of one or more soil function(s) and restriction to current or approved future use (e.g. through degradation, compaction, erosion of soil resource). |
| | Contamination – human health | Contaminant concentrations are below relevant screening criteria (e.g. category 4 screening levels (CL:AIRE, 2014)).<br>Significant contamination is unlikely with a low risk to human health.<br>Best practice measures can be required to minimise risks to human health. |
| | Contamination – surface water | Failure of either acute soluble or chronic sediment related pollutants in HEWRAT.<br>Calculated risk of pollution from spillages ≥0.5 % annually and <1 % annually.<br>Minor effects on water supplies. |
| | Contamination – groundwater | Potential low risk of pollution to groundwater from routine runoff – risk score <150.<br>Calculated risk of pollution from spillages ≥0.5 % annually and <1 % annually.<br>Minor effects on an aquifer, GWDTEs, abstractions. |

| Magnitude of impact (change) | Description | Typical examples |
|---|---|---|
| Negligible | Geology | Very minor loss or detrimental alteration to one or more characteristics, features or elements of geological feature / designation.<br>Overall integrity of resource not affected. |
| | Soils | Physical removal or permanent sealing of <1 ha of agricultural land.<br>No discernible loss / reduction of soil function(s) that restrict current or approved future use. |
| | Contamination – human health | Contaminant concentrations substantially below levels outlined in relevant screening criteria (e.g. category 4 screening levels (CL:AIRE, 2014)). No requirement for control measures to reduce risks to human health / make land suitable for intended use. |
| | Contamination – surface water | No risk identified by HEWRAT (pass both acute-soluble and chronic-sediment related pollutants).<br>Risk of pollution from spillages <0.5 %. |
| | Contamination – groundwater | No measurable impact upon an aquifer and / or groundwater receptors and risk of pollution from spillages <0.5 %. |
| No change | Geology | No temporary or permanent loss / disturbance of characteristics, features or elements. |
| | Soils | No loss / reduction of soil function(s) that restrict current or approved future use. |
| | Contamination – human health | Reported contaminant concentrations below background levels. |
| | Contamination – surface water | No loss or alteration of characteristics, features or elements; no observable impact in either direction. |
| | Contamination – groundwater | No loss or alteration of characteristics, features or elements; no observable impact in either direction. |

## Assumptions and Limitations

9.4.26 The geology and soils assessment is based on information obtained from a geo-environmental desk study and intrusive site investigation works using the sources described in Section 9.4. The assessment is based on the information available at the time of reporting and is based on the Scheme design as described in Chapter 2: The Scheme, including the likely extents of land take required for its construction and operation.

9.4.27 As part of the assessment, it is assumed that the junction will be partially in use during construction of the Scheme. Therefore, site users (roads) are included as receptors during the construction phase.

9.4.28 It is assumed that the Scheme will not include the development of any new land uses that could result in additional contamination sources or receptors.

9.4.29 It is assumed that all areas of temporary land use during the construction phase will be returned to the current land use.

9.4.30 Re-use or disposal of materials arising from construction will be managed in accordance with the Definition of Waste: Development Industry Code of Practice or appropriate waste management regulations, as applicable.

9.4.31 In accordance with DMRB LA 109, potential effects related to ground stability do not form part of the geology and soils assessment. It is noted that the Envirocheck report (see Appendix 9-1 of Volume 2D) did not identify any significant natural ground stability hazards at the site. However, ground stability risks are expected to be low. The results of the Phase 2 ground investigation will be used by the design team to verify the design.

9.4.32 Potential effects related to impacts on future mineral resources do not form part of the geology and soils assessment, in accordance with DMRB LA 109. However, as the Scheme will be located in the area of the existing road junction, it is not expected to have any significant impacts on mineral resources.

## 9.5 Baseline Conditions

9.5.1 Baseline conditions have been identified for the study area to assess the potential geology and soils effects of the Scheme on the receptors identified in Table 9-2.

### Topography

9.5.2 The topographic baseline has been determined using the results of a topographic survey of the proposed Scheme permanent works and OS topographic mapping included within the Envirocheck report. These documents are included within the desk study (Appendix 9-1 of Volume 2D).

9.5.3 The existing junction is located at an elevation of 47 m above Ordnance Datum (aOD). The following changes in elevation were recorded within the assessment boundary, moving away from the junction:

9.5.4 To the north-west, the A6097 / Bridgford Road falls to approximately 38.5 m aOD.

9.5.5 To the south-east, the A6097 / Bridgford Road rises to approximately 47.5 m aOD, before gradually falling to approximately 45.7 m aOD in the south-eastern area of the site.

9.5.6 To the west of the junction, the ground level rises to approximately 48.0 m aOD around the edge of the agricultural field on-site.

9.5.7 To the south, the roadside verge rises to approximately 48.0 m aOD within the assessment boundary.

9.5.8 The Envirocheck report (Volume 2D, Appendix 9-1) indicates that the surrounding topography falls to the north-west from the north-western tip of the site, towards the River Trent. The topography also falls in elevation to the south-east of the site, but with a gentler gradient than the area to the north-west.

### Published Geology

A summary of the geological setting of the site, based on BGS mapping sources (Section 9.4) is presented in Table 9-4.

Table 9-4 Summary of Published Geology

| Geological Feature | Description |
|---|---|
| Artificial Deposits | No deposits of artificial ground are shown on the geological mapping sources. However, due to the development history of the site, shallow |

| Geological Feature | Description |
|---|---|
| | deposits of made ground are expected to be present across much of the study area. |
| Superficial deposits | No superficial deposits are mapped within the area of the site. However, the published BGS geological mapping identifies glacial till at the south-eastern edge of the study area. |
| Bedrock Geology | The published BGS geological mapping identifies the bedrock geology within the assessment boundary and the surrounding study area as the Sidmouth Mudstone Formation (SMF).<br>The site traverses the stratigraphic boundary between the Edwalton Member of the SMF in the central, southern and eastern areas of the site, the Cotgrave Sandstone Member of the SMF locally in the northern area of the site and the Gunthorpe Member of the SMF in the north-western area of the site.<br>The Edwalton Member is described as red-brown and greenish grey mudstone and siltstone, with beds of variably dolomitic siltstone and very fine-grained sandstone common in the lower half and finely disseminated gypsum common in the upper half. Skerries of green dolomitic siltstone are mapped partially in a swathe running through the central area of the site.<br>The Cotgrave Sandstone Member is described as pale greenish grey, fine to medium grained sandstone, interbedded with mudstone and siltstone, with common gypsum nodules.<br>The Gunthorpe Member is described as red-brown mudstone with subordinate greenish grey dolomitic siltstone and fine-grained sandstone. Gypsum veins and nodules are common. |
| Faults | The BGS 1:50,000 map 126 Nottingham identifies a fault trending approximately west-north-west to east-south-east within the site area. This fault crosses the A6097 Bridgford Street in the north-western area of the site. The fault also crosses Kirk Hill, on the northern side of the existing junction. The downthrow of the fault is to the north-north-east.<br>A fault trending approximately north-north-west to south-south-east is located to the south of the site and crosses East Bridgford Road. The downthrow of the fault is to the east-north-east.<br>The two faults converge in the north-western part of the study area. |

## Encountered Ground Conditions

9.5.9 The ground conditions identified at the site during the Phase 2 ground investigation are summarised in Table 9-5. The exploratory holes (WS01 – WS04) were located along the grass-covered south-western verge of the A6097 / Bypass Road. All of the boreholes were located within the permanent works for the Scheme.

### Table 9-5 Summary of Encountered Ground Conditions

| Material Name | Depth Range to Base (m bgl) | Description |
|---|---|---|
| Topsoil (made ground) | 0.15 – 0.20 | Soft dark brown sandy silt with frequent rootlets. |
| Made ground | 0.60 (WS04 only) | Light grey, slightly clayey, gravelly, fine to coarse sand. The gravel comprised limestone, siltstone and some brick. |

| Material Name | Depth Range to Base (m bgl) | Description |
|---|---|---|
| Possible made ground | 0.80 (WS01 only) | Brown to dark brown, slightly clayey, gravelly, fine to coarse sand. The gravel comprised mudstone, sandstone and some quartz. |
| Sidmouth Mudstone Formation: | 1.80 – 2.25 | Soft to firm reddish brown slightly silty slightly gravelly clay (possible EDW). |
| - Edwalton Member (EDW)<br>- Cotgrave Sandstone Member (COT) | 2.75 – >5.45* | Firm to stiff, reddish brown (with off-white lenses), friable, clayey silt. Occasional gravel sized pockets of off-white silty fine sand (possible EDW). |
| - Gunthorpe Member (GUN) | >5.45* (not encountered in WS01) | Dense, off white, silty, fine to medium sand with rare gravel sized pockets of soft light grey silty clay (possible COT). |

*Base not proven

9.5.10 Made ground comprising topsoil was recorded in all locations. Slightly deeper made ground deposits (0.6 m bgl) were recorded in WS04 at the south-eastern extent of the site. Possible made ground was also recorded between 0.2 m and 0.8 m bgl in WS01 at the north-western extent of the site.

9.5.11 The bedrock geology encountered was very similar across the section investigated, with materials consistent with mudstones of the Sidmouth Mudstone Formation (SMF) recorded in all locations. Based on the locations of the boreholes, along the roadside verge, it is possible that the upper layer of the SMF has been previously disturbed / reworked during the original construction of the road and could therefore be made ground.

9.5.12 In the central and north-western area, mudstone was underlain by sandstone. Based on the published geology, this could potentially represent the Cotgrave Sandstone Member of the SMF, which should locally underlie this area.

9.5.13 However, the Edwalton Member and Gunthorpe Member can also include layers of sandstone. Furthermore, the BGS descriptions for the Edwalton Member and Gunthorpe Member mudstones are very similar. Therefore, it was not possible to confirm the expected changes in bedrock geology across the site within the limited depth of investigation.

### Geological Features

9.5.14 No designated regionally important geological sites (RIGS) or local geological sites (LGS) are indicated on the MAGIC application within the study area.

9.5.15 Information from the NBGRC also indicates that there are no RIGS / LGS within the study area; however, Gunthorpe Weir LGS was identified approximately 700 m north of the site. Although the LGS is not close to the site, there could be potential effects related to access routes for visitors to the LGS. Therefore, Gunthorpe Weir LGS has been included as a receptor within the geology and soils assessment.

9.5.16 The environmental sensitivity of this receptor is considered to be medium.

### Hydrogeology

9.5.17 The key hydrogeological features of the study area, which are considered relevant to the geology and soils assessment, are summarised in Table 9-6.

Table 9-6 Summary of Hydrogeological Baseline

| Hydrogeological Feature | Description |
|---|---|
| Aquifers | The glacial till, which underlies the south-eastern part of the study area, is classed as a Secondary Aquifer (undifferentiated).<br>The Edwalton Member (mudstone) and Gunthorpe Member are Secondary B Aquifers, while the Edwalton Member (siltstone) and the Cotgrave Sandstone Member are Secondary A Aquifers. |
| Groundwater vulnerability | Groundwater vulnerability is classed as high in relation to the bedrock geology. High vulnerability is defined as 'areas able to easily transmit pollution to groundwater. They are characterised by high-leaching soils and the absence of low-permeability superficial deposits'. |
| Groundwater Source Protection Zones (SPZ) and Drinking Water Groundwater Safeguard Zones (SgZ) | The study area is not located within or near to a groundwater SPZ or a Drinking Water SgZ for groundwater. |
| Groundwater abstractions | No licenced groundwater abstractions have been identified within the site or within 1 km of the assessment boundary.<br>No private water supply boreholes have been identified by Newark and Sherwood District Council within 1 km of the assessment boundary. One borehole is located approximately 1.8 km north of the site. |
| Discharge consents to groundwater | Information on discharge consents is based on the Envirocheck report only.<br>There are five discharge consents listed in the Envirocheck report within 1 km of the assessment boundary, one of which has been revoked. The closest is located approximately 100 m north-west of the assessment boundary, at Hill Farm. The discharge consents relate to sewage effluent discharges to groundwater or land / soakaway. |
| Groundwater levels | During the Phase 2 ground investigation, groundwater was not encountered within any of the boreholes (maximum depth 5.45 m bgl).<br>Monitoring wells were installed in two locations and have yet to be monitored for presence of groundwater at the time of writing. |
| Permeability | Infiltration testing in two locations indicated very slow rates of infiltration within the near surface deposits at the site, with estimated permeability (K) of $2.02 \times 10^{-9}$ m/s in WS01 and $1.43 \times 10^{-9}$ m/s in WS03.<br>The low permeability of the near surface strata is expected to restrict and reduce the migration of contaminants from the ground surface into the underlying aquifers. |

9.5.18 The baseline information indicates that the groundwater receptors within the study area have a medium environmental sensitivity.

## Hydrology

9.5.19 The key hydrological features of the study area, which are considered relevant to the geology and soils assessment, are summarised in Table 9-7.

## Table 9-7 Summary of Hydrological Baseline

| Hydrological Feature | Description |
|---|---|
| Surface water features – linear | A land drain is located adjacent to the site, to the north-west of the existing junction. The drain flows approximately south-east to north-west between Bridgford Road and a water reclamation works to the north-west.<br>Shelford Brook is located approximately 600 m north-west of the site, flowing north-east.<br>Several land drains are located within the agricultural land to the south and west of the site.<br>The adjacent land drain and Shelford Brook are tributaries of the River Trent, which is located approximately 700 m north of the site, flowing from west to east, with a change in direction to the north-east beyond. |
| Surface water features – non-linear | A small pond is located within the south-eastern section of the drain and a larger pond is located at the north-western end of the drain, at the water reclamation works.<br>Several small pond features are located within the agricultural land surrounding the site. |
| Surface water quality | The site is within the Shelford Brook Catchment (tributary of Trent) Water Body.<br>The catchment was recorded to have bad ecological status in 2019. Impacts from point source sewage discharges (intermittent) from the water industry were identified. However, no objectives have been set to improve the ecological status, due to an unfavourable balance of costs and benefits. |
| Drinking Water Surface Water Safeguard Zones (SgZ) | No Drinking Water SgZ for surface water are located within 2 km of the site. |
| Surface water abstractions | Information from the Environment Agency indicates that there is one active surface water abstraction within 1 km of the assessment boundary. This is related to hydroelectric power generation, with a daily quantity of 1,728,000 L.<br>There are four additional surface water abstractions listed in the Envirocheck report. These are related to mineral washing from the River Trent at Gunthorpe Lock. |
| Discharge consents to surface water | Information on discharge consents is based on the Envirocheck report only.<br>There are 15 records of surface water discharge consents in the Envirocheck report within 1 km of the site. The closest is located approximately 500 m north-west. Most of the discharge consents are related to sewage discharges. |
| Pollution incidents to controlled waters (up to 1999) | There are four records for incidents within 1 km of the assessment boundary in the Envirocheck report. The closest was approximately 780 m north of the site and was related to crude sewage due to a blocked sewer at a domestic property in 1999.<br>The remaining incidents were related to unidentified foam in the River Trent, to the north of the site. |
| Substantiated pollution incidents register (from 1999) | The Environment Agency has provided information on substantiated pollution incidents in the last five years. Within 1 km of the site, one incident was recorded in 2018 and three incidents were recorded in 2020. The closest to the site was approximately 540 m south-west of the site and was a category 3 (minor incident) to land and water. This was related to diesel pollution from a road traffic accident. |

| Hydrological Feature | Description |
|---|---|
| | No substantiated pollution incidents between 1999 and 2014 were identified in the Envirocheck report within 1 km of the site. |
| Surface water flooding | The site does not lie within an area at risk from flooding from rivers or sea without defences.<br>The site is generally at low risk (1000- year return) of surface water flooding relating to the central and western site area.<br>The far eastern area of the site is in an area with potential for groundwater flooding to occur below ground level. The northern portion of the site has limited potential for groundwater flooding to occur. |

9.5.20 The baseline information indicates that the adjacent watercourse to the north-west has a medium environmental sensitivity. This is due to the presence of a water treatment works and the distance to the River Trent downstream. The River Trent, along with the nearby tributary to the north-west are considered to have a very high environmental sensitivity.

### Historical and Current Land Uses

9.5.21 The baseline conditions related to historical and current land uses and their potential land contamination effects are summarised in Table 9-8.

Table 9-8 Historical and Current Land Uses

| Identified Land Use | Description |
|---|---|
| Highways | The site was historically developed as a road prior to 1883, which ran through the site approximately north-east to south-west, with a bend to the north-west in the northern section of the site. The A6097 / Bridgford Road had been constructed by 1952, running north-west to south-east through most of the site area.<br>The existing junction is located in the centre of the site. Kirk Hill branches off at the junction to the north-east, with a tight bend to the north-west. East Bridgford Road branches off at the junction to the south-west.<br>The roadside verges on Bridgford Road are variably grass covered, with hard covered footpath areas, hedges and trees. The south-eastern verge on Bridgford Road is slightly raised above the level of the road. Various service covers are present alongside the road.<br>A pedestrian crossing is located on Bridgford Road, to the south-east of the junction. Two utility boxes are located on the south-western verge, in line with the pedestrian crossing.<br>No evidence of contamination was encountered during the Phase 2 ground investigation. Limited testing on three samples along the highway (all from the roadside verges to the south-west of the A6097 / Bridgford Road) did not identify any significantly elevated concentrations of potential contaminants, such as lead or total petroleum hydrocarbons (TPH). The samples were collected at depths of between 0.20 m and 1.65 m bgl. |
| Agriculture | Agricultural fields are located within the study area, to the south and west of Bridgford Road and to the north-east of Kirk Hill. Small portions of the fields to the south and west of Bridgford Road (<1 ha) are also located within the assessment boundary (temporary works). The assessment boundary slightly encroaches the field to the north-east of Kirk Hill.<br>Farm buildings (Hill Farm) are located in the northern part of the study area, adjacent to Kirk Hill. |

| Identified Land Use | Description |
|---|---|
| Residential | Terraced houses are located adjacent to the assessment boundary, on Kirk Hill.<br>A house and garden are located at the edge of the study area, to the north-east of the site.<br>The village of East Bridgford is located immediately north-east of the study area. |
| Public open space (POS) | Small woodland areas are located in the north-western part of the study area, to the south-west and north-east of Bridgford Road.<br>A bridleway and public footpaths also cross the site area at the existing junction. |
| Water reclamation works | A water reclamation works is located approximately 300 m north-west of the assessment boundary and is downstream of the study area. |
| Mining and waste | An area of worked ground (possible pit) was located in the western area of the Scheme in the early 1900s. The northern part of the pit underlies the existing Bridgford Road. To the south-west of the road, the feature is shown on historical maps up until 2000. The Envirocheck report includes a record of potentially infilled ground (non-water) at this location.<br>No registered or historical landfill or waste transfer sites have been identified within 250 m of the assessment boundary. However, as noted above, there is evidence of a possible pit filled with unknown materials in the north-western area of the site. |
| Industrial | A council yard was located immediately north of the site, on a narrow strip of land between Bridgford Road and Kirk Hill, from circa. 1967. During a site walkover in December 2020, this site was identified as a former plumbing and heating engineers (now closed). Piles of rubble and building debris were observed within the yard, which could potentially include asbestos-containing materials (ACM). |
| Allotments | Allotment gardens are shown on historical mapping at the edge of the study area, to the north-east of the site until at least 1989. This land appears to have been redeveloped as a residential garden. |
| Designated Sites | The site lies within two nitrate vulnerable zones (NVZ), named as the River Trent from River Soar to Carlton-On-Trent NVZ and the Smite R NVZ.<br>The site lies within an area of adopted greenbelt under Rushcliffe Borough Council, Development Service. |

9.5.22 The baseline information in Table 9-8 identifies the following potential sources of contamination at the site:

- made ground and infilled ground (possible pit) on-site;
- hardstanding materials containing coal tar and other potential contaminants;
- spills and leaks of fuels / oils from vehicles utilising the roads on-site;
- water reclamation works to the north-west;
- disused council depot (e.g. potential asbestos rubble);
- pollution incidents within the study area; and
- agricultural land uses (e.g. fertilisers, pesticides, herbicides, leaks and spills).

9.5.23 Based on the Scheme design (see Chapter 2: The Scheme) and baseline information in Table 9-8, the following potential human health receptors have been identified at the site:

- current and future users of the site and surrounding roads;
- current and future residents in the surrounding area;

- current and future consumers of agricultural products (e.g. crops, meat products); and
- potential current and future visitors to the areas of POS (e.g. woodland).

### Soil Resources and Agricultural Land Classification

9.5.24 The baseline conditions related to agricultural land classification (ALC) and soil resources are summarised in Table 9-9.

Table 9-9 Soil Resources and ALC

| Resource | Description |
|---|---|
| Soil Types | The soils within the study area are described as slightly acid loamy and clayey soils with impeded drainage. These soils have moderate to high fertility and low carbon content. Water resources are vulnerable to pollution run-off and rapid through-flow to streams as farmed land is drained. Surface capping can trigger erosion of the sediment. |
| Agricultural soils | The site boundary includes approximately 1.06 ha of agricultural land, comprising a larger area to the west of the existing road junction and small areas to the north-east and south-east of the existing junction. The land is largely required for the temporary works during construction (0.77 ha). A total of 0.29 ha will be required for the permanent works, including areas of proposed woodland (0.06 ha).<br>The initial findings of the ALC survey carried out at the site indicate that the agricultural land at the site predominantly comprises fine loamy soils over slowly permeable reddish clay that gives land of subgrade 3b agricultural quality. Soils of subgrade 3a and grade 2 have been identified in the eastern area, where soils are permeable to depth (1.2 m bgl).<br>The baseline information indicates that the site locally includes areas of BMV agricultural land. |

9.5.25 Based on the desk study information and initial survey findings, the environmental sensitivity of the soil resources is assessed to be high.

### Future Baseline

9.5.26 The future baseline is expected to be very similar to the existing conditions as there will be limited changes in land use.

## 9.6 Design, Mitigation and Enhancement Measures

9.6.1 The geology and soils assessment is based on the absence of any specific / additional mitigation measures for geology and soils effects. However, general design, mitigation and enhancement measures, outlined in Chapter 2 – The Scheme, are included within the assessment. The relevant mitigation measures for geology and soils are summarised in Table 9-10.

Table 9-10 Mitigation Measures

| Receptor | Mitigation | Design / Implementation |
|---|---|---|
| Geology | None required. | N/A |
| Soil resources | Mitigation measures will include the following:<br>Prior to commencing construction works, agricultural topsoil and / or subsoil from areas of | The mitigation measures will be determined within a soil resources plan. The plan will be based on the findings of the soil resources and |

| Receptor | Mitigation | Design / Implementation |
|---|---|---|
| | permanent loss will be stripped and stockpiled separately. A soil resources plan will be developed to identify re-use options for the material, where possible.<br>Construction traffic will use designated traffic routes within the work sites to prevent unnecessary compaction and degradation of soil resources.<br>Soil stockpiles will be not be stored close to potentially contaminative materials (e.g. fuel storage containers) and will not be mixed with construction waste or potentially contaminated materials. | agricultural land quality survey and will be implemented by the appointed contractor.<br>An earthworks strategy (or equivalent document) will be produced by the designer. This will be implemented by the contractor.<br>A SWMP will be required for the Scheme. As part of the SWMP, a Materials Management Plan (MMP) will be prepared, to reduce the volume of material requiring waste disposal, including re-usable soil resources.<br>The works will be carried out in accordance with the Defra "Code of Practice for the Sustainable Use of Soils on Construction Sites" (2009), BS 3882:2015 "Specification for Topsoil and Requirements for Use" (BSI, 2015), BS 8601:2013 "Specification for Subsoil and Requirements for Use" (BSI, 2013) and the CL:AIRE guidance "The Definition of Waste: Development Industry Code of Practice" (CL:AIRE, 2011). |
| Human health | Mitigation measures will include the following:<br>Identification and assessment of unexpected areas of contamination.<br>Removal of contamination hotspots, if identified.<br>Dust control measures, to mitigate inhalation risks (e.g. damping down).<br>Excavated materials will be stockpiled separately based on soil type, to prevent mixing of contaminated materials with uncontaminated materials.<br>Spill control measures will be used, such as dedicated areas for fuel storage and refuelling, bunded tanks, impermeable bases / trays.<br>Emergency spill response procedures and reporting will be in place throughout the construction phase of the project. | Prior to commencing construction works on site, the SWMP and SWMP / MMP will be prepared by the appointed contractor. This will be implemented by the contractor on-site.<br>A contamination watching brief will be prepared and implemented by the contractor. This will identify the procedures required to ensure that any potential contamination encountered is identified, assessed and, if necessary, remediated. |
| Controlled waters | Mitigation measures will include the following:<br>Spill control measures will be used, such as dedicated areas for fuel storage and refuelling, bunded tanks, impermeable bases / trays.<br>Emergency spill response procedures and reporting will be in place throughout the construction phase of the project.<br>The adjacent watercourse will be protected from surface water runoff related to the construction works. This could require, for example, dedicated areas to store hazardous materials | Prior to commencing construction works on site, a CEMP will be prepared by the appointed contractor. This will be implemented by the contractor on-site.<br>A drainage strategy will be prepared to inform the Scheme design. This will consider the potential risks to controlled waters associated with the proposed surface water drainage and identify any additional mitigation |

| Receptor | Mitigation | Design / Implementation |
|---|---|---|
| | further away from the watercourse and barriers to prevent uncontrolled runoff. | measures required to protect controlled waters.<br>The drainage will be designed to have a neutral to beneficial effect compared with the existing baseline conditions. |

## 9.7 Assessment of Likely Significant Effects

### Construction

9.7.1 The possible geology and soils effects identified for the Scheme are described in Table 9-11.

Table 9-11 Geology and Soils Effects – Construction

| Receptor Type | Type of Effect | Description |
|---|---|---|
| Geology | Adverse | Potential temporary impacts on access to Gunthorpe Weir LGS during construction. However, as no daytime road closures are expected, there is not expected to be any measurable change in access to the LGS. |
| Soils | Adverse | Permanent loss of approximately 0.29 ha agricultural land, in total. |
| | | Temporary loss of approximately 0.77 ha of agricultural land during construction. |
| | | Potential reduced soil quality (e.g. ALC) in areas of agricultural land used during the temporary works. |
| Contamination<br>- human health<br>- controlled waters | Adverse | The construction works could expose or disturb existing ground contamination at the site. This could create new pathways for contaminants to migrate to receptors through wind-blown dust, increased leaching of contaminants from soil into groundwater, surface water runoff and changes in the movement of groundwater and ground gas / vapours.<br>The following potential sources of contamination have been identified:<br>Made ground and infilled ground on-site.<br>Hardstanding materials containing coal tar and other potential contaminants.<br>Spills and leaks of fuels / oils from vehicles utilising the roads on-site.<br>Sewage / other discharges from the water reclamation works to the north-west.<br>Agricultural runoff (e.g. nitrate).<br>Migration of contaminants from the adjacent disused council depot (e.g. asbestos).<br>Previous pollution incidents within the study area. |
| | | Land or groundwater contamination could occur during the construction works, for example through leaks and spills of hazardous substances within the construction compound, access routes and work sites. This could potentially lead to short-term pollution incidents during the construction phase, and / or long-term detrimental impacts on the land and water quality of the study area, including the Scheme and restored areas of agricultural land. |

| Receptor Type | Type of Effect | Description |
|---|---|---|
| | | There could be slightly increased risks of contamination if road planings generated from breaking out the existing road surface are re-used within the Scheme. This is due to the potential presence of coal tar in older types of bituminous hardstanding. Road planings would have a much higher surface area exposed to the environment, compared with the intact hardstanding. |
| | Beneficial | Potentially contaminated soils or materials might be removed as part of the ground works operation, for example due to unsuitable geotechnical properties. |
| | | Any imported materials used in the Scheme will be required to pass chemical compliance criteria and, as such, could be lower risk than existing fill materials. |
| | | Contamination risks are likely to be reduced compared with the existing baseline if old surfacing containing coal tar is removed from the site entirely. |

9.7.2 An assessment of the likely significance of the above effects during the construction of the Scheme is presented in Table 9-12. The magnitude of impact and significance are based on the possible effects in the absence of any specific mitigation measures for geology and soils effects.

Table 9-12 Significance of Geology and Soils Effects – Construction

| Geology and Soils Receptor | Description of Sources / Cause of Impact | Description of Impacts | Receptor Value (Sensitivity) | Magnitude of Impact | Significance of Effects | Significant Effect? (Yes / No) |
|---|---|---|---|---|---|---|
| Geology | Impacts on Gunthorpe Weir LGS due to loss of access during operation. | Potential for temporary reduced access to visitors during construction works. | Medium | No change | Neutral | No |
| Soils | Use of agricultural land for temporary compound, storage and access during construction of the Scheme. | Permanent damage to agricultural land during the construction works. | High | Minor (adverse) | Moderate adverse (due to potential unnecessary loss of soil resources) | Yes |
| | | Temporary loss of agricultural land, compared with the existing baseline (approximately 0.77 ha). | High | Negligible (adverse) | Slight adverse | No |
| | Use of agricultural land within the permanent works for the Scheme. | Permanent loss of approximately 0.29 ha of agricultural land, compared with the existing baseline. | High | Negligible (adverse) | Slight adverse | No |
| Contamination – human health | Soil and groundwater contamination related to historical sources and construction works (see Table 9-11). | Impacts on nearby residents from ingestion of contaminated particulates, dermal contact with soils and / or inhalation of contaminated dust / particles. | Very high | Negligible (adverse) | Slight (due to short duration and low potential for contamination). | No |
| | | Impacts on future consumers of agricultural produce (e.g. crops or meat products) due to contamination of agricultural land during construction (e.g. areas used for storage and compound). | Very high | Negligible (adverse) | Slight adverse (due to potential for permanent contamination impact from construction works). | No |
| | | Impacts on visitors to areas of POS from ingestion of contaminated particulates, dermal contact with | High | Negligible (adverse) | Slight adverse (due to short duration and low potential for contamination). | No |

| Geology and Soils Receptor | Description of Sources / Cause of Impact | Description of Impacts | Receptor Value (Sensitivity) | Magnitude of Impact | Significance of Effects | Significant Effect? (Yes / No) |
|---|---|---|---|---|---|---|
| | | soils and / or inhalation of contaminated dust / particles. | | | | |
| | | Impacts on road users from ingestion of contaminated particulates, dermal contact with soils and / or inhalation of contaminated dust / particles. | Low | Negligible (adverse) | Slight adverse | No |
| | | Impacts on nearby residents from inhalation of ground gas or vapours in indoor air that may have migrated from the site. | Very high | Negligible (adverse) | Slight adverse (due to short duration and low potential for ground gas) | No |
| Contamination – surface water | Soil and groundwater contamination related to historical sources and construction works (see Table 9-11). | Impacts on adjacent watercourse from surface water run-off and / or migration of contaminated groundwater. | Medium | Minor (adverse) | Slight adverse | No |
| | | Impacts on River Trent and tributaries to the north-west from surface water run-off and / or migration of contaminated groundwater. | Very High | Negligible (adverse) | Slight adverse (due to distance from site) | No |
| Contamination – groundwater | Soil and groundwater contamination related to historical sources and construction works (see Table 9-11). | Impacts on Secondary Aquifer (undifferentiated) from leaching of contaminated soils, surface water run-off and / or migration of contaminated groundwater. | Medium | Minor (adverse) | Slight adverse | No |
| | | Impacts on Secondary A Aquifers from leaching of contaminated soils, | Medium | Minor (adverse) | Slight adverse | No |

| Geology and Soils Receptor | Description of Sources / Cause of Impact | Description of Impacts | Receptor Value (Sensitivity) | Magnitude of Impact | Significance of Effects | Significant Effect? (Yes / No) |
|---|---|---|---|---|---|---|
| | | surface water run-off and / or migration of contaminated groundwater. | | | | |
| | | Impacts on Secondary B Aquifers from leaching of contaminated soils, surface water run-off and / or migration of contaminated groundwater. | Medium | Minor (adverse) | Slight adverse | No |

## Operation

9.7.3 The possible geology and soils effects identified for the Scheme are described in Table 9-13.

### Table 9-13 Geology and Soils Effects – Operation

| Receptor Type | Type of Effect | Description |
|---|---|---|
| Contamination<br>- human health<br>- controlled waters | Adverse | The operation of the Scheme could potentially result in increased pathways for existing ground contamination from the identified potential sources (see Section 8.5) to migrate to receptors. For example:<br>▪ increased infiltration of groundwater through areas of contaminated ground; and<br>▪ migration of ground gas or contaminated groundwater through new service conduits or buried structures. |
| | | Future contamination impacts from the road junction could be slightly higher than the current conditions (e.g. spills and leaks from vehicles on the road). This is due to the predicted increase in traffic and the increased risk of traffic collisions associated with the Scheme. |
| | Beneficial | Improvements in road surfacing, drainage and buried services could reduce the potential for contaminated surface water runoff to migrate to the receptors during operation. |
| | | Improvements in road surfacing, drainage and buried services could also reduce the potential infiltration of groundwater through areas of contaminated ground during operation. |

9.7.4 An assessment of the likely significance of the above effects during the operation of the Scheme is presented in Table 9-14. The magnitude of impact and significance are based on the possible effects in the absence of any specific mitigation measures for geology and soils effects.

Table 9-14 Significance of Geology and Soils Effects – Operation

| Geology and Soils Receptor | Description of Sources / Cause of Impact | Description of Impacts | Receptor Value (Sensitivity) | Magnitude of Impact (Degree of Change) | Significance of Effects | Significant Effect? (Yes / No) |
|---|---|---|---|---|---|---|
| Geology | None identified. | None identified. | Medium | No change | Neutral | No |
| Soils | None identified. | None identified. | High | No change | Neutral | No |
| Contamination – human health | Soil and groundwater contamination related to historical sources, construction works, and future uses of the site (see Table 9-13). | Impacts on future road users from ingestion of contaminated particulates, dermal contact with soils and / or inhalation of contaminated dust / particles during operation. | Low | No change | Neutral | No |
| | | Impacts on nearby residents from ingestion of contaminated particulates, dermal contact with soils and / or inhalation of contaminated dust / particles during operation. | Very high | No change | Neutral | No |
| | | Impacts on visitors to areas of POS from ingestion of contaminated particulates, dermal contact with soils and / or inhalation of contaminated dust / particles during operation. | High | No change | Neutral | No |
| | | Impacts on future consumers of agricultural produce (e.g. crops or meat products) due to contamination of agricultural land during operation. | Very high | Negligible (adverse) | Slight adverse | No |
| | | Impacts on future road users from inhalation of ground gas or vapours during operation. | Low | No change | Neutral | No |

| Geology and Soils Receptor | Description of Sources / Cause of Impact | Description of Impacts | Receptor Value (Sensitivity) | Magnitude of Impact (Degree of Change) | Significance of Effects | Significant Effect? (Yes / No) |
|---|---|---|---|---|---|---|
| | | Impacts on nearby residents from inhalation of ground gas or vapours migrating from the Scheme during operation. | Very high | Negligible (adverse) | Slight adverse | No |
| Contamination – surface water | Soil and groundwater contamination related to historical sources, construction works, and future uses of the site (see Table 9-14). | Impacts on adjacent watercourse from surface water run-off and / or migration of contaminated groundwater during operation. | Medium | Negligible (adverse) | Slight adverse (due to potential for increased runoff / infiltration) | No |
| | | Impacts on River Trent and tributaries to the north-west from surface water run-off and / or migration of contaminated groundwater during operation. | Very High | Negligible (adverse) | Slight adverse | No |
| Contamination – groundwater | Soil and groundwater contamination related to historical sources, construction works, and future uses of the site (see Table 9-14). | Impacts on Secondary Aquifer (undifferentiated) from leaching of contaminated soils, surface water run-off and / or migration of contaminated groundwater during operation. | Medium | Negligible (adverse) | Slight adverse (due to potential for increased runoff / infiltration) | No |
| | | Impacts on Secondary A Aquifers from leaching of contaminated soils, surface water run-off and / or migration of contaminated groundwater during operation. | Medium | Negligible (adverse) | Slight adverse (due to potential for increased runoff / infiltration) | No |
| | | Impacts on Secondary B Aquifers from leaching of contaminated soils, surface water run-off and / or migration of contaminated groundwater during operation. | Medium | Negligible (adverse) | Slight adverse (due to potential for increased runoff / infiltration) | No |

## 9.8 Additional Mitigation

9.8.1 Additional mitigation measures to address the likely significant geology and soils effects are presented in Table 9-15.

Table 9-15 Additional Mitigation Measures

| Receptor | Additional Mitigation | Design / Implementation |
|---|---|---|
| Geology | None required. | N/A |
| Soil resources | Prior to commencing construction works, agricultural topsoil and, if required, subsoil will be excavated from the temporary work areas and will be stockpiled for use in restoration of the land on completion of the temporary works. Topsoil and subsoil will not be mixed together. | The mitigation measures will be determined within the soil resources plan. |
| Human health | Additional mitigation may be required if significant contamination is identified that presents a risk to one or more receptors. | A Phase 2 geo-environmental ground investigation will be carried out at the site in advance of any development works. Environmental risk assessments will be carried out to identify any additional mitigation measures required prior to construction.<br>In the event that any unexpected contamination is identified, a remediation strategy will be prepared by a geo-environmental specialist. This will be implemented on site by the contractor, or a suitably qualified contaminated land consultant. |
| Controlled waters | Aquifer protection measures will be used if deeper excavations are required, subject to risk assessment. This could include, for example, measures to ensure that potentially contaminated materials are not smeared or mixed into the natural aquifers at depth and measures to prevent increased migration pathways forming between the ground surface and the underlying groundwater. | A Phase 2 geo-environmental ground investigation will be carried out at the site in advance of any development works. Environmental risk assessments will be carried out to identify any additional mitigation measures required prior to construction. |

## 9.9 Residual Effects

9.9.1 An assessment of the geology and soils effects following implementation of additional mitigation measures is presented in Table 9-16.

9.9.2 The assessment concludes that all geology and soils effects will be reduced to slight adverse or neutral following implementation of mitigation measures and will not be significant.

9.9.3 The cumulative effects associated with the permanent loss of agricultural land across the whole Project are discussed in Volume 1, Chapter 9.

Table 9-16: Residual Effects

| Description of Effect | Sensitivity of Receptor | Nature of Effect/ Geographic Scale | Magnitude of Impact | Initial Classification of Effect (with embedded mitigation) | Additional Mitigation | Residual Effect Significance |
|---|---|---|---|---|---|---|
| Potential for temporary reduced access to Gunthorpe LGS visitors during construction works. | Medium | Restricted access to LGS outside study area. | No change | Neutral | No additional mitigation required. | Neutral |
| Permanent damage to agricultural land during construction works. | High | Loss or damage to soil resources within the assessment boundary. | Minor (adverse) | Moderate adverse | See Table 9-15 for additional mitigation. | Slight adverse |
| Temporary loss of agricultural land, compared with the existing baseline, during construction works. | High | Loss of agricultural land within the site boundary. | Negligible (adverse) | Slight adverse | No mitigation proposed due to short duration. | Slight adverse |
| Permanent loss of approximately 0.29 ha of agricultural land, compared with the existing baseline. | High | Loss of agricultural land within the site boundary. | Negligible (adverse) | Slight adverse | No mitigation proposed due to no discernible loss. | Slight adverse |
| Construction impacts on nearby residents from ingestion of contaminated particulates, dermal contact with soils and / or inhalation of contaminated dust / particles during construction. | Very high | Contamination impacts on human health receptors within the study area. | Negligible (adverse) | Slight adverse | No additional mitigation required. | Slight adverse |
| Construction impacts on future consumers of agricultural produce (e.g. crops or meat products) due to contamination of agricultural land (e.g. areas used for storage and compounds). | Very high | Human health impacts from consumption of contaminated crops / meat. | Negligible (adverse) | Slight adverse | See Table 9-15 for additional mitigation. | Neutral |
| Construction impacts on visitors to areas of POS from ingestion of contaminated particulates, dermal contact with soils and / or inhalation of contaminated dust / particles. | High | Contamination impacts on human health receptors within the study area. | Negligible (adverse) | Slight adverse | See Table 9-15 for additional mitigation. | Neutral |

| Description of Effect | Sensitivity of Receptor | Nature of Effect/ Geographic Scale | Magnitude of Impact | Initial Classification of Effect (with embedded mitigation) | Additional Mitigation | Residual Effect Significance |
|---|---|---|---|---|---|---|
| Construction impacts on road users from ingestion of contaminated particulates, dermal contact with soils and / or inhalation of contaminated dust / particles. | Low | Contamination impacts on human health receptors within the study area. | Negligible (adverse) | Slight adverse | No additional mitigation required. | Slight adverse |
| Construction impacts on adjacent residents from inhalation of ground gas or vapours in indoor air that may have migrated from the site. | Very high | Contamination impacts on human health receptors within the study area. | Negligible (adverse) | Slight adverse | No additional mitigation required. | Slight adverse |
| Construction impacts on adjacent watercourse from surface water run-off and / or migration of contaminated groundwater. | Medium | Contamination impacts on surface water receptor within the study area. | Minor (adverse) | Slight adverse | See Table 9-15 for additional mitigation. | Neutral |
| Construction impacts on River Trent and tributaries to the north-west from surface water run-off and / or migration of contaminated groundwater. | Very High | Contamination impacts on surface water receptors within the study area. | Negligible (adverse) | Slight adverse | See Table 9-15 for additional mitigation. | Neutral |
| Construction impacts on Secondary Aquifer (undifferentiated) from leaching of contaminated soils, surface water run-off and / or migration of contaminated groundwater. | Medium | Contamination impacts on groundwater receptor within the study area. | Minor (adverse) | Slight adverse | See Table 9-15 for additional mitigation. | Neutral |
| Construction impacts on Secondary A Aquifers from leaching of contaminated soils, surface water run-off and / or migration of contaminated groundwater. | Medium | Contamination impacts on groundwater receptor within the study area. | Minor (adverse) | Slight adverse | See Table 9-15 for additional mitigation. | Neutral |
| Construction impacts on Secondary B Aquifers from leaching of contaminated soils, surface water run-off and / or migration of contaminated groundwater. | Medium | Contamination impacts on groundwater receptor within the study area. | Minor (adverse) | Slight adverse | See Table 9-15 for additional mitigation. | Neutral |

| Description of Effect | Sensitivity of Receptor | Nature of Effect/ Geographic Scale | Magnitude of Impact | Initial Classification of Effect (with embedded mitigation) | Additional Mitigation | Residual Effect Significance |
|---|---|---|---|---|---|---|
| Impacts on future consumers of agricultural produce (e.g. crops or meat products) due to contamination of agricultural land during operation. | Very high | Contamination impacts on human receptors outside the study area. | Negligible (adverse) | Slight adverse | See Table 9-15 for additional mitigation. | Neutral |
| Impacts on nearby residents from inhalation of ground gas or vapours migrating from the Scheme during operation. | Very high | Contamination impacts on human receptors outside the study area. | Negligible (adverse) | Slight adverse | See Table 9-15 for additional mitigation. | Neutral |
| Impacts on adjacent watercourse from surface water run-off and / or migration of contaminated groundwater during operation. | Medium | Contamination impacts on surface water receptor within the study area. | Negligible (adverse) | Slight adverse | See Table 9-15 for additional mitigation. | Neutral |
| Impacts on River Trent and tributaries to the north-west from surface water run-off and / or migration of contaminated groundwater during operation. | Medium | Contamination impacts on surface water receptor within the study area. | Negligible (adverse) | Slight adverse | See Table 9-15 for additional mitigation. | Neutral |
| Impacts on Secondary Aquifer (undifferentiated) from leaching of contaminated soils, surface water run-off and / or migration of contaminated groundwater during operation. | Medium | Contamination impacts on groundwater receptor within the study area. | Negligible (adverse) | Slight adverse | See Table 9-15 for additional mitigation. | Neutral |
| Impacts on Secondary A Aquifers from leaching of contaminated soils, surface water run-off and / or migration of contaminated groundwater during operation. | Medium | Contamination impacts on groundwater receptor within the study area. | Negligible (adverse) | Slight adverse | See Table 9-15 for additional mitigation. | Neutral |
| Impacts on Secondary B Aquifers from leaching of contaminated soils, surface water run-off and / or migration of contaminated groundwater during operation. | Medium | Contamination impacts on groundwater receptor within the study area. | Negligible (adverse) | Slight adverse | See Table 9-15 for additional mitigation. | Neutral |

# 10. NOISE AND VIBRATION

## 10.1 Introduction

10.1.1 This chapter considers the noise and vibration impacts of the construction and operation of the proposed Scheme by using the assessment methodology described in the DMRB LA 111 Noise and Vibration Version 2 (Highways England, 2020h).

10.1.2 This chapter should be read in conjunction with Figures 10-1 to 10-3 within Volume 2D.

## 10.2 Legislation and Policy

10.2.1 Information relating to relevant noise and vibration legislation and policy can be viewed in Volume 1, Chapter 10.

## 10.3 Consultation

10.3.1 During the consultation on the Scoping Report, the proposed methodologies were set out and the statutory consultees were invited to comment on the proposals.

10.3.2 No specific comments were received in relation to the noise assessment methodology within the formal Scoping Opinions or the consultee responses.

10.3.3 A comment was received from the NCC Ecologist regarding the potential noise impacts on sensitive ecological receptors. Figure 10-2 of Volume 2D, shows the noise contour changes across the study area and any impacts on ecological receptors is assessed in Chapter 8: Biodiversity, of this Environmental Statement.

## 10.4 Assessment Methodology

### General Approach

10.4.1 The noise and vibration assessment includes the following elements:

- quantitative/qualitative assessment of construction noise and vibration impacts; and
- quantitative assessment of operational traffic noise impacts.

10.4.2 Construction traffic noise was scoped out as traffic changes during construction are expected to be minimal, and use the Major Road Network, resulting in minimal increases in the proportion of Heavy Goods Vehicles (HGV) within the traffic flows. Where short-term diversions are required, these are expected to be diverted to the Strategic Road Network (SRN), which would be likely to result in minor changes to traffic flows on these roads during construction.

10.4.3 Operational impacts resulting from vibration are scoped out of further assessment in accordance with DMRB.

10.4.4 Key methodology documents of relevance to the noise and vibration assessment are as follows:

- DMRB LA 111 Noise and Vibration;
- Calculation of Road Traffic Noise (CRTN) (Department for Transport, 1988);

- BS 5228-1&2:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites (British Standards Institute, 2009); and
- BS 7385-2: 1993 Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from ground borne vibration (British Standards Institute, 1993).

10.4.5 DMRB LA 111 describes a standard methodology for the assessment of noise and vibration impacts during the construction and operational phases of road projects.

10.4.6 The CRTN is the standard method applied in the UK to assess noise from road traffic. The document defines calculation methods for assessing road traffic noise based on the following five parameters: traffic flows, percentage of heavy vehicles, the traffic speed, the gradient of the road, and the road surfaces.

10.4.7 BS 5228-1&2 gives recommendations for basic methods of noise and vibration control relating to construction and open sites where work activities/operations generate significant noise and vibration levels. These are the standards more typically used to assess noise and vibration arising from construction activities.

## Baseline Conditions

10.4.8 Baseline conditions in the vicinity of the Scheme are detailed in Section 10.5, which provides details of potentially sensitive receptors within the study area which have been determined from the OS address base dataset and OS mapping.

10.4.9 Sensitive receptors are illustrated in Figure 10-1 in Volume 2D. The vast majority of potentially sensitive receptors in the vicinity of the Scheme are residential properties. Non-residential potentially sensitive receptors can include educational buildings, medical buildings and facilities (such as places of worship).

10.4.10 The Institute of Acoustics (IOA) and the Association of Noise Consultants (ANC) published a document called “Joint Guidance on the Impact of COVID-19 on the Practicality and Reliability of Baseline Sound Level Surveying and the Provision of Sound & Noise Impact Assessments – Version 6 (Institute of Acoustics, 2021) of 12th January 2021 to help their members to adjust their baseline assessments in light of the COVID pandemic.

10.4.11 The COVID pandemic has resulted in variation in journey patterns compared to pre-COVID travel patterns. Therefore, traditional baseline noise measurements have not been used to validate the noise model due to potential unreliability and inaccuracy of the data.

10.4.12 Current guidance states that for transport schemes, there may still need to be some reliance on predicted sound levels to describe the baseline conditions, with a corresponding need to obtain flow/ activity data. There are now many sources of noise/transport data available, and these should be used, along with (where possible) previously made direct site measurements to describe baseline conditions. A link is provided to the most recent noise mapping carried out in England which includes the roads around Kirk Hill Junction. The noise modelling undertaken for this Scheme was compared and validated against the noise levels in the Defra strategic noise maps (Extrium, 2018), produced in accordance with the requirements of the Environmental Noise (England) Regulations 2006 (as amended) for the baseline year traffic data of 2018.

10.4.13 The 18-hour Average Annual Weekday Traffic ($AAWT_{18hr}$) flows for the baseline year of 2018 were used to create the baseline noise scenario (data provided from the traffic modelling as described in Chapter 4: Environmental Assessment Methodology) by using the CRTN method, and then compared with Defra’s strategic

noise maps at three different validation locations for the following road traffic noise indicators: $L_{den}$, $L_{night}$, and $LA_{eq,16hr}$. The results of the validation exercise are presented in Section 10.5

10.4.14 The future Do Minimum (without Scheme) conditions have been determined for the opening (2023) and future (2037) years, at all identified sensitive receptors based on predicted traffic noise levels in the absence of the Scheme. Details of the traffic noise prediction methodology for Do Something (with Scheme) scenarios are provided in the Operational section below.

10.4.15 A comparison has been made of the forecast Do Minimum Opening Year (DMOY) and Do Minimum Future Year (DMFY) to determine the change in the baseline condition. The DMOY vs DMFY will be modelled using traffic data factored to opening and future years.

## Study Area

10.4.16 The study area for the construction phase noise and vibration impacts focuses on quantifying the potential impacts at the closest existing identified sensitive receptors to the various works, with some additional receptors selected to represent the impacts further away from the works. The selected receptors are collectively representative of all identified potentially sensitive receptors in the study area. By focussing on a selection of the closest identified potentially sensitive receptors the reported impacts at these receptors will, therefore, be typical of the worst affected receptors and all potentially significant effects will be identified. The receptors selected further away from the works will demonstrate how the impact will reduce further away from the works.

10.4.17 As detailed in DMRB LA 111 noise impacts from construction activities are assessed up to a maximum distance of approximately 300 m from the works, and vibration impacts up to a maximum distance of approximately 100 m from the works, as this is normally sufficient to encompass Noise Sensitive Receptors (NSRs). A total of 14 NSRs were identified within the 300 m study area and three were identified within the 100 m study area.

10.4.18 For the operational phase, the study area comprises an area 600 m from the roads physically changed by the Scheme. A total of 209 NSRs were identified with the 600 m study area.

10.4.19 The baseline assessment will identify any Noise Important Areas (NIA) located within the study as shown in the Defra Strategic Noise maps.

10.4.20 The construction and operational study areas and location of the NSRs are illustrated in Figure 10-1 of Volume 2D.

## Methodology for Determining Construction Effects

### Construction Noise

10.4.21 BS 5228-1 gives recommendations for basic methods of noise control relating to construction and open sites where work activities/ operations have the potential generate significant noise levels.

10.4.22 BS 5228-1 is the standard typically used to assess noise arising from construction activities. The methodology for predicting noise arising from construction activities described in BS 5228-1 has been used to predict noise levels arising from the proposed works at the nearest sensitive receptors.

10.4.23 Precise information on the construction works is not available at this stage and will be confirmed during the detailed design stage. Therefore, the estimated

construction noise levels reported herein are based on a range of typical construction activities utilising the number and type of plant likely to be required for each construction activity. Noise levels have then been predicted for each activity for a range of distances from the works boundary.

10.4.24 Annex C presented in BS 52228-1 provides the sound level data from a range of site equipment and activities. Values of the sound power levels for a particular type and size of machine and the equivalent continuous sound pressure levels for the site activities given in Tables C.1 to C.12 of BS 5228-1 has been used in the prediction of the activity noise levels.

10.4.25 Noise levels generated by construction activities are deemed to be significant if the total noise (pre-construction ambient plus construction noise) exceeds the pre-construction ambient noise by 5 dB or more, subject to lower cut-off values of 65 dB, 55 dB and 45 dB $LA_{eq}$, from construction noise alone, for the daytime, evening and night-time periods, respectively.

10.4.26 DMRB adopts the ABC method in BS 5228-1 for identifying the threshold of potentially significant construction noise effects. This approach is based on setting the threshold for the onset of potentially significant adverse effects (i.e. the significant observation adverse effect level (SOAEL)) depending on the existing ambient noise level. The lowest observed adverse effect level (LOAEL) is the existing ambient noise level. Table 10-1 below is adopted from Table E.1 in BS5228-1, which sets out the construction noise SOAEL and LOAEL proposed for this assessment.

Table 10-1 Example threshold of SOAEL and LOAEL at dwellings

| Time of Day | SOAEL $LA_{eq,T}$ (dB) Façade | | | LOAEL $LA_{eq,T}$ (dB) Façade |
|---|---|---|---|---|
| | Category A[1] | Category B[2] | Category C[3] | |
| Daytime<br>(07:00 – 19:00) and Saturdays (07:00 – 13:00) | 65 | 70 | 75 | Existing ambient noise level |
| Evenings<br>(19:00 – 23:00 weekdays)<br>(13:00 – 23:00 Saturdays)<br>(07:00 – 23:00 Sundays) | 55 | 60 | 65 | Existing ambient noise level |
| Night-time<br>(23:00 – 07:00) | 45 | 50 | 55 | Existing ambient noise level |

[1]**Category A:** threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.

[2]**Category B:** threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as the category A values.

[3]**Category C:** threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than the category A values.

**NOTE:** if the ambient noise level exceeds the Category C threshold values then the SOAEL and LOAEL are defined as equal to the existing ambient.

10.4.27 To determine the SOAEL and LOAEL, ambient noise levels at the relevant façade of each of the selected receptors have been predicted based on the 2018 Baseline traffic data.

### Construction Vibration

10.4.28 Construction generated vibration has been assessed in accordance with guidance in BS 5228-2. The main construction activities that can result in significant levels of vibration are percussive piling, earth compaction works, or other works requiring the use of a vibratory roller. Vibration levels have been estimated in accordance with the relevant methodologies in BS 5228-2. Table 10-2 details Peak Particle Velocity (PPV) vibration levels and provides a semantic scale for the description of construction vibration effects on human receptors, based on guidance contained in BS 5228-2.

Table 10-2 Construction vibration criteria for human receptors (annoyance).

| PPV (in $mms^{-1}$) | Description |
|---|---|
| 10 $mms^{-1}$ | Vibration is likely to be intolerable for any more than a very brief exposure to this level. |
| 1.0 $mms^{-1}$ | 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. |
| 0.3 $mms^{-1}$ | Vibration might be just perceptible in residential environments. |
| 0.14 $mms^{-1}$ | Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration. |

10.4.29 In addition to human annoyance, building structures may be damaged by high levels of vibration. The levels of vibration that may cause building damage are far in excess of those that may cause annoyance. Consequently, if vibration levels within buildings are controlled to those relating to annoyance (i.e. 1.0 $mms^{-1}$), then it is highly unlikely that buildings would be damaged by construction vibration.

### Construction Significance of Effect

10.4.30 The magnitude of the impact (from construction noise and vibration levels) is considered on a scale from negligible to major, as detailed in Table 10-3, adopted from DMRB LA 111.

Table 10-3 Magnitude of the impacts from construction noise and vibration

| Magnitude of the Impact | Construction noise level | Construction vibration level |
|---|---|---|
| Major | Above or equal to the SOAEL + 5 dB | Above or equal to 10 $mms^{-1}$ PPV |
| Moderate | Above or equal to the SOAEL and below +5 dB | Above or equal to the SOAEL (1.0 $mms^{-1}$) and below 10 $mms^{-1}$ PPV |
| Minor | Above or equal to the LOAEL and below the SOAEL | Above or equal to the LOAEL (0.3 $mms^{-1}$) and below the SOAEL (1.0 $mms^{-1}$) |
| Negligible | Below LOAEL | Below LOAEL (0.3 $mms^{-1}$) |

10.4.31 DMRB states that construction noise, or construction vibration shall constitute a significant effect where a major or moderate magnitude of impact would occur for a duration of:

- 10 or more working days (or evenings/weekends or nights) in any 15 consecutive days; or
- more than 40 days (or evenings/weekends or nights) in any 6 consecutive months.

## Methodology for Determining Operational Effects

10.4.32 Noise from road traffic is generated by the vehicle engines and the interaction of tyres with the road surface. The traffic noise level at a receptor, such as an observer at the roadside or residents within a property, is influenced by a number of factors including traffic flow, speed, composition (percentage of HGV), road gradient, the type of road surface, the distance from the road and the presence of any obstructions between the road and the receptor.

10.4.33 The index adopted by the UK Government in CRTN to assess traffic noise is $LA_{10,18h}$. This value is determined by taking the highest 10% of noise readings in each of the 18 one-hour periods between 06:00 and 00:00, and then calculating the arithmetic mean.

10.4.34 CRTN provides the standard methodology for predicting the $LA_{10,18h}$ road traffic noise level. Noise levels are predicted at a point measured 1 m horizontally from the external façade of buildings. DMRB LA 111 also request the use of the indicator $L_{night}$.

10.4.35 The prediction of the $LA_{10,18hr}$ and $L_{night}$ at the noise sensitive-receptors locations will be assessed by using the noise modelling software NoiseMap® Five (Noisemap LTD, 2008), through the creation of digital terrain models (DTM) of the different scenarios for the study area.

10.4.36 The following traffic scenarios have been modelled and assessed:

- Do Minimum (without the Scheme) in the opening year (DMOY);
- Do Something (with the Scheme) in the opening year (DSOY);
- Do Minimum in the future assessment year (DMFY); and
- Do Something in the future assessment year (DSFY).

10.4.37 The SOAEL and the LOAEL for road traffic noise used in this assessment are detailed in Table 10-4, as defined in DMRB LA 111.

Table 10-4 Noise SOAEL and LOAEL for all receptors

| Time of Day | SOAEL | LOAEL |
|---|---|---|
| 06:00 – 00:00 | 68 dB $LA_{10,18h}$ (façade) | 55 dB $LA_{10,18h}$ (façade) |
| 23:00 – 07:00 | 55 dB $L_{night,outside}$ (free-field) | 40 dB $L_{night,outside}$ (free-field) |

10.4.38 The operational road traffic noise SOAELs and LOAELs have been applied successfully for numerous road schemes in recent years, including schemes which have successfully been determined through the Planning Act 2008 procedures.

10.4.39 No special circumstances have been identified for the Scheme which suggest an alternative SOAEL or LOAEL should be adopted.

### Operational Significance of Effect

10.4.40 An initial identification of significant effects (in terms of EIA) is carried out based on the magnitude of change in traffic noise levels due to the Scheme. DMRB provides two classifications for the magnitude of the traffic noise impact of a proposed road scheme, as shown in Table 10-5. These relate to both short-term changes and long-term changes in traffic noise levels. The short-term classification detailed in Table 10-5 is the main driver of the initial identification of significant effects.

Table 10-5 Magnitude of Change in traffic noise (short and long-term).

| **Short-Term Change** | | **Long-term Change** | |
|---|---|---|---|
| Noise level change (rounded to 0.1 dB) $LA_{10,18h}$ dB | Magnitude of the Impact | Noise level change (rounded to 0.1 dB) $LA_{10,18h}$ dB | Magnitude of the Impact |
| 0 | No change | 0 | No change |
| Less than 1.0 | Negligible | Less than 3.0 | Negligible |
| 1.0 – 2.9 | Minor | 3.0 – 4.9 | Minor |
| 3.0 – 4.9 | Moderate | 5.0 – 9.9 | Moderate |
| 5.0+ | Major | 10.0+ | Major |

10.4.41 As proposed in DMRB LA 111, an initial identification of significant environmental impact assessment effects has been carried out based on the magnitude of change in traffic noise levels due to the Scheme in the short-term in the opening year as shown in Table 10-6.

Table 10-6 Initial assessment of operational noise significance

| **Significance** | **Short-term magnitude of change** |
|---|---|
| Significant | Major |
| Significant | Moderate |
| Not Significant | Minor |
| Not Significant | Negligible |

10.4.42 Negligible changes in the short-term would not cause changes to behaviour or response to noise, and as such, would not give rise to significant effects. For minor, moderate, and major changes DMRB LA 111 outlines a range of additional factors which will be considered in identifying significant effects.

- Where the magnitude of change in the short-term lies relative to the boundaries between the bands outlined in Table 10-5. In some circumstances a change

within 1 dB of the top of the minor range may be appropriate to be considered a likely significant effect. Conversely a change within 1 dB of the bottom of the moderate range, may in some circumstances be more appropriate to be considered as not likely to be a significant effect.

- The magnitude of change in the long-term is different to that in the short-term: If the short-term change is minor (not significant), but the long-term change is moderate (significant) it may be more appropriate to be considered as a likely significant effect. Conversely, a smaller magnitude of change in the long-term compared to the short-term may indicate that it is more appropriate to be considered as not likely to be a significant effect.
- The absolute noise levels relative to the SOAEL. If the Do Something traffic noise levels are high i.e. above the SOAEL, a traffic noise change in the short-term opening year of 1.0 dB or more may be more appropriate to be considered as a likely significant effect.
- The location of noise sensitive parts of a receptor: A receptor may contain areas which are more or less sensitive than others e.g. office spaces or kitchens in a school would be considered less sensitive than classrooms.
- The acoustic context, if the Scheme changes the acoustic character of an area: If a scheme introduces road noise into an area where road noise is not currently a major source, it may be appropriate to conclude a minor short-term change is a likely significant effect.
- The likely perception of a traffic noise change: If the Scheme results in obvious changes to the landscape or setting of a receptor it is likely the traffic noise level changes would be more acutely perceived, and it may be more appropriate to conclude a minor short-term change is a likely significant effect. Conversely if the Scheme is not visible it can be more appropriate to conclude a moderate change is not a likely significant.

10.4.43 With regard to significant policy effects, the traffic noise SOAEL and LOAEL has been used to consider how the Scheme complies with the policy aims detailed in the NPPF, within the context of government policy on sustainable development, namely to:

- avoid noise from giving rise to significant adverse effects on health and quality of life resulting from noise from new development i.e. reduce traffic noise levels at receptors to below the SOAEL; and
- mitigate and reduce to a minimum, other adverse effects on health and quality of life resulting from noise from new development i.e. reduce traffic noise levels at receptors which are between the LOAEL and the SOAEL.

### Noise Insulation Regulations

10.4.44 A preliminary indication of any properties likely to qualify under the Noise Insulation Regulations is provided in the assessment. A full assessment would be completed once the detailed design of the Scheme is finalised and in accordance with the timescales set out in the Regulations.

### Assumptions and Limitations

10.4.45 The following assumptions or limitations are relevant to this noise and vibration impact assessment:

- The main limitation is the reliance on the Defra noise maps (Extrium, 2018) to undertake validation of the noise model as it has not been possible to undertake

reliable site-based noise measurements due to the ongoing effects of the COVID-19 pandemic on journey patterns. The validation has been undertaken in accordance the Joint Guidance on the Impact of COVID-19 on the Practicality and Reliability of Baseline Sound Level Surveying and the Provision of Sound & Noise Impact Assessments provided by the IOA and ANC as described earlier in this section.

- Ordnance Survey (OS) Address Base Plus data detailing building usage and OS Building Height Attribute data have been used as provided in 2020. However, the heights of residential buildings have been standardised as a 6 m height. All the noise models developed were created by assuming a calculation height of 4 m.
- The construction assessment is based on the construction information that is currently available as described in Chapter 2: The Scheme and noted herein. As with all construction assessments, the exact details of the construction activities would not be fully understood before the detailed design stage of a scheme when the exact construction methods and programme will be determined. Whilst the precise details may be subject to change, the overall picture of significant construction effects is unlikely to be materially worse, and therefore the conclusions of the assessment would not be affected. Given the robust approach adopted in the ES the number of significant effects may well be less than those reported in the ES.

## 10.5 Baseline Conditions

10.5.1 Three sensitive receptors were identified in close proximity (within less than 100 m) to the proposed Scheme located to the north on Kirk Hill. Further sensitive receptors are concentrated to the north-east of the junction on the edge of East Bridgford village, within the 600 m study area.

10.5.2 The existing noise climate at the nearest properties is dominated by traffic noise, with those located further east on the edge of East Bridgford village dominated by distant road traffic, wildlife/ livestock and occasional noise associated with agricultural activities. In total 209 NSRs have been identified within the study area including three other non-residential NSRs – St Peter's CE Primary School, East Bridgford Village Hall, and St Peter’s Church. Therefore, there are a designated conservation area and within the Scheme study area: East Bridgford Conservation Area. Heritage assets within the study area are considered in Chapter 6: Cultural Heritage.

10.5.3 No NIAs were identified through the Extrium, England Noise and Air Quality Viewer (Extrium, 2018) within 600 m of the Kirk Hill Junction Scheme.

10.5.4 The validation point locations and comparison with the Strategic Noise Maps (Extrium, 2018) are described in Table 10-7.

Table 10-7: Baseline Assessment (Comparison between Defra data and the Scheme noise model developed).

| Validation Point Location | $LA_{eq,16hr}$ (dB(A)) | | $L_{den}$ (dB(A)) | | $L_{night}$ (dB(A)) | |
|---|---|---|---|---|---|---|
| | Defra Noise Levels Range | Noise Level from the Baseline Model | Defra Noise Levels Range | Noise Level from the Baseline Model | Defra Noise Levels Range | Noise Level from the Baseline Model |
| 12 Kirk Hill, NG13 8PE | 65 - 69.9 | 65.0 | 65 - 69.9 | 66.5 | 60 - 64.9 | 57.0 |
| 14 Kirk Hill, NG13 8PE | 65 - 69.9 | 64.1 | 65 - 69.9 | 65.6 | 60 - 64.9 | 56.1 |

10.5.5 The results obtained from the Scheme developed noise model for Kirk Hill show noise levels at the validation points are either inside or within 1dB of the Defra Noise Level range for $L_{Aeq,16hr}$ and $L_{den}$.

10.5.6 For night-time noise ($L_{night}$) there is greater variation with the Scheme developed model producing a baseline noise level of 3-4 dB below the Defra noise level range. It is not uncommon for greater variation to occur during the night-time due to lower traffic flows and variation occurring over the period. As such, given the modelled baseline in this assessment is lower and would only lead to an over-estimation rather than an under-estimation of the impact, it is deemed that this would present a worst-case scenario.

10.5.7 The correlation with the other parameters which includes the daytime traffic noise, provides assurance that the Scheme developed noise model is representative and valid for use in this assessment.

10.5.8 A comparison of the baseline traffic noise level changes without the Scheme for the opening and forecast years has been made in the Table 10-8.

Table 10-8: Long-term change in predicted Do Minimum traffic noise levels (DM 2023 to DM 2037)

**Scenario/Comparison: DMOY VS DMFY (No-Change)**

| Change in Noise Level, dB(A) | | Magnitude of Impact | Number of dwellings ($LA_{10,18hr}$) | Number of other Sensitive Receptors ($LA_{10,18hr}$) | Number of dwellings ($L_{night}$) | Number of other Sensitive Receptors ($L_{night}$) |
|---|---|---|---|---|---|---|
| Increase in noise level dB $LA_{10,18hr}/L_{night}$ (adverse) | 0.1 - 2.9 | Negligible | 206 | 3 | 206 | 3 |
| | 3.0 - 4.9 | Minor | 0 | | 0 | |
| | 5 - 9.9 | Moderate | 0 | | 0 | |
| | > 10 | Major | 0 | | 0 | |
| No Change | 0 | No Change | 0 | | 0 | |
| Decrease in noise level dB | 0.1 - 2.9 | Negligible | 0 | | 0 | |
| | 3.0 - 4.9 | Minor | 0 | | 0 | |
| | 5 - 9.9 | Moderate | 0 | | 0 | |

**Scenario/Comparison: DMOY VS DMFY (No-Change)**

| Change in Noise Level, dB(A) | Magnitude of Impact | Number of dwellings ($LA_{10,18hr}$) | Number of other Sensitive Receptors ($LA_{10,18hr}$) | Number of dwellings ($L_{night}$) | Number of other Sensitive Receptors ($L_{night}$) |
|---|---|---|---|---|---|
| $LA_{10,18hr}/L_{night}$ > 10 (beneficial) | Major | 0 | | 0 | |

10.5.9 The results demonstrate that at all NSRs a negligible adverse increase in noise levels will occur due to the general growth of traffic over time.

## 10.6 Design, Mitigation and Enhancement Measures

10.6.1 A reduction in the speed limit from de-restricted to 50 mph beyond the existing 40 mph terminal point around 930 m north-west of the Kirk Hill to the junction with the A46 around 1.1 km south-east of the Kirk Hill Junction. This will make the speed limit consistent with the rest of the A6097 and A614 corridors.

## 10.7 Assessment of Likely Significant Effects

### Construction

#### Construction Noise

10.7.1 At this stage, precise information on the construction works is not available. To provide an indication of the likely construction noise levels for various road construction activities, noise predictions were made at various distances from these activities based on a representative distance between construction activities and NSRs. Table 10-9 provides a summary of the predicted $LA_{eq,1hr}$ at various distances from the different typical road construction activities at all dwellings with a direct line of sight to the construction activities. Each activity consists of a range of typical construction plant associated with that particular activity and is assumed to be operating at the nearest works boundary.

Table 10-9: Summary of construction noise level predictions for different construction activities

| | Predicted construction noise levels at different distances ($LAeq_{,1hr}$ dB(A)) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Construction Activity | 10 m | 25 m | 50 m | 75 m | 100 m | 150 m | 200 m | 250 m | 300 m |
| Site Clearance | 83.0 | 75.1 | 67.5 | 63.1 | 60.0 | 55.6 | 52.5 | 50.1 | 48.1 |
| Earthworks | 82.8 | 74.9 | 67.3 | 62.9 | 59.8 | 55.4 | 52.3 | 49.9 | 47.9 |
| Drainage/Ducting | 80.1 | 72.2 | 64.6 | 60.2 | 57.1 | 52.7 | 49.6 | 47.2 | 45.2 |
| Road Formation/Surfacing | 83.5 | 75.6 | 68.0 | 63.6 | 60.5 | 56.1 | 53.0 | 50.6 | 48.6 |
| Signs and Lighting | 80.3 | 72.4 | 64.8 | 60.4 | 57.3 | 53.9 | 49.8 | 47.4 | 45.4 |
| Landscaping | 81.4 | 73.5 | 65.9 | 61.5 | 58.4 | 54.0 | 50.9 | 48.5 | 46.5 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Number of NSRs (based on the nearest works boundary) | 3 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 6 |

10.7.2 The predicted construction noise levels described above represent the likely worst-case scenario, and they are based on noise levels at representative distances across the study area. There are three NSRs within 10 m of the assessment boundary, with further three NSRs at approximately 50, 75, and 100 m with the remaining NSRs (8 in total) all located in excess of 200 m from the assessment boundary.

Table 10-10: Magnitude of noise Impact at the NSRs due to construction activities

| Noise Sensitive Receptor Address | Ambient noise levels (LOAEL) ($LA_{eq,16hr}$) | Ambient noise levels (rounded to nearest 5 dB) | BS 5228 threshold value (SOAEL) | Distance from works boundary | Predicted Max noise levels ranges ($LA_{eq,1hr}$) | Exceedance of BS 5228 threshold | Magnitude of the Impact |
|---|---|---|---|---|---|---|---|
| R1: 10 Kirk Hill, NG13 8PE, East Bridgford | 66.4 | 65 | 70 | Less than 10 m | 80.1 - 83.5 dB(A) | 10.1 - 13.5 dB(A) | Major |
| R2: 12 Kirk Hill, NG13 8PE, East Bridgford | 65.9 | 65 | 70 | Less than 10 m | 80.1 - 83.5 dB(A) | 10.1 - 13.5 dB(A) | Major |
| R3: 14 Kirk Hill, NG13 8PE, East Bridgford | 65.8 | 65 | 70 | Less than 10 m | 80.1 - 83.5 dB(A) | 10.1 - 13.5 dB(A) | Major |
| R4: 8A Kirk Hill, NG13 8PE, East Bridgford | 56.5 | 55 | 65 | 25 - 50 m | 64.6 - 75.6 dB(A) | 0.0 - 10.6 dB(A) | Minor to Major |
| R5: 8 Kirk Hill, NG13 8PE, East Bridgford | 51.2 | 50 | 65 | 50 - 75 m | 60.2 - 68.0 dB(A) | 0.0 - 3.0 | Minor to Moderate |
| R6: 11 Kirk Hill, NG13 8PE, East Bridgford | 55.3 | 55 | 65 | 75 - 100 m | 57.1 - 63.6 dB(A) | 0.0 | Minor |

10.7.3 Table 10-10 considers the six closest NSRs and indicates potential for a major impact from the construction noise activities at receptors R1, R2 and R3 on Kirk Hill nearest the A6097, due to the proximity of the NSRs to the nearest works boundary.

10.7.4 At distances between 50 m and 100 m where R4, R5, and R6 are located on Kirk Hill but further from the junction, the magnitude of noise impact is predicted to be minor to major adverse (Table 10-11) when plant is operating at the nearest works boundary.

10.7.5 DMRB states that construction noise, shall constitute a significant effect where a major or moderate magnitude of impact would occur for a duration of:

- 10 or more working days (or evenings/weekends or nights) in any 15 consecutive days; or
- more than 40 days (or evenings/weekends or nights) in any 6 consecutive months.

10.7.6 At this stage there is insufficient information on the construction activities and programme to discount the possibility that the timescales outlined would be exceeded. Therefore, it is conceivable that a significant adverse effect due to construction noise may occur at the five NSRs predicted to experience moderate or major impacts.

10.7.7 Given the calculated noise levels at all other NSRs located in excess of 200 m away being 53 dB ($L_{Aeq,1hr}$) or less, the resulting magnitude of impact would be negligible – minor for daytime and evening activities, with the potential for a moderate to major magnitude of impact to occur during any night-time working dependent on pre-existing ambient night-time noise levels. Therefore, there is potential for a significant adverse impact at other NSRs dependent on the duration of night-time working and precise location of the construction activities taking place.

10.7.8 Consideration will therefore need to be given to additional controls to mitigate noise as low as practicably possible through the employment of Best Practicable Means (BPM) techniques by the contractor. This is discussed further in Section 10.8

### Construction Vibration

10.7.9 The potential for temporary construction vibration impacts is dependent on the need for construction activities which are a potentially significant source of vibration, such as earthworks and road construction (pavement) works using vibratory rollers. No piling operations are anticipated to be required.

10.7.10 Vibration levels during works using vibratory rollers have been estimated in accordance with the procedures set out in BS 5228-2 Table E.1.

10.7.11 The effects of vibration can vary according to a number of factors including: the magnitude of the vibration source, the particular ground conditions between the source and receiver, the foundation-to-footing interaction and the large range of structures that exist in terms of design (e.g. dimensions, materials, type and quality of construction, and footing conditions). The intensity, duration, frequency, and number of occurrences of a vibration all play an important role in both the annoyance levels caused and the strains induced in structures.

10.7.12 The typical sources of ground vibration include hydraulic breakers and vibratory rollers during the road construction phases.

10.7.13 For human receptors the LOAEL for vibration annoyance is defined as a PPV of 0.3 $mms^{-1}$, this being the point at which construction vibration is likely to become perceptible. The SOAEL is defined as a PPV of 1.0 $mms^{-1}$, this being the level at which construction vibration can be tolerated with prior warning.

10.7.14 The estimated PPV due to the steady state operation of vibratory plant is estimated to exceed the SOAEL for vibration annoyance within approximately 50 m of works using a large (approximately 13 tonnes) roller, and approximately 20 m for the medium sized twin drum roller and medium sized towed roller (approximately 3.5 tonnes).

10.7.15 Three receptors are located within 20 m of works of the nearest works boundary where using a large vibratory roller and a medium sized towed roller has the potential to generate vibration levels in excess of SOAEL for periods during the works.

10.7.16 The magnitude of the potential vibration annoyance impact is considered moderate adverse at these receptors in accordance with the Magnitude of the Impacts for Construction Vibration in Table 10-3. Even when working at the closest works boundary, vibration levels are not expected to exceed to exceed the threshold for major adverse impact of 10 $mms^{-1}$

10.7.17 The remaining 11 receptors inside the construction vibration study area are located at distances of 50 m or greater from the main construction works and where only negligible to minor adverse effects are expected to occur.

10.7.18 With regards to structural damages, the PPV due to vibratory rollers would be well below the threshold for cosmetic damage of 15 $mm^{-1}$ according to Table B.2 of BS5228-2. The associated magnitude of the impacts is considered to be negligible to minor adverse.

## Operation

10.7.19 Detailed predictions have been carried out for a total of 209 receptors identified within the study area (which includes three other identified non-residential NSRs – St Peter's CE Primary School, East Bridgford Village Hall, and St Peter's Church).

10.7.20 The noise contours ($LA_{10,18hr}$ and $L_{night}$) for all the required scenarios (DMOY, DSOY, DMFY, and DSFY) were produced based on free-field traffic noise levels at first floor level (4.0 m above ground) using a 10 m x 10 m grid.

### Short-term

10.7.21 The assessment details the short-term and long-term impacts of the Scheme. For short-term impacts, a comparison is made between the DMOY and the DSOY (Table 10-11).

Table 10-11: Short-term traffic noise levels changes with the Scheme (DMOY VS DSOY).

**Scenario/Comparison: DMOY VS DSOY (Short-Term)**

| Change in Noise Level, dB(A) | | Magnitude of Impact | Number of dwellings ($LA_{10,18hr}$) | Number of other Sensitive Receptors ($LA_{10,18hr}$) | Number of dwellings ($L_{night}$) | Number of other Sensitive Receptors ($L_{night}$) |
|---|---|---|---|---|---|---|
| Increase in noise level dB $LA_{10,18hr}/L_{night}$ (adverse) | 0.1 - 0.9 | Negligible | 83 | 0 | 73 | 0 |
| | 1.0 - 2.9 | Minor | 0 | 0 | 0 | 0 |
| | 3.0 - 4.9 | Moderate | 0 | 0 | 0 | 0 |
| | > 5 | Major | 0 | 0 | 0 | 0 |
| No Change | 0 | No Change | 94 | 3 | 104 | 3 |
| Decrease in noise level dB $LA_{10,18hr}/L_{night}$ (beneficial) | 0.1 - 0.9 | Negligible | 29 | 0 | 29 | 0 |
| | 1.0 - 2.9 | Minor | 0 | 0 | 0 | 0 |
| | 3.0 - 4.9 | Moderate | 0 | 0 | 0 | 0 |
| | > 5 | Major | 0 | 0 | 0 | 0 |

10.7.22 During the daytime in the opening year of 2023, 13.9% of receptors within the 600 m study area are anticipated to experience a negligible beneficial impact (0.1 - 0.9 dB decrease) in traffic noise levels due to the Scheme. 39.7% are anticipated to

experience a negligible adverse impact (0.1 - 0.9 dB increase) in traffic noise levels. The remaining 46.4 % of receptors are anticipated to experience no change in traffic noise levels.

10.7.23 During the night-time, 13.9% of receptors within the 600 m calculation area are anticipated to experience a negligible beneficial impact (0.1 - 0.9 dB decrease) in traffic noise levels due to the Scheme. A further 34.9% are anticipated to experience a negligible adverse impact (0.1 - 0.9 dB increase) in traffic noise levels. The remaining 51.2% of receptors are anticipated to experience no change in traffic noise levels.

10.7.24 In the short-term, the overall trend is for either no change or a negligible adverse impact due to the introduction of the Scheme.

10.7.25 Noise contours illustrating the predicted short-term (DMOY to DSOY) noise level change within the 600 m study area are presented in Figure 10-2 of Volume 2D.

### Long-term

10.7.26 For long-term impacts as a result of the Scheme, a comparison is made between the DMOY and DSFY in Table 10-12.

Table 10-12: Long-term change in Do Minimum traffic noise levels (DM 2023 to DM 2037)

**Scenario/Comparison: DMOY VS DSFY (Long-Term)**

| Change in Noise Level, dB(A) | | Magnitude of Impact | Number of dwellings ($LA_{10,18hr}$) | Number of other Sensitive **Receptors ($LA_{10,18hr}$)** | Number of **dwellings ($L_{night}$)** | Number of other Sensitive **Receptors ($L_{night}$)** |
|---|---|---|---|---|---|---|
| Increase in noise level dB $LA_{10,18hr}/L_{night}$ (adverse) | 0.1 - 2.9 | Negligible | 206 | 3 | 206 | 3 |
| | 3.0 - 4.9 | Minor | 0 | | 0 | |
| | 5.0 - 9.9 | Moderate | 0 | | 0 | |
| | > 10 | Major | 0 | | 0 | |
| No Change | 0 | No Change | 0 | | 0 | |
| Decrease in noise level dB $LA_{10,18hr}/L_{night}$ (beneficial) | 0.1 - 2.9 | Negligible | 0 | | 0 | |
| | 3.0 - 4.9 | Minor | 0 | | 0 | |
| | 5.0 - 9.9 | Moderate | 0 | | 0 | |
| | > 10 | Major | 0 | | 0 | |

10.7.27 During the daytime and night-time in the DMOY vs DSFY, all receptors within the 600 m study area are anticipated to experience a negligible adverse impact (0.1 - 2.9 dB increase) in traffic noise levels.

10.7.28 It should be noted that the negligible adverse impacts in the long-term will be mainly attributable to traffic growth over this period as illustrated in Table 10.8 of the Baseline assessment.

10.7.29 As no receptors are expected to experience any adverse impact greater than a negligible adverse impact in both the short and long-term, it can be concluded that there will be no significant adverse effects during the daytime or night-time due to operational noise as a result of the implementation of the Scheme.

### Operational traffic noise – above SOAEL

10.7.30 Details of the number of residential receptors in the 600 m study area which are predicted to have one or more facades exposed to noise levels above the daytime or night-time SOAEL (68 dB(A) $LA_{10,18hr}$ or 55 dB(A) $L_{night}$) respectively in any of the four assessment scenarios are provided in Table 10-13.

Table 10-13: Number of residential buildings above the SOAEL

| Scenario | Day ($LA_{10,18hr}$) | Night ($L_{night}$) |
|---|---|---|
| DMOY | 3 | 3 |
| DSOY | 3 | 3 |
| DMFY | 3 | 3 |
| DSFY | 3 | 3 |

10.7.31 For daytime and night -time traffic noise levels, the Scheme would result in no change in receptors with one or more façades experiencing traffic noise levels above SOAEL (68dB $LA_{10,18hr}$) in the short and long-term.

10.7.32 The receptors experiencing SOAEL in all scenarios are R1, R2, and R3 (all located in close proximity of A6097). However, these three receptors will experience a negligible beneficial impact (less than 0.5 dB(A) decrease) for the day and night-time periods (in the short-term), and they will experience a negligible adverse impact (less than 0.5 dB(A) increase) for the day and night-time periods (in the long-term).

10.7.33 This demonstrates compliance with the NPPF which aims to ensure that development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment.

10.7.34 It is also demonstrated that the Scheme also complies with the aims of the Noise Policy Statement for England (NPSE) which introduced LOAEL and SOAEL and sets out the Government's policy on noise and long-term vision of sustainable development to achieve the following:

- avoid significant adverse impacts on health and quality of life;
- mitigate and minimise adverse impacts on health and quality of life; and
- where possible, contribute to the improvement of health and quality of life.

### Noise Insulation Regulations

10.7.35 An initial assessment indicates that there are no receptors which would be eligible for noise insulation, as the assessment indicates that the proposed Scheme would not generate a "Relevant Noise" which is at least 1 dB greater than the "Prevailing Noise Level" and exceeds the "Specified Noise Level" as defined in the Regulations.

## 10.8 Additional Mitigation

10.8.1 Full details of the proposed construction plant, timescales and hours of operation were not available at the time of the assessment; however, it is anticipated that the contractor will employ standard BPM controls to manage noise and vibration levels during the construction phase and such measures would be detailed in the CEMP. It is expected that measures would include but not be limited to:

- liaison with local receptors throughout the various phases of works and to notify them in advance of any particularly noisy activities;
- selection of quiet and low vibration equipment and methodologies;
- review of construction programme and methodology to consider low noise and low vibration methods (including non-vibratory compaction plant where required);
- optimal location of equipment on site to minimise noise disturbance;
- the provision of acoustic enclosures around static plant, where necessary;
- use of less intrusive alarms, such as broadband vehicle reversing warnings;
- no start-up or shut down of large vibratory rollers (approximately 13 tonnes) within 50 m of receptors and medium vibratory rollers (approximately 3.5 tonnes) within 20 m of receptors;
- undertake milling of pavement surfaces where possible which produces lower levels of non-damaging vibration compared to other breaking out methods; and
- where mechanical excavators and associated equipment is used to break up pavement surfaces ensure good practices are adopted and non-approved practices such as pounding large tarmac sections with excavator buckets and dropping from height to break into smaller pieces are prohibited on site.

10.8.2 There is also the potential for additional attenuation of noise from construction activities using localised temporary noise screening. This has not been included in the assessment of construction noise in order to represent a worst-case scenario. BS 5228 (Ref 11.16) advises that such screening can provide a reduction in noise levels of 5 dB when the top of the plant is just visible over the noise screening, and 10 dB when the plant is completely screened from a receptor. The effectiveness of a noise barrier depends upon its length, effective height, position relative to the noise source and to the receptors, and the material from which it is constructed. Therefore, the potential attenuation provided by any such additional localised screening cannot be quantified at this stage. Proposals for the use of localised temporary noise screening would be developed at the detailed design stage and implemented during the works.

10.8.3 In accordance with the aims of the NPSE and ProPG, the Scheme could avoid significant adverse impacts through the inclusion of a range of noise mitigation measures and coupled with effective operational management and control of noise, will minimise any adverse impact on health and quality of life for its neighbours.

## 10.9 Residual Effects

10.9.1 The residual effects taking into account further mitigation (where feasible) is outlined in Table 10-14. At this stage any noise/vibration reduction benefits of the measures outlined in Section 10.8 or the feasibility thereof, cannot be accurately quantified and so no change to the significance of effect has been accounted for at this stage to ensure that a ‘worst case scenario’ has been presented.

10.9.2 Given the robust approach adopted in the construction noise and vibration assessments in the ES, the number of significant effects may well be less than

those reported.

Table 10-14: Summary of Residual Effects

| Description of Effect | Sensitivity of Receptor | Nature of Effect/ Geographic Scale | Magnitude of Impact | Initial Classification of Effect (with embedded mitigation) | Additional Mitigation | Residual Effect Significance |
|---|---|---|---|---|---|---|
| Construction Noise | High | Temporary 5no. receptors (R1-R5) Kirk Hill, NG13 8PE | Up to Major | Significant Adverse | BPM & Temporary screening where feasible | Significant Adverse |
| Construction Vibration | High | Temporary 3no. receptors (R1-R3) Kirk Hill, NG13 8PE | Up to Major | Significant Adverse | BPM | Significant Adverse |
| Construction Noise | High | Temporary 9no. receptors | Negligible to Minor | Not Significant | - | Not Significant |
| Operational Traffic | High | Long-term Local across study area (209 NSRs) | Negligible Adverse to Negligible Beneficial | Not Significant | - | Not Significant |

# 11. CLIMATE

## 11.1 Introduction

11.1.1 This chapter of the Environmental Statement (ES) reports the findings of an assessment of the likely significant effects on climate as a result of the Scheme at Kirk Hill Junction. It also considers the impacts of climate change on the Scheme. The overall Project summary detailing the cumulative impacts of all the Schemes which compose the Project are detailed in Volume 1 Chapter 12: Climate.

11.1.2 To align with the requirements of the EIA Regulations and DMRB LA 114 Climate (Highways England, 2021), the following two separate aspects have been considered for the potential for likely significant effects:

- **Lifecycle greenhouse gas (GHG) impact assessment** – the effects on the climate of GHG emissions arising from the construction of the Scheme; and
- **Vulnerability of Scheme to climate change assessment** – the resilience of the Scheme to climate change, including how the Scheme design will be adapted to take account for the projected impacts of climate change.

11.1.3 The following lifecycle stages were scoped out of the GHG impact assessment:

- **Pre-construction stage:** as the Scheme consists of realignment of existing junctions, it is anticipated there will be limited enabling works or land clearance necessary, due to this land use change was also scoped out.
- **Operation stage**: it is anticipated the operation of associated road, signalling and maintenance (including resurfacing) will be similar to the baseline scenario. In addition, traffic count and traffic speed are expected to remain comparable.
- **Decommissioning**: it is anticipated the Scheme will be in use beyond the design life of the road infrastructure. Any future decommissioning would require a separate planning submission. Therefore, the decommissioning of the Scheme was also scoped out of the GHG assessment.

## 11.2 Legislation and Policy

11.2.1 Information relating to relevant climate legislation and policy can be viewed in Volume 1, Chapter 12: Climate.

## 11.3 Consultation

11.3.1 A summary of the climate related responses from the Scoping Opinion, which relate to the Scheme at Kirk Hill Junction, is included in Table 11-1.

Table 11-1: Comments raised in Scoping Opinion

| Stakeholder | Comment raised | Response and where addressed in the ES |
|---|---|---|
| Nottinghamshire County Council | As part of the GHG impact assessment consideration should be given to the impact of emissions arising from increased traffic growth and potential to ease congestion | As noted in the Transport Assessment (AECOM, 2021), the Scheme is designed to relieve congestion, and results in very limited re-routing of traffic or significant traffic growth. |
| | The need for accurate modelling of GHG emissions identified by | During operation it is anticipated that the operation of associated road, signalling and maintenance (including |

| Stakeholder | Comment raised | Response and where addressed in the ES |
|---|---|---|
| | Nottinghamshire Wildlife Trust should be noted. | resurfacing) will be similar to the baseline scenario. |
| Nottinghamshire Wildlife Trust | In the face of the climate emergency, it is essential that accurate modelling for changes in GHG emissions are undertaken in advance, and that NCC considers how they could be reduced through this scheme. | The nature of the assessment ensures that GHG emissions related to the Scheme are modelled as per the methodology in Section 12.4. |

## 11.4 Greenhouse Gas Assessment Methodology

11.4.1 The GHG emissions calculation methodology is based upon a lifecycle assessment. Lifecycle stages and the activities applicable to the Scheme are presented in Table 11-2 below. This approach is consistent with the principles set out in DMRB LA 114.

Table 11-2 Potential GHG emissions sources for the lifecycle GHG Impact Assessment of the Scheme

| Lifecycle stage | Activity | Primary Emission Sources |
|---|---|---|
| Product stage | Raw material extraction and manufacturing of products required to build the Scheme | Embodied GHG emissions |
| Construction process stage | On-site construction activity<br>Transport of construction materials (where these are not included in embodied GHG emissions)<br>Transport of construction workers<br>Disposal of any waste generated during the construction processes | GHG emissions from energy (electricity, fuel, etc.) consumption for plant and vehicles, generators on site.<br>Fuel consumption from transport of materials to site (where these are not included in embodied GHG emissions)<br>GHG emissions from fuel use for worker commuting<br>GHG emissions from disposal of waste and GHG emissions from fuel consumption of transportation of waste |

### Baseline Conditions

11.4.2 For the purposes of the GHG emissions impact assessment, the baseline conditions are defined as the ‘Do Minimum’ scenario where the Scheme does not go ahead. The baseline for the Scheme comprises of existing carbon stocks and sources of GHGs within the boundary of the existing site relating to construction of the Scheme.

11.4.3 The baseline for the Scheme does not include decommissioning or operational carbon emissions, therefore the baseline is effectively zero.

## Study Area

11.4.4 The identified receptor for GHG emissions is the global climate. As the effects of GHGs are not geographically constrained, “any GHG emissions might be considered significant” (IEMA, 2017) due to their combined environmental effect in the atmosphere. In order to assess the magnitude of impact of GHG emissions from Scheme, UK Carbon Budgets have been used as a proxy for the climate.

11.4.5 The methodology for calculating GHG emissions and removals is consistently used across the baseline, construction, and operations phases of the Scheme, and is as described next.

11.4.6 In line with British Standard ISO14064 (BSI, 2019a, 2019b), principles of the GHG Protocol (WRI & WBCSD, 2015) and Defra reporting guidance (Defra BEIS, 2020), the GHG emissions have been calculated by multiplying activity data by a relevant emission factor:

*Activity data x GHG emissions factor = GHG emissions value.*

11.4.7 Activity data is a quantifiable measure of activity, such as operating hours or volumes of fuels used. Emission factors convert the activity data into GHG volumes. Activity data has been sourced from information provided by Via. Where specific data is not available, a mix of assumptions and industry benchmarks have been used to fill data gaps. Where this is not possible, then a qualitative approach to assessing the GHG impacts has been followed, in line with the IEMA guidance (IEMA, 2017).

11.4.8 Emission factors have been sourced from publicly available sources, such as Defra (Defra BEIS, 2020), IPCC (IPCC, 2019), the Bath University ICE (University of Bath, 2019), and EcoInvent database (EcoInvent, 2021).

11.4.9 In line with the British Standard ISO14064 (BSI, 2019a, 2019b) and the principles of the GHG Protocol (WRI & WBCSD, 2015) when calculating GHG emissions, the seven Kyoto Protocol (UNFCCC, 1997) GHGs have been considered, specifically:

- carbon dioxide ($CO_2$);
- methane ($CH_4$);
- nitrous oxide ($N_2O$);
- sulphur hexafluoride ($SF_6$);
- hydrofluorocarbons (HFCs);
- perfluorocarbons (PFCs); and
- nitrogen trifluoride ($NF_3$).

11.4.10 These gases are broadly referred to in this report under an encompassing definition of ‘GHGs’, with the unit of $tCO_2e$ (tonnes $CO_2$ equivalent) or Mt $CO_2e$ (mega tonnes of $CO_2$ equivalent).

## Methodology for Determining Construction Effects

11.4.11 To determine the effects of the Scheme, the Do Minimum scenario is compared with a Do Something scenario where the Scheme is built. The Do Something scenario includes emissions associated with the construction of the Scheme.

11.4.12 Direct and indirect emissions sources from different lifecycle stages of the development are detailed in Table 11-2.

## Significance Criteria

### Sensitivity of Receptor

11.4.13 There is currently no published standard definition for receptor sensitivity of GHG emissions. All GHG emissions are classed as being capable of being significant on the basis that all emissions contribute to climate change. The global climate has been identified as the receptor for the purposes of the GHG assessment. The sensitivity of the climate to GHG emissions is considered to be 'High'. The rationale supporting this includes:

- GHG emission impacts could compromise the UK's ability to reduce its GHG emissions and therefore the ability to meet its future carbon budgets;
- The need to reduce GHG emissions to reduce the risks and impacts of climate change, as broadly identified by the climate science community and agreed under the Paris Agreement which aims to keep global temperature rise this century below two degrees above pre-industrial levels, (Paris Agreement UNFCCC, 2016). Additionally, a recent report by the IPCC highlighted the importance of limiting global warming below 1.5°C (IPCC, 2018); and
- A disruption to global climate is already having diverse and wide-ranging impacts to the environment, society, economic and natural resources. Known effects of climate change include increased frequency and duration of extreme weather events, temperature changes, rainfall and flooding, and sea level rise and ocean acidification. These effects are largely accepted to be negative, profound, global, likely, long-term to permanent, and are transboundary and cumulative from many global actions.

### Magnitude of Impact

11.4.14 In GHG accounting, it is considered good practice to contextualise emissions against pre-determined carbon budgets (Committee on Climate Change, 2020). In the absence of sector-based or local emissions budgets, the UK Carbon Budgets can be used to contextualise the level of significance and this approach has been adopted in the present case as a cogent and reasonable basis. DMRB LA 114 states that it is considered unlikely that a project in isolation will have a significant effect on climate.

11.4.15 Both the Department of Energy and Climate Change (Department of Energy and Climate Change, 2012) and the PAS 2050 Specification (BSI, 2011) allow emissions sources of <1% contribution to be excluded from emission inventories and these inventories to still be considered complete for verification purposes. This exclusion of emission sources that are <1% of a given emissions inventory is on the basis of a 'de minimis' (relatively minimal) contribution.

11.4.16 On this basis, where GHG emissions from the Scheme are equal to or more than 1% of the relevant annual UK Carbon Budgets, the impact of the proposed development on the climate is considered to be of high magnitude. This is summarised in Table 11-3. Impacts that are considered to be of a high magnitude are considered to result in major adverse significant effects on climate as noted in Table 11-4.

Table 11-3 Magnitude criteria for GHG emissions

| Magnitude | Magnitude Criteria Description |
|---|---|
| High | Estimated GHG emissions from the Scheme equate to equal to or more than 1% of total emissions across the relevant 5-year UK Carbon Budget period in which they arise |

| | |
|---|---|
| Low | Estimated GHG emissions from the Scheme equate to less than 1% of total emissions across the relevant 5-year UK Carbon Budget period in which they arise |

### Significance of Effect

Table 11-4 Significance of GHG Emissions

| Magnitude | Significance of Effect |
|---|---|
| High | Major adverse (significant) |
| Low | Minor adverse (not significant) |

11.4.17 GHG emissions have been assessed against the relevant UK carbon budgets to determine significance. Where a project stage extends over multiple carbon budget periods, the project's GHG emissions are considered against each carbon budget for each project stage. A project is only considered to have a significant effect where increases in GHG emissions will have a material impact on the ability of Government to meet its carbon reduction targets. Consideration will be given to how the Scheme will operate in line with the UK Government's target to achieve net zero emissions by 2050, since the current carbon budgets are based on the 80% reduction target up until 2032, the 5th carbon budget. The UK Carbon Budgets are detailed in Table 11-5.

Table 11-5 UK Carbon Budgets

| UK Carbon Budget Period | UK Carbon Budget ($MtCO_2e$) |
|---|---|
| 3rd (2018-2022) | 2,544 |
| 4th (2023-2027) | 1,950 |
| 5th (2028-2032) | 1,725 |
| 6th (2033-2037) | 965 |

## 11.5 Climate Change Vulnerability (CCV) Assessment Methodology

11.5.1 The CCV assessment has followed the method detailed in the DMRB LA 114. This was completed in liaison with the Scheme design team and the other EIA technical disciplines by considering the UKCP18 data (Met Office, 2020a) for the geographical location and timeframe of the Scheme (from construction through to operation).

11.5.2 The potential impacts for the CCV assessment are based upon the UKCP18 data. Climatic parameters to be taken into account include those identified in Table 11-6.

Table 11-6 Climatic parameters for the vulnerability assessment

| Climatic Parameter | Scoped in or out | Rationale for inclusion conclusion |
|---|---|---|
| Extreme weather events | In | The Scheme may be vulnerable to extreme weather events such as storm damage to structures and assets. |

| Climatic Parameter | Scoped in or out | Rationale for inclusion conclusion |
|---|---|---|
| Temperature | In | Increased temperatures may increase cooling requirements of the Scheme and could impact on structural integrity of roads and materials. |
| Sea level rise | Out | The Scheme is not located in an area that is susceptible to sea level rise. |
| Precipitation | In | The Scheme may be vulnerable to changes in precipitation, for example, pressure on water supply during periods of reduced rainfall, and damage to structures and drainage systems during periods of heavy precipitation. |
| Wind | Out | The impacts of wind on receptors in the surrounding environment are likely to be no worse relative to baseline conditions. |

## Baseline Conditions

11.5.3 For the purposes of the CCV assessment, the baseline conditions are based upon historic climate change data obtained from the Met Office recorded by the closest meteorological station to the Scheme (Watnall).

## Study Area

11.5.4 The receptor for the CCV assessment is the construction and operation of the Scheme itself, including associated scheme users (construction workers and members of the public).

## Methodology for Determining Construction Effects

11.5.5 DMRB LA 114 details how to assess the relevance of potential impacts during operations, significance criteria, evaluation of significance and when further design and mitigation measures are required. As the construction phase is approximately40 weeks and is expected to occur in the immediate future (October 2024 to April 2025), the vulnerability analysis will be described through a descriptive approach as future climate change impacts are not considered material.

11.5.6 Construction phase receptors may include the workforce, plant, machinery and materials.

## Methodology for Determining Operational Effects

11.5.7 The CCV assessment has addressed the resilience of the Scheme to climate change impacts in operation. It included all infrastructure and assets associated with the Scheme and assessed resilience against both gradual climate change, and the risks associated with an increased frequency of extreme weather events.

11.5.8 The assessment assumed that the Scheme will be designed to be resilient to impacts arising from current weather events and climatic conditions, and designed in accordance with current planning, design and engineering practice and codes. The assessment took into account the existing resilience and adaptation measures for each risk either already in place or in development for infrastructure and assets.

11.5.9 Climate change projections for the operational phase are produced using UKCP18 data (Met Office, 2020a).

## Significance Criteria

11.5.10 The likelihood and consequences to project receptors were assessed according to Table 11-7 and Table 11-8 as per DMRB LA 114.

### Table 11-7 Measure of likelihood for CCV assessment

| Likelihood | Description (probability and frequency of occurrence) |
|---|---|
| Very high | The event occurs multiple times during the lifetime of the Scheme (60 years) e.g. approximately annually, typically 60 events |
| High | The event occurs several times during the lifetime of the Scheme (60 years) e.g. approximately once every five years, typically 12 events. |
| Medium | The event occurs limited times during the lifetime of the Scheme (60 years) e.g. approximately once every 15 years, typically 4 events. |
| Low | The event occurs during the lifetime of the Scheme (60 years) e.g. once in 60 years. |
| Very low | The event can occur once during the lifetime of the Scheme (60 years). |

### Table 11-8 Measure of consequence for CCV assessment

| Consequence of impact | Description |
|---|---|
| Very large adverse | National level (or greater) disruption to strategic route(s) lasting more than 1 week. |
| Large adverse | National level disruption to strategic route(s) lasting more than 1 day but less than 1 week or regional level disruption to strategic route(s) lasting more than 1 week. |
| Moderate adverse | Regional level disruption to strategic route(s) lasting more than 1 day but less than 1 week. |
| Minor adverse | Regional level disruption to strategic route(s) lasting less than 1 day. |
| Negligible | Disruption to an isolated section of a strategic route lasting less than 1 day. |

11.5.11 The significance of each climatic impact has been evaluated using a matrix as detailed in Table 11-9. Any significant conclusions are based on and incorporate confirmed design and mitigation measures, as described by DMRB LA 114.

### Table 11-9 Significance matrix ('S' significant, 'NS' not significant)

| | | Measure of Likelihood | | | | |
|---|---|---|---|---|---|---|
| | | **Very Low** | **Low** | **Medium** | **High** | **Very High** |
| **Measure of consequence** | **Very Large** | NS | S | S | S | S |
| | **Large** | NS | NS | S | S | S |
| | **Moderate** | NS | NS | S | S | S |
| | **Minor** | NS | NS | NS | NS | NS |
| | **Negligible** | NS | NS | NS | NS | NS |

11.5.12 In line with the DMRB LA 114 and for the purposes of the CCV assessment, a lifespan of 60 years is used.

### Assumptions and Limitations

11.5.13 Detailed design of the Scheme has not been undertaken at this stage. As a result, some data are not available to provide a fully quantified assessment of the GHG emissions from the construction and operation of the Scheme. Accordingly, appropriate industry estimates and averages have been used. The following assumptions, inclusions and exclusions, made on a precautionary basis, have been used in this calculation:

11.5.14 Products (construction):

- where materials size was not specified, it was assumed the largest diameter and depth of materials;
- it is assumed precast concrete to be worst-case scenario for the following materials: gullies, catch pits, and outlets;
- it is assumed that flow control chamber materials were the same as plastic inspection chamber;
- carrier drains and attenuation were assumed to be polypropylene;
- it is assumed that the materials of base, sub-base and capping were all fill, aggregate and sand;
- it is assumed that the acceptable and unacceptable materials are accounted for in the disposal of them; and
- topsoil assumed in situ therefore no associated embodied carbon.

11.5.15 Waste (construction):

- the walls of all pipes were assumed to be 0.3 inches thick;
- the density of fill, aggregate and sand was assumed to be the same as sand;
- the amount of waste material was calculated as 5% of each construction materials;
- unacceptable material was included as bitumen; and
- disposal of topsoil assumed all disposed off-site.

11.5.16 Fuel use on site (construction):

- the fuel use on site is based on an assumption that is calculation based on Scheme value; and
- the Scheme value has been calculated based on the cost of civils for each junction and one quarter of the total cost given for land and fees (cost for total works divided into four junctions evenly).

11.5.17 Material Transport (construction):

- assumed a single trip distance of 50 km.

11.5.18 Land use change:

- scoped out.

11.5.19 Limitations associated with the approach taken for the GHG assessment include the

material densities used to calculate the weight of materials. Material density was assumed based on the assumed material input. The following material densities have been used as per the Highways England Carbon Tool:

- Surface and Binder were assumed to be Asphalt and have a resultant material density of 1.7 t/m$^3$.
- Base, Sub-base and Capping were assumed to be Fill, aggregate and sand with a resultant material density of 1.85 t/m$^3$.
- Soil was assumed to have a material density of 1.7 t/m$^3$.
- unacceptable material was assumed to be Aggregate and soil and have a resultant material density of 1.7 t/m$^3$.
- attenuation was assumed to be Polypropylene with a resultant material density of 1.4 t/m$^3$.

11.5.20 Information provided by Via used higher densities than the Highways England Carbon Tool. For example, aggregate densities of 2.2 to 2.4 t/m$^3$ and 1.3 t/m$^3$ for soil. For both materials this gives an average difference in weight of circa ± 28% and therefore would have the same impact on the GHG emissions associated with the materials in construction and disposal.

11.5.21 Limitations associated with the approach taken for the climate resilience assessment relate to uncertainties inherent within UK Climate Projections (UKCP18 data) (Met Office, 2020a). By its very nature, climate change is associated with a range of assumptions and limitations. UKCP18 are currently the leading climate change projections for the UK.

11.5.22 While the projections used in the vulnerability assessment represent anticipated average weather conditions, they do not capture the full range of possible future severe weather events (i.e. droughts, heatwaves and prolonged heavy rainfall).

11.5.23 Assessments being made in relation to climate change risk and impact likelihood and severity are relying on professional judgement and evidence gathered through other EIA discipline assessments.

## 11.6 Baseline Conditions

### GHG Impact Assessment

11.6.1 The current and future baseline for the lifecycle GHG impact assessment is a ‘business as usual’ scenario where the Scheme is not constructed, and the existing road remains (Do Minimum scenario).

11.6.2 As detailed within ES Volume I Chapter 8: Biodiversity, the ecological baseline conditions consider current and future baseline conditions including habitats lost due to the construction and habitats retained / or planted during the scheme. No material change is expected to the baseline conditions of the carbon stocks due to the Scheme comprising primarily of improvements to the junction and no significant removal or addition of habitat.

### CCV Assessment

11.6.3 The current baseline for the vulnerability assessment is based on historic climate data obtained from the Met Office (Met Office, 2020b) recorded by the closest meteorological station to the Scheme (Watnall, 20km from Kirk Hill) for the period 1981-2010. These data are listed in Table 11-10.

Table 11-10 Historic Climate Data

| Climatic Variable | Month | Value |
|---|---|---|
| Average annual maximum daily temperature (°C) | - | 13.4 |
| Warmest month on average (°C) | July | 21.3 |
| Coldest month on average (°C) | January | 6.6 |
| Mean annual rainfall levels (mm) | - | 709.4 |
| Wettest month on average (mm) | October | 71.2 |
| Driest month on average (mm) | February | 47.2 |

11.6.4 The Met Office historic 10-year averages for the 'Midlands' identify gradual warming between 1971 and 2020, with increased rainfall also. Information on mean maximum annual temperatures (°C) and mean annual rainfall (mm) is summarised in Table 11-11.

Table 11-11 Historic 10-year averages

| Climate Period | Climate Variable | |
|---|---|---|
| | Mean maximum annual temperatures (°C) | Mean annual rainfall (mm) |
| 1971-1980 | 12.7 | 739.7 |
| 1981-1990 | 13.0 | 768.8 |
| 1991-2000 | 13.4 | 796.2 |
| 2001-2010 | 13.8 | 794.6 |
| 2011-2020 | 14.1 | 825.1 |

11.6.5 The future baseline for the vulnerability assessment is based on UK Climate Projections 2018 (Met Office, 2020a). This projection data provides probabilistic indications of how global climate change is likely to affect areas of the UK using pre-defined climate variables and time periods.

11.6.6 For the purpose of the CCV assessment, UKCP18 probabilistic projections for pre-defined 20-year periods for the following average climate variables have been obtained and will be further analysed:

- mean annual temperature;
- mean summer temperature;
- mean winter temperature;
- maximum summer temperature;
- minimum winter temperature;
- mean annual precipitation;
- mean summer precipitation; and

- mean winter precipitation.

11.6.7 Projected temperature and precipitation variables are presented in Table 11-12 and Table 11-13 respectively. UKCP18 probabilistic projections have been analysed for the 25km grid square in which the scheme is located. These figures are expressed as temperature/precipitation anomalies in relation to the 1981-2000 baseline.

11.6.8 UKCP18 uses a range of possible scenarios, classified as Representative Concentration Pathways (RCPs), to inform differing future emission trends. These RCPs "… *specify the concentrations of greenhouse gases that will result in total radiative forcing increasing by a target amount by 2100, relative to preindustrial levels*". RCP8.5 has been used for the purposes of this assessment as a worst-case scenario. RCP 8.5 highlights the UKs worst-case scenario, representing a 4.3°C temperature increase by 2081 – 2100, where greenhouse gas emissions continue to grow unmitigated.

11.6.9 The Scheme's design life is 60 years. The projected climate variables presented in Table 11-12 and Table 11-13 show time periods that intersect these stages. The 2020-2039 time period intersects the construction stage and earliest operations. The 2040-2059 time period covers the majority of the operations of the Scheme. The 2060-2079 time period intersects the end of the design life of the Scheme.

11.6.10 The vulnerability assessment considers an RCP scenario that reflects a high level of greenhouse gas emissions at the 10%, 50% and 90% probability levels to assess the impact of climate change over the lifecycle of the Scheme. A 10% probability result indicates that 10% of model results were below this figure. A 50% probability results indicates that 50% of model results were above and below this figure. A 90% result indicated that 90% of model results were below this figure.

Table 11-12 Projected Changes in Temperature Variables (°C), 50% Probability (10% and 90% probability in parenthesis)

| | **Climate Period** | | |
|---|---|---|---|
| | **2020-2039** | **2040-2059** | **2060-2079** |
| Mean annual air temperature anomaly at 1.5 m (°C) | +1.0 (+0.3 to +1.7) | +1.8 (+0.8 to +2.8) | +2.8 (+1.3 to +4.4) |
| Mean summer air temperature anomaly at 1.5 m (°C) | +1.2 (+0.4 to +2.1) | +2.3 (+0.9 to +3.7) | +3.4 (+1.1 to +5.8) |
| Mean winter air temperature anomaly at 1.5 m (°C) | +0.9 (-0.0 to +1.9) | +1.6 (+0.4 to +2.9) | +2.4 (+0.7 to +4.2) |
| Maximum summer air temperature anomaly at 1.5 m (°C) | +1.3 (+0.2 to +2.6) | +2.6 (+0.8 to +4.5) | +3.9 (+1.1 to +6.8) |
| Minimum winter air temperature anomaly at 1.5 m (°C) | +0.8 (-0.1 to +1.9) | +1.6 (+0.3 to +3.0) | +2.4 (+0.7 to +4.3) |

Table 11-13 Projected Changes in Precipitation Variables (%), 50% Probability (10% and 90% probability in parenthesis)

| | Climate Period | | |
|---|---|---|---|
| | 2020-2039 | 2040-2059 | 2060-2079 |
| Annual precipitation rate anomaly (%) | +1.1<br>(-3.4 to +6.0) | -1.7<br>(-8.5 to +5.4) | -0.7<br>(-6.4 to +5.1) |
| Summer precipitation rate anomaly (%) | -7.7<br>(-28.6 to +14.4) | -20.2<br>(-43.2 to +3.0) | -26.9<br>(-56.6 to +3.4) |
| Winter precipitation rate anomaly (%) | +5.2<br>(-4.7 to +15.7) | +8.2<br>(-5.4 to +22.5) | +15.2<br>(-1.7 to +33.1) |

## 11.7 Design, Mitigation and Enhancement Measures

### GHG Emissions

11.7.1 Mitigation measures would be implemented to reduce lifecycle emissions across the Scheme as shown in Table 11-14.

Table 11-14 Embedded GHG emission mitigation measures

| Lifecycle Stage | Mitigation Measures | Delivery Mechanism |
|---|---|---|
| Construction | The Principal Contractor would develop and implement a plan to reduce energy consumption and associated carbon emissions. This could include the consideration of renewable and/or low or zero carbon energy sources and record percentage of savings implemented.<br>Energy consumption and materials use would be recorded and reported on an ongoing basis during the construction phase. | CEMP by the Principal Contractor. |
| | Where practicable, measures would be implemented to manage material resource use during construction including:<br>using materials with lower embodied GHG emissions and water consumption;<br>using sustainably sourced materials; and<br>using recycled or secondary materials. | CEMP by the Principal Contractor. |
| | Where possible, the use of local construction staff to minimize commuting distances. | CEMP |
| | Use of well-maintained plant, and no idling of plant or vehicles when stationary. | CEMP |
| | Use contractors/suppliers with low emission fleet vehicles | CEMP |
| | Waste management measures to reduce wastes include: | SWMP by the Principal Contractor. |

| Lifecycle Stage | Mitigation Measures | Delivery Mechanism |
|---|---|---|
| | Agreements with material suppliers to reduce the amount of packaging or to participate in a packaging take-back scheme;<br>Implementation of a 'just-in-time' material delivery system to avoid materials being stockpiled, which increases their risk of damage and disposal as waste;<br>Attention to material quantity requirements to avoid over-ordering and generation of waste materials;<br>Re-use of materials wherever feasible, e.g. re-use of excavated soil for landscaping. Concrete will be taken off-site for crushing and re-use;<br>Segregation of waste at source where practical; and<br>Re-use and recycling of materials off-site where re-use on-site is not practical (e.g. through use of an off-site waste segregation facility and re-sale for direct re-use or re-processing). | |
| | During the design phase, opportunities to reduce wastes include:<br>waste arisings will be prevented and designed out where possible;<br>opportunities to re-use material resources will be sought where practicable, such as the re-use of existing on-site lighting if in adequate condition; and<br>where re-use and prevention are not possible, waste arisings will be managed in line with the waste hierarchy. | Detailed design and SWMP |

## Climate Change Vulnerability

11.7.2 Mitigation measures would be implemented to reduce climate change vulnerability across the lifecycle of the Scheme. Measures to mitigate the potential impact of climate change impacts are summarised in Table 11-15.

Table 11-15 Embedded climate change vulnerability mitigation measures

| Lifecycle Stage | Mitigation Measures | Delivery Mechanism |
|---|---|---|
| Construction | The Principal Contractor would develop and implement a plan to prevent or reduce the likelihood of climatic hazards affecting construction staff and assets. | CEMP<br>SWMP<br>Site Safety Plan |
| | Net gain of biodiversity through retained, enhanced or created habitats through landscaping | Landscape Proposals and BNG strategy (see BNG Report (Appendix 2-2 in Volume 3D and Volume 3 Appendix 4-2) |
| Operation | The Scheme has been designed to accommodate a 1 in 100-year flood event (with a climate change allowance of 40 % added. | Flood Risk Assessment (Volume 3 Appendix 4-3) |
| | A range of measures would be put in place to improve the resilience of the scheme to climate change during the scheme operation, including | Operation and Maintenance Manuals |

| Lifecycle Stage | Mitigation Measures | Delivery Mechanism |
|---|---|---|
| | maintenance plans for drainage systems to allow them to operate effectively, and temperature and extreme weather resilient surfaces. | |
| | The detailed landscaping proposals are to include drought, and extreme weather -tolerant species where appropriate. | Landscape Proposals (see Appendix 2-2 in Volume 3D) |

## 11.8 Assessment of Likely Significant Effects

### Construction

11.8.1 As described in Chapter 2: The Scheme, the construction stage is anticipated to take approximately40 weeks.

11.8.2 In order to assess the magnitude of the impact of the Scheme on the climate, GHG emissions associated with the construction of the Scheme have been calculated based on the methodologies discussed in Section 11.4.

11.8.3 As is usual with projects of this nature, a detailed design of the construction activities has not been undertaken for this stage of design, the GHG emissions calculations are based on the following conditions using a mixture of existing project data and information, industry benchmarks and professional judgement. These are detailed in section 11.5.

11.8.4 As detailed in Table 11-16 the total GHGs estimated to be emitted from construction associated with the Scheme have been calculated to be 728 $tCO_2e$ over the course of the 38-week construction period. The majority of emissions are associated with embodied carbon in transport of materials to site accounting for approximately 55% of all construction emissions.

11.8.5 All these emissions are considered ‘additional’ and are included in the impact assessment of the Scheme. They are defined as additional as they are considered new and would not occur if the Scheme did not go ahead.

Table 11-16 Estimated Construction GHG Emissions

| Emission Source | Emissions ($tCO_2e$) | Percentage of Stage Emissions |
|---|---|---|
| Embodied carbon in raw materials | 254 | 35% |
| Fuel usage onsite | 20 | 3% |
| Transport of materials to site | 403 | 55% |
| Disposal of construction waste | 11 | 1% |
| Employee commuting | 40 | 5% |
| Total emissions | 728 | |

### GHG Emissions Significance

11.8.6 As stated in Section 11.4, all emissions are considered to be capable of being significant due to their combined environmental effect in the atmosphere. To contextualise the level of significance, these emissions have been compared to the

UK Carbon budgets. As highlighted in Table 11-17, detailing the construction emissions against that of the relevant UK Carbon Budgets, the Scheme contributes 0.00004% to the 4th Carbon Budget only.

11.8.7 The magnitude of impact during construction is therefore considered to be Low. As per Table 11-3 and Table 11-4, this is considered to be a minor adverse significant effect.

Table 11-17 Contribution of the Construction Emissions to the UK Carbon Budgets

| UK Carbon Budget Period | UK Carbon Budget ($MtCO_2e$) | Do Something Construction Phase Emissions ($MtCO_2e$) | Do Something Percentage Contributions to UK Carbon Budget |
|---|---|---|---|
| 4th (2023-2027) | 1,950 | 0.000728 | 0.00004 |

## 11.9 CCV Assessment

### Construction

11.9.1 During construction works, receptors such as the construction work force, construction plant, vehicles, materials and workplan may be vulnerable to a range of climate risks. These could include:

- inaccessible construction site due to severe weather event (flooding, snow and ice, storms) restricting working hours and delaying construction;
- health and safety risks to the workforce during severe weather events;
- unsuitable conditions (due to very hot weather or very wet weather, for example) for certain construction activities; and
- damage to construction materials, plant and equipment, including damage to temporary buildings/facilities within the site boundary, such as offices, compounds, material storage areas and worksites, for example as a result of stormy weather.

11.9.2 In consideration of the embedded and design mitigation and management measures described in Section 12.7, the resulting significance matrix for climate vulnerability has been undertaken in Table 11-18. No significant vulnerability impacts have been identified for the construction phase of work.

Table 11-18 Construction Stage Climate Vulnerability Significance Assessment

| Climate Variable | Potential Impacts from Climate Variables | Likelihood (Probability and Frequency of Occurrence) 2020-2039 | Measure of Consequence | Significance Level |
|---|---|---|---|---|
| Increased frequency and severity of extreme weather events (such as heavy and/or prolonged precipitation, storm events and heatwaves) | Flooding and storm damage to site and site assets, danger to construction workers, inaccessible work site, possible power disruption, overheating of electrical equipment | Low | Minor Adverse | Not Significant |

| Climate Variable | Potential Impacts from Climate Variables | Likelihood (Probability and Frequency of Occurrence) 2020-2039 | Measure of Consequence | Significance Level |
|---|---|---|---|---|
| Increased winter precipitation | Flooding of construction site, damage to site assets, danger to construction workers, inaccessible work site | Medium | Minor Adverse | Not Significant |
| Decreased summer precipitation | Drought | Low | Negligible | Not Significant |
| Increased summer and winter temperatures | Heat stress to construction workers, deterioration of materials and assets, overheating of electrical equipment | Medium | Minor Adverse | Not Significant |

## Operation

11.9.3 During operation, receptors such as the road users, physical assets, maintenance workers, maintenance plant and maintenance vehicles may be vulnerable to a range of climate risks. These could include:

- inaccessible maintenance site due to severe weather event (flooding, snow and ice, storms) restricting working hours and delaying construction;
- health and safety risks to the workforce and road users during severe weather events;
- unsuitable conditions (due to very hot weather or very wet weather, for example) for certain construction activities; and
- damage to assets, landscaping, materials, plant and equipment as a result of stormy weather, flooding and excessive heat.

11.9.4 In consideration of the embedded and design mitigation and management measures described in Section 11.7, the resulting significance matrix for climate vulnerability has been undertaken in Table 11-19. No significant vulnerability impacts have been identified for the operational phase of work.

Table 11-19: Operational Stage Climate Vulnerability Significance Assessment

| Climate Variable | Potential Impacts from Climate Variables | Likelihood (Probability and Frequency of Occurrence) 2020-2039 | Measure of Consequence | Significance Level |
|---|---|---|---|---|
| Increased frequency and severity of extreme weather events (such as heavy | Flooding and storm damage to site and site assets, danger to maintenance workers and road users, inaccessible work site, possible power disruption, | Medium | Minor Adverse | Not Significant |

| Climate Variable | Potential Impacts from Climate Variables | Likelihood (Probability and Frequency of Occurrence) 2020-2039 | Measure of Consequence | Significance Level |
|---|---|---|---|---|
| and/or prolonged precipitation, storm events and heatwaves) | overheating of electrical equipment, damage and deterioration of assets, 'summer ice' slippery roads after prolonged periods of no rain, land subsidence, traffic related rutting and migration of road material, damage to landscaping | | | |
| Increased winter precipitation | Flooding of the site, damage to site assets, danger to maintenance workers and road users and drainage systems, inaccessible work site, damage to roads, land subsidence, damage to landscaping | Medium | Minor Adverse | Not Significant |
| Decreased summer precipitation | Drought, damage to landscaping | Medium | Negligible | Not Significant |
| Increased summer and winter temperatures | Heat stress to maintenance workers, deterioration of materials and assets, overheating of electrical equipment, thermal expansion and movement of bridge joints and paved surfaces, damage to landscaping | Medium | Minor Adverse | Not Significant |

## 11.10 Residual Effects

11.10.1 There will be unavoidable GHG emissions resulting from the construction phase as materials, energy and fuel use, and transport will be required. The effects are of Low magnitude and therefore not likely to be significant. No mitigation measures further to the ones detailed in the 'Environmental Design and Management' section of this ES chapter have been identified.

11.10.2 The residual effects resulting from the Scheme are summarised in Table 11-20 and Table 11-21 below.

Table 11-20 Project Wide Residual Effects of GHG Assessment

| Description of Effect | Sensitivity of Receptor | Nature of Effect/ Geographic Scale | Magnitude of Impact | Initial Classification of Effect (with embedded mitigation) | Additional Mitigation | Residual Effect Significance |
|---|---|---|---|---|---|---|
| Construction | | | | | | |
| Effect of GHG emissions on global climate | High | Long-term global | Low | Minor Adverse | No further mitigation measures are proposed | Low Significance |

Table 11-21: Project Wide Residual Effects of CCV Assessment

| Description of Effect | Sensitivity of Receptor | Nature of Effect/ Geographic Scale | Magnitude of Impact | Initial Classification of Effect (with embedded mitigation) | Additional Mitigation | Residual Effect Significance |
|---|---|---|---|---|---|---|
| **Construction** | | | | | | |
| Increased frequency and severity of extreme weather events (such as heavy and/or prolonged precipitation, storm events and heatwaves) | Medium | Long-term, isolated to the Scheme | Minor adverse | Not significant | No further mitigation measures are proposed. | Not significant |
| Increased winter precipitation | Medium | Long-term, isolated to the Scheme | Minor adverse | Not significant | No further mitigation measures are proposed. | Not significant |
| Decreased summer precipitation | Medium | Long-term, isolated to the Scheme | Minor adverse | Not significant | No further mitigation measures are proposed. | Not significant |
| Increased summer and winter temperatures | Medium | Long-term, isolated to the Scheme | Minor adverse | Not significant | No further mitigation measures are proposed. | Not significant |
| **Complete and Operational** | | | | | | |
| Increased frequency and severity of extreme weather events (such as heavy and/or prolonged precipitation, storm | Medium | Long-term, isolated to the Scheme | Low | Minor Adverse | No further mitigation measures are proposed | Not Significant |

| Description of Effect | Sensitivity of Receptor | Nature of Effect/ Geographic Scale | Magnitude of Impact | Initial Classification of Effect (with embedded mitigation) | Additional Mitigation | Residual Effect Significance |
|---|---|---|---|---|---|---|
| events and heatwaves) | | | | | | |
| Increased winter precipitation | Medium | Long-term, isolated to the Scheme | Low | Minor Adverse | No further mitigation measures are proposed | Not Significant |
| Decreased summer precipitation | Medium | Long-term, isolated to the Scheme | Low | Minor Adverse | No further mitigation measures are proposed | Not Significant |
| Increased summer and winter temperatures | Medium | Long-term, isolated to the Scheme | Low | Minor Adverse | No further mitigation measures are proposed | Not Significant |

# 12. SUMMARY

## 12.1 Introduction

12.1.1 This chapter summarises the findings of the assessments, not the residual environmental effects, and states the proposed mitigation and monitoring measures to be implemented during construction and operation of the Scheme.

## 12.2 Summary of Significant Effects

12.2.1 The following chapters reported no likely significant residual environmental effects during the construction or operation phases of the Scheme:

- Air quality;
- Cultural heritage;
- Landscape and visual;
- Biodiversity;
- Geology and soils;
- Road drainage and the water environment; and
- Climate.

12.2.2 The assessments reported in the following chapters identified likely significant environmental effects during the construction phases of the Scheme:

- Noise and vibration.

12.2.3 Table 12-1 summarises the likely significant effects associated with the construction and operation of the Scheme as detailed in Chapters 5 to 11 of this report.

Table 12-1 Summary of Likely Significant Residual Effects

| Topic | Receptor | Phase | Proposed Mitigation and Monitoring | Residual effect |
|---|---|---|---|---|
| Construction Noise | 5no. receptors (R1-R5) Kirk Hill, NG13 8PE | Construction | BPM and temporary screening where feasible | Significant adverse |
| Construction vibration | 3no. receptors (R1-R3) Kirk Hill, NG13 8PE | Construction | BPM | Significant adverse |

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# 14. ABBREVIATIONS

| Abbreviation | Definition |
|---|---|
| AADT | Annual Average Daily Traffic |
| AAWT | Average Annual Weekday Traffic |
| ACM | Asbestos-Containing Materials |
| ALC | Agricultural Land Classification |
| AM | Morning peak |
| ANC | Association of Noise Consultants |
| aOD | Above Ordnance Datum |
| APIS | Air Pollution Information System |
| AQMA | Air Quality Management Area |
| AQO | Air Quality Objective |
| AQS | Air Quality Strategy |
| ARN | Affected Road Network |
| AW | Ancient Woodland |
| BAP | Biodiversity Action Plan |
| BEIS | Department for Business, Energy and Industrial Strategy |
| BGS | British Geological Society |
| BMV | Best and Most Versatile |
| BNG | Biodiversity Net Gain |
| BPM | Best Practicable Means |
| BS | British Standard |
| BSI | British Standards Institution |
| CCV | Climate Change Vulnerability |
| CEMP | Construction Environmental Management Plan |
| CERC | Cambridge Environmental Research Consultant |
| $CH_4$ | Methane |
| CIEEM | Chartered Institute of Ecology and Environmental Management |
| CL:AIRE | Contaminated Land: Application in Real Environments |
| $CO_2$ | Carbon Dioxide |
| CRTN | Calculation of Road Traffic Noise |
| cSAC | Candidate Special Area |
| CWS | County Wildlife Site |

| Abbreviation | Definition |
|---|---|
| dB | Decibel |
| DCP | Dynamic Cone Penetration |
| Defra | Department for the Environment Food and Rural Affairs |
| DfT | Department for Transport |
| DM | Do Minimum |
| DMFY | Do Minimum Future Year |
| DMOY | Do Minimum Opening Year |
| DMRB | Design Manual for Roads and Bridges |
| DTM | Digital Terrain Model |
| DS | Do Something |
| EcIA | Ecological Impact Assessment |
| ECoW | Ecological Clerk of Works |
| EFT | Emissions Factor Toolkit |
| EHTO | Environmental Health Technical Officer |
| EIA | Environmental Impact Assessment |
| EQS | Environment Quality Standard |
| ES | Environmental Statement |
| ETRO | Environmental Health Technical Officer |
| EU | European Union |
| FRA | Flood Risk Assessment |
| GCN | Great Crested Newt |
| GBC | Gedling Borough Council |
| GHG | Greenhouse Gas |
| GLIVIA | Guidelines for Landscape and Visual Impact Assessment |
| GWDTE | Groundwater Dependent Terrestrial Ecosystem |
| HDV | Heavy Duty Vehicle |
| HE | Historic England |
| HER | Historic Environment Record |
| HEWRAT | Highways England Water Risk Assessment Tool |
| HFC | Hydrofluorocarbons |
| HGV | Heavy Goods Vehicle |
| HSI | Habitat Suitability Index |
| ICE | Inventory of Carbon and Energy |

| Abbreviation | Definition |
|---|---|
| IEMA | Institute of Environmental Management and Assessment |
| IOA | Institute of Acoustics |
| IP | Inter-peak |
| LAQM | Local Air Quality Management |
| LBAP | Local Biodiversity Action Plan |
| LCA | Local Character Area |
| LGS | Local Geology Site |
| LNR | Local Nature Reserve |
| LOAEL | Local Observed Adverse Effect Level |
| LVIA | Landscape and Visual Impact Assessment |
| LWS | Local Wildlife Site |
| MAGIC | Multi-agency Geographic Information Centre |
| MCZ | Marine Conservation Zone |
| MHCLG | Ministry of Housing, Communities and Local Government |
| MMP | Materials Management Plan |
| MRN | Major Road Network |
| Mt $CO_2e$ | Mega tonnes of $CO_2$ equivalent |
| $N_2O$ | Nitrous Oxide |
| NaCl | Sodium Chloride |
| NBGRC | Nottinghamshire Biological and Geological Records Centre |
| NCA | National Character Area |
| NCC | Nottinghamshire Country Council |
| NERC | Natural Environment and Rural Communities |
| $NF_3$ | Nitrogen Trifluoride |
| NGR | National Grid Reference |
| NHLE | National Heritage List for England |
| NIA | Noise Important Area |
| NIR | Noise Insulation Regulations |
| NMU | Non-Motorised User |
| NNR | National Nature Reserve |
| $NO_2$ | Nitrogen Dioxide |
| $NO_X$ | Nitrogen Oxides |
| NOEL | No Observed Effect Level |

| Abbreviation | Definition |
|---|---|
| NPPF | National Planning Policy Framework |
| NPSE | Noise Policy Statement for England |
| NRMM | Non-Road Mobile Machinery |
| NSDC | Newark and Sherwood District Council |
| NSR | Noise Sensitive Receptors |
| NVZ | Nitrate Vulnerable Zone |
| NWT | Nottingham Wildlife Trust |
| OBC | Outline Business Case |
| OP | Overnight |
| OS | Ordnance Survey |
| PCM | Pollution Climate Mapping |
| PDBE | Polybrominated diphenyl ethers |
| PFOS | Perfluorooctance sulfonate |
| PM | Afternoon peak |
| $PM_{10}$ | Particulate Matter |
| ppSPA | Possible Potential Special Protection Area |
| PRoW | Public Right of Way |
| pSAC | Possible Special Area of Conservation |
| pSPA | Potential Special Protection Area |
| PZ | Policy Zone |
| RBC | Rushcliffe Borough Council |
| RBMP | River Basin Management Plan |
| RCP | Representative Concentration Pathway |
| RIGS | Regionally Important Geological Sites |
| SAC | Special Area of Conservation |
| SCI | Sites of Community Importance |
| SEO | Statements of Environmental Opportunity |
| $SF_6$ | Sulphur Hexafluoride |
| sHRA | Shadow Habitat Regulations Assessment |
| SINC | Sites of Importance for Nature Conservation |
| SLNCI | Sites of Local Nature Conservation Importance |
| SMF | Sidmouth Mudstone Formation |
| SOAEL | Significant Observed Adverse Effect Level |

| Abbreviation | Definition |
|---|---|
| SPA | Special Protection Area |
| SPZ | Source Protection Zone |
| SRN | Strategic Road Network |
| SSSI | Site of Special Scientific Interest |
| SuDS | Sustainable Urban Drainage |
| SWMP | Site Waste Management Plan |
| SWOT | Strength, weakness, opportunities and threats |
| $tCO_2e$ | Tonnes $CO_2$ equivalent |
| UK | United Kingdom |
| UNFCCC | United Nations Framework Convention on Climate Change |
| WBCSD | World Business Council for Sustainable Development |
| WFD | Water Framework Directive |
| WMP | Water Management Plan |
| WRAP | Waste and Resources Action Plan |
| WRI | Water Resources Institute |
| Via | Via East Midlands Ltd |
| ZoI | Zone of Influence |
| ZTV | Zone of Theoretical Visibility |

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