A614/A6097 Major Road Network Improvement Environmental Statement

Volume 1B
Scheme Specific Assessment - Mickledale Lane Junction

Via East Midlands Ltd

Project number: 60643622

February 2022

Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position
1	December 2021	First Draft	SB	S Banks	Project Manager
2	February 2022	Final	SB	S Banks	Project Manager

Distribution List

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Environmental Statement Contents

Table of Contents

List of Tables

1. INTRODUCTION

1.1.1 Mickledale Lane 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 Mickledale Lane 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 Mickledale Lane 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 2B, and appendices are within Volumes 3 and 3B.

2. THE SCHEME

2.1 Existing Situation

2.1.1 The existing junction is currently a priority controlled four-arm crossroads junction with the side roads giving way to the A614 traffic flows.

2.1.2 Four houses occupy the south-east corner of the junction, and a transport café (Limes Café) and a further residential property are located to the north-west of the junction. Other than these buildings, the junction is surrounded by agricultural land. Inkersall Lane is a narrow road leading westward from the junction to a small number of private properties and the former Rufford Colliery site. To the east, Mickledale Lane leads to the centre of Bilsthorpe village. Strawsons Ltd farm produce business is present approximately 200 m to the south-east of the junction.

2.1.3 There are footpaths on both the east and west sides of the existing junction and a dropped crossing and refuge have been provided to assist crossing movements to the north of the junction. Inkersall Lane is a Public Right of Way (PRoW) and Rufford Bridleway No. 5 (Rufford BW5).

2.1.4 Route Number 645 of the National Cycle Network (NCN 645) lies 210 m to the north of the junction and is a traffic free route. The route follows the disused mineral line and terminates just south of Kirklington to the south-east of the A614 corridor.

2.1.5 A key concern at this junction is the ability of minor-arm traffic to safely judge gaps when entering the A614 and to do so without undue delay.

2.1.6 Current speed limits approaching the junction are as follows:

- A614 Old Rufford Road (north and south of junction) – 50 mph; and
- Mickledale Lane – 60 mph.

2.1.7 Key environmental constraints include but are not limited to:

- residential properties around the junction and within the nearby village of Bilsthorpe to the east;
- several LWS including Alder Carr LWS adjacent to the south-east of the Scheme; and
- Sherwood Forest Area possible potential Special Protection Area (ppSPA) approximately 600 m to the west.

2.1.8 Key environmental constraints and receptors are illustrated in figures associated with each topic chapter (Chapters 5 to 12) in Volume 2B.

Future Situation

2.1.9 Without improvement, the safety concerns at Mickledale Lane Junction will remain, with future traffic growth along the route corridor likely to exacerbate these concerns.

2.2 Scheme Description

2.2.1 The Mickledale Lane 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 It is proposed to construct a new three-arm roundabout on the A614 to the south of the existing junction. A new link road would connect the A614 and Mickledale Lane (leading to Bilsthorpe village) passing through a field to the south-east of the

existing junction. The new link road would tie into Mickledale Lane via a second three-arm mini-roundabout.

2.2.3 It is proposed that the Inscribed Circle Diameter (ICD) of the A614 roundabout would be 70 m with approaches from the A614 widened to provide two entry lanes onto and around the circulatory of the roundabout. The A614 roundabout exits would provide a short section of two lanes with a merge in turn arrangement to tie back into the single carriageway arms. The new link road would see single lane entry and exit.

2.2.4 Mickledale Lane would be closed off to vehicles leaving the A614 and become a cul-de-sac accessed from the east at the mini-roundabout junction with the new link road, maintaining access only for maintenance vehicles and maintaining Non-Motorised User (NMU) access by providing a link for cyclists, equestrians and pedestrians travelling east-west towards the A614 Limes Café and beyond.

2.2.5 New access would be provided off the new link road into Strawsons Ltd premises to the east.

2.2.6 The properties located to the south-east corner of the existing Mickledale Lane junction would maintain access to their properties directly from the A614 as with the current situation.

2.2.7 The junction and the link road would be required to be illuminated. This has been designed in line with current design standards and using LED lanterns.

2.2.8 The A614 roundabout junction would be subject to a 50 mph speed limit, and the link road would be subject to a 30 mph speed limit by way of a permanent Traffic Regulation Order.

2.2.9 The total area needed for the Scheme construction and operation is approximately 8.6 hectares (ha) as shown on the red line planning boundary on the general arrangement plans in Appendix 2-1 of Volume 3.

Land Take

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

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

2.2.12 Temporary and permanent land take consists of agricultural land. Temporary land would be restored to current condition or better on return to the landowner.

2.2.13 A new highway boundary would be formed that would encapsulates the required permanent land take for the Scheme.

Earthworks and Landform

2.2.14 A614 carriageway levels would be increased by up to 0.5 m to allow the road to tie into existing road levels to the north and south of the new roundabout.

2.2.15 Where the roundabout extends into the field on the western side of the roundabout, the road would be within an approximately 1 m cutting. The link road would be in a mixture of cut and embankment. All cutting and embankment slopes would be cut to a maximum gradient of 1:3 with a maximum embankment height of approximately 2 m and a maximum depth of cut to approximately 1.5 m.

2.2.16 Gabion baskets are proposed to be used within the vicinity of the mini-roundabout, although these would provide no structural benefit. They are provided as ecological mitigation proposals for lizards.

2.2.17 The existing carriageway of Mickledale Lane that becomes a cul-de-sac would be reduced to provide half the current width as an access track, with the remainder returned to soft landscaping. The extent of vegetation clearance is shown on Appendix 2-1 in Volume 3B.

Drainage

2.2.18 Carriageway and footway surface drainage would be collected by a mixture of carriageway gullies and kerb drainage units, connected into a number of catchpit chambers. Some kerb drainage units may be utilised to minimise clashes with buried services.

2.2.19 Catchpit chambers and a new filter drain would run along the new link road to 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.

2.2.20 Storage tanks would connect into the existing surface water drainage system which runs down Mickledale Lane.

Lighting and Signage

2.2.21 Street lighting design at the Mickledale Lane 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.

2.2.22 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 around the periphery of the roundabout as this is the focal area of any potential conflict zone[1].

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

2.2.24 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).

2.2.25 An Environmental Weight Limit is in place on Mickledale Lane which would remain. The proposed direction signing for the new A614 roundabout includes advisory routes for lorries intending to travel to Bilsthorpe.

The lighting design is shown on Figure 8-2 in Volume 2B.Fencing and Boundary Treatment

2.2.26 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 Figure 2-2 in Volume 2B).

Non-motorised User Provisions

2.2.27 The existing footpath along the east and west sides of the A614 would be improved through widening to a minimum width of 3 m. A shared use facility would be

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

provided along the west side of the new link road between the A614 and Mickledale Lane.

2.2.28 Mickledale Lane would be closed off to vehicles and would become a cul-de-sac accessed from the east using the new link road and mini-roundabout junction. This means that a NMU link for equestrians, cyclists and pedestrians travelling east-west towards the BW5, PRoW at Inkersall Lane and beyond, can be maintained as a preferred route encouraging NMUs to cross the A614 at a location with the least amount of potential conflict using existing uncontrolled pedestrian crossing provision. It is anticipated that the new roundabout would generate gaps in the 'platoons' of traffic and reduce vehicular speeds on the approaches to the roundabout, which would aid east-west crossing movements.

2.2.29 As mentioned previously, NCN 645 lies 210 m to the north of the junction and is a traffic free route. The route is signposted, accessed from Bilsthorpe village and promoted as a multi-access route using the disused railway bridge to enable safe passage of NMUs over the A614.

2.2.30 While it is acknowledged that Rufford BW5 runs east of the A614 along Inkersall Lane and Rufford BW19 joins Mickledale Lane approximately 500 m to the east of the proposed mini-roundabout, NMU survey returns identified low levels of equestrian usage at the junction. Therefore, it is not proposed to provide specific facilities for equestrian users at this location.

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 Mickledale Lane Junction includes specific planting to support the local environment.

2.3.2 Ecological mitigation is included within the landscape design for this junction as a population of common lizards was identified in the field bisected by the link road, during ecology survey work (see Chapter 8: Biodiversity for further details). Gabion baskets would be provided within the highway boundary on a south-east facing aspect to provide a suitable area for basking.

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 east of the A614 Old Rufford Road, to the south of the proposed new link road. This is expected to include temporary offices, compounds, vehicle parking and storage areas.

2.4.3 There may also be a need to use the existing Bilsthorpe Road Maintenance Compound for storage during the construction of the Scheme.

Construction Programme and Phasing

2.4.4 Scheme construction would commence in Winter 2024/25 and take approximately 54 weeks.

2.4.5 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

2.4.6 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 07.30 – 13:00 Saturdays with no working on Bank Holidays

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

Construction Activities

2.4.8 Scheme construction activities are anticipated to require the following:

- 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;
- piling works;
- accommodation work; and
- installation of verge furniture (e.g. new lighting and new or replacement signage) and planting of vegetation.

Earthworks

2.4.9 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.

2.4.10 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.

2.4.11 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.

2.4.12 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, and the Control of Pollution (Oil Storage) (England) Regulations 2001. Further details on the measures required for handling and storing fuels are

[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.

provided in Chapter 14: Road Drainage and the Water Environment.

Highways works

2.4.13 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.

2.4.14 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.

2.4.15 All vehicles would be supervised to ensure they wash out before driving onto the live carriageway. All compound areas would have a concrete wash out facility.

Structures works

2.4.16 No structural work is proposed at the Mickledale Lane Junction other than the provision of gabion walls in the vicinity of the mini-roundabout to support ecology mitigation work. The gabion baskets would not provide any structural benefit.

Plant

2.4.17 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

2.4.18 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. Some evening and 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 The A614 and A6097 is used as a diversion route for planned and unplanned activities on the SRN including the A1(T) to the north of Ollerton Roundabout and the A46(T) in the south-east.

2.4.20 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.

2.4.21 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

2.4.22 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).

2.4.23 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.

2.4.24 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.

2.4.25 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.

2.4.26 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

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

2.4.28 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).

2.4.29 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.

2.4.30 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 2016 (as amended) (HMSO, 2016b);
- the Waste (England and Wales) Regulations 2011 (as amended) (HMSO, 2001);
- the Waste Management (England and Wales) Regulations 2006 (HMSO, 2006b); and
- the Clean Neighbourhoods and Environment Act 2005 (HMSO, 2005).

2.4.31 Whilst the Site Waste Management Plan (SWMP) Regulations (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.

2.4.32 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

2.4.33 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

2.4.34 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.

2.4.35 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

2.4.36 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.

4.1.2 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.

4.1.3 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.

4.1.4 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, 2020a), other relevant DMRB guidance documents and other published guidance as applicable.

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 2B, Appendix 5-1 of Volume 3 and Appendix 5-1 of Volume 3A.

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, NSDC's Environmental Health Technical Officer (EHTO)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 NSDC's EHTO, 9th September 2020. NSDC's EHTO replied on 10th 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) (UK Centre for Ecology and Hydrology, 2021a). 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. 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. 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:

- NSDC 2020 Air Quality Annual Status Report (NSDC, 2020);
- Defra's 2018-based background concentration maps (Defra, 2020a);
- Defra's 2020 Pollution Climate Mapping (PCM) Model (Defra, 2020b); and
- Ordnance Survey (OS) Mastermap (Ordnance Survey, 2021a), OS Address Base 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 (see Figure 5-2 of Volume 2B) 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 2B.

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 NSDC.

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

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 (Highways England, 2019a). 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 14 months for the Mickledale Lane 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 (without the Scheme) 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 2B.

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 roundabout were extended to either 1 km from the roundabout 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 roundabout 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 they are not 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 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 project 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.

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 air quality assessment has been undertaken based on the Scheme drawing produced for consultation in 2021 (see Appendix 5-1 of Volume 3B). Following completion of the modelling assessment, the Scheme was updated to the version as available in Appendix 5-1 of Volume 3B. The difference between the modelled Scheme and the final Scheme design was the size of the roundabout linking the A614 and Mickledale Lane. As the nearest sensitive receptors are approximately 200 m away, it was considered very unlikely that the final Scheme would result in a noticeable change in predicted concentrations and therefore it was considered unnecessary to update the assessment.

5.4.61 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.

5.4.62 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 Monitoring undertaken by NSDC has indicated that there are no records of exceedances of NO_2 within the study area.

5.5.3 NSDC undertakes monitoring at one location in the study area ('Big Fish

Roundabout, Ollerton' (Big Fish is now Costa Coffee), which is located at the Ollerton roundabout. Annual mean NO_2 concentrations at this location have remained below the AQO since 2016. As this is the only monitoring location in the Project 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 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 NSDC within the study area.

Pollutant Background Maps

5.5.5 Annual mean background pollutant concentration estimates for 1km 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 1 km x 1 km 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
463500_361500	8.6	7.2	15.9	15.0
463500_360500	8.5	7.1	16.4	15.5
464500_360500	9.0	7.5	15.9	15.0

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 As a consequence of the new roundabouts on the A614 and Mickledale Lane, there will be localised reductions in traffic speed on the approaches to the new junctions.

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 2B. The construction dust risk potential is considered to be ‘large’ for the Scheme as it is a new junction with a link road. Therefore, the sensitivity to potential dust effects is considered to be ‘High’ for receptors located within 100 m of the construction

activity and 'Low' for any receptors located between 100 and 200 m.

5.7.5 There are approximately sixteen residential receptors within 100 m of the assessment boundary. These are located along the A614 to the north, near the Limes Café; next to the existing crossroads east of the A614, along Mickledale Lane and on Mickledale Close. There are approximately 42 further residential receptors located within 100 and 200 m of the assessment boundary.

5.7.6 Alder Carr is the only designated habitat within 100 m of the assessment boundary. However, it is not within 100 m of the dust-generating works. The works closest to Alder Carr are related to signage and lighting installation.

5.7.7 As the potential dust effects is identified as 'high' for receptors located within 100 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	19.0	26.1	23.3	21.7	-1.6
R2	1.5	16.8	14.6	12.8	12.7	-0.1
R3	1.5	18.9	25.6	22.8	21.5	-1.3
R4	1.5	16.4	12.4	10.8	10.9	0.1
R5	1.5	16.1	10.2	8.8	8.9	0.1

5.7.11 The largest change in annual mean NO_2 concentrations as a result of the Scheme were predicted to occur at receptors R1, R3 and R3, situated adjacent to the existing A614/ Mickledale Lane Junction. At these receptors decreases of up to -

1.6µg/m^3 are predicted. This is due to the reduction in flow on the section of Mickledale Lane, adjacent to these properties, as with the Scheme in place it would be used as an access road and NMU route only. Vehicles which currently used this section of Mickledale Lane to access the A614 would now join the road approximately 200 m to the south using the new roundabout. An imperceptible change is predicted for R4 and R5.

5.7.12 As the annual mean concentrations of NO_2 are below 60 µg/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 (HMSO, 2016a) 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 Mickledale Lane Junction.

6.1.2 The 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 The chapter is supported by an aerial photograph and map regression exercise produced by Trent and Peak Archaeology (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 2B.

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. No specific comments were raised in relation to this Scheme, other than those raised as part of the Scoping Opinion consultation.

6.3.2 A summary of the cultural heritage related responses from the Scoping Opinion which relate to the Mickledale Lane Junction Scheme is 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.
	NCC Historic Buildings comments that the conservation area is not directly affected and where historic buildings fall within the influence of the scheme it is their setting that requires examination. Harm to designated heritage assets (including their settings) is in some cases avoidable through carefully considered design. For instance, noise and light pollution can 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 the local district council should take place before designs are fully developed, providing an 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. Consultation was undertaken with the County Archaeologist during the preparation of the EIA, as minuted in Appendix 6-1 of Volume 3.
Historic England	In line with the NPPF, we would expect the ES to contain a thorough assessment of the likely effects which the Scheme 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 non-designated features of historic, 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 associated activities (such as construction, servicing and maintenance, and associated traffic) might have upon perceptions, understanding and 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.
	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. This report includes the Nottinghamshire Historic Environment Record (HER) (Nottinghamshire County Council, 2021b) data of the study area, aerial photographs, LiDAR and historic mapping (refer to Appendix 6-2 in Volume 3) 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) reference number (Historic England, 2021). 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 2B). 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, 2020b) and DMRB LA 104 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 LA 104, 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 no designated assets located within 500 m of this junction.

Non-designated Assets

6.5.2 There are four non-designated assets recorded within 500 m of the Scheme. None of these assets are located within the assessment boundary. The heritage assets are recorded with their HER number. The heritage assets are recorded in Appendix 6-1 in Volume 3B and are shown on the known heritage assets figure (See Figure 6-1 of Volume 2B).

Archaeological and Historical Background

Prehistoric (Up to AD43)

6.5.3 The earliest evidence comprises a find of a Neolithic polished flint axe head (MNT4061). This was found approximately 100 m east of the Scheme. The find has been removed from the site.

6.5.4 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).

6.5.5 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.

6.5.6 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). An Iron Age univallate hillfort is located approximately 5.6 km south-west of the Mickledale Lane Junction. The scheduled hillfort (1003483) survives as earthworks of a bank and an outer ditch, which encloses an area of c.1.4 ha. Excavation at the at this location revealed buried remains of the bank as well as Roman finds of pottery, brick and tile.

Roman (AD43-410)

6.5.7 There are no assets of Roman date recorded within the study area. 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).

6.5.8 Approximately 6 km to the south-east of the Mickledale Lane Junction is a scheduled Roman vexillation fortress (1018122). Situated on the summit of a hill, the fort comprises buried remains visible as cropmarks covering an area of approximately 8.8ha. This monument is a rare example of this type of in Nottinghamshire.

Early Medieval (410-1066) and Medieval (1066-1540)

6.5.9 There are no assets of early medieval or medieval date recorded within the study area. Bilsthorpe to the east of the Site is recorded within the Domesday Book in 1086. The settlement recorded 19 households as well as ploughlands, meadow and woodland (Open Domesday, 2011).

6.5.10 The road running east-west at Mickledale Lane Junction is present on the early historic mapping (Chapman, 1774) and it is thought that it may have medieval origins as a road between Bilsthorpe and Inkersall. This is also indicated by the existing road name (Inkersall Lane).

6.5.11 To the north-east of the junction is Rufford Abbey (1001085), situated approximately 2.2km north-east of the Proposed Scheme. The site was founded by Cistercian monks in 1146 and built between 1147 and c 1170. It was added to in 1233 when the King licensed the Rufford abbot to enlarge the site. The site is a Grade II registered park and garden and includes medieval remains of the abbey, including an undercroft containing chambers with medieval vaults, which was converted in the 16th century into a country house (1302352).

Post-Medieval (1540-1900)

6.5.12 There are three assets of post-medieval date recorded within the study area. There are two extant post-medieval buildings which comprise Featherstone House Farm (MNT25737), a post-medieval farm building, located approximately 110 m east of and Labour in Vain Cottage (MNT23412), located approximately 250 m east of the Site.

6.5.13 The additional asset located within the study area is a bridge at Rufford (MNT26545), comprising a post-medieval bridge recorded on the Chapman map of Nottinghamshire, 1774, located approximately 80 m south of this Junction, although this was not visible during the site visit.

6.5.14 From the earliest historic mapping, Chapman's map of 1774, the junction at Mickledale Lane is present. A building to the south-east of the junction recorded on this map is also thought to represent Labour in Vain Cottage (MNT23412). The field boundaries are recorded on Sanderson's map, 1835, which records a series of narrow, rectangular fields to the east and west of the A614, although these appear to have been altered by the 1884 OS map (see Appendix 6-2 of Volume 3).

Modern (1900-present)

6.5.15 There are no assets of modern date recorded within the study area.

6.5.16 During the 20th century the road layout of Mickledale Lane Junction remained unchanged and the surrounding landscape has remained mostly rural in nature, albeit with the expansion of Bilsthorpe to the east. However, there are several additions to the landscape during this period, including a row of buildings to the south-east of the existing junction and the Bilsthorpe Colliery Branch railway to the north, both of which are first recorded on the 1947 OS map (see Appendix 6-2 of Volume 3). The railway line has since been removed although the buildings are still extant.

Site Visit

6.5.17 This junction is located to the west of Bilsthorpe, with a modern café to the north-west of the junction, a row of houses to the south-east and agricultural fields to the south-west and north-east. Both of these fields were in arable use at the time of the Site visit. There is low visibility of the junction from the non-designated buildings in Bilsthorpe due to screening from mature trees to the east and west of the Strawson Ltd. compound and the position of the buildings set back from the road.

Plate 6-1 View to the south of Mickledale Lane Junction

Plate 6-2 View to the west from Mickledale Lane Junction, along Inkersall Lane

Plate 6-3 View to the east of Mickledale Lane Junction towards Bilsthorpe

Plate 6-4 View to the south showing the agricultural field to the south-west of Mickledale Lane Junction

Plate 6-5 View to the south into the agricultural field to the south-east of Mickledale Lane Junction

Plate 6-6 View of north and east faces of Labour in Vain Cottage (MNT23412)

Plate 6-7 View of Featherstone House Farm (MNT25737), viewed from the north

Future Baseline

6.5.18 The future baseline is expected to include a solar farm at Inkersall Grange Farm (application number 19/01165/FULM), approximately 700 m from the Scheme. This is outside of the study area used for the assessment and therefore is not expected to change the baseline within the study area. In the absence of the Scheme, it is considered that the site would remain as existing.

6.6 Design, Mitigation and Enhancement Measures

6.6.1 There are no embedded mitigation or enhancement measures relevant to cultural heritage included within the Scheme design as described in Chapter 2: The Scheme.

6.7 Assessment of Likely Significant Effects

Construction

6.7.1 There is no known archaeology within the assessment boundary. There is however the potential for previously unrecorded archaeological remains to survive within the assessment boundary, particularly in agricultural land to the east and west of the A614, which may be physically impacted during the construction of the Scheme. These features may include buried remains associated with the historic road from Bilsthorpe to Inkersall. 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. This is likely to be of low heritage value.

6.7.2 Any construction work may remove surviving archaeological remains within these areas of the Site, resulting in a moderate magnitude of impact. On an asset of low heritage value, this would result in a slight adverse (not significant) effect.

6.7.3 Featherstone House Farm (MNT25737) is a non-designated building located approximately 110 m south-east of the Scheme. The building comprises a post-medieval building identified on Sanderson's 1835 map. The building is single storey with attics, L-shaped in plan and constructed of brick. The building has modern windows although it has an original loft door to the west gable. The building is set within a farm complex with various large barns and warehouses with agricultural land to the east and west and the setting of the building contributes to its value as part of a larger farm complex. The building possesses architectural and historical interest as a surviving post-medieval farm building with some retained features. The building is of low heritage value.

6.7.4 The eastern edge of the Scheme is approximately 110 m north-west of the building. The building is partially screened to the north-west by mature trees to the south of Mickledale Lane, although there are some views between the trees. The construction of a junction to the east of the existing Mickledale Lane Junction would lead to increased noise and traffic closer to the building. The construction of the proposed road through the field to the west of the building may remove part of the building's agricultural setting, although this field is screened from building by large barns to the west and would not change the immediate surroundings of the house. The construction impacts would have a minor magnitude of impact, resulting in a slight adverse (not significant) effect.

6.7.5 Labour in Vain Cottage (MNT23412) is a non-designated building located approximately 250 m east of the Scheme. The building comprises a two storey brick structure, with a white-washed eastern elevation with exposed timber. The building is recorded on Chapman's map of 1774. The setting of the building comprises its location directly to the south of Mickledale Lane, which contributes to its value. The building possesses architectural and historical interest as a surviving post-medieval cottage. The building is of low heritage value.

6.7.6 The Scheme is located to the east of the building and there would be no physical impacts to the building from the construction of the Scheme. The construction of the proposed junction, to the east of the existing Mickledale Lane Junction would increase the noise and traffic that the building experiences, and there would also be temporary increased noise and traffic associated with the construction of the Scheme. The construction of the Scheme would have a minor magnitude of impact, resulting in a slight adverse (not significant) effect.

Operation

6.7.7 There may be a change in the setting of the Featherstone House Farm and Labour in Vain Cottage due to the presence of the Scheme which is proposed to the east of the existing junction. This change would result in increased noise and traffic movement to the north-west of the buildings. This change is considered to have a minor magnitude of impact, resulting in a slight adverse (not significant) effect.

6.8 Additional Mitigation

6.8.1 A watching brief would be required to identify any surviving archaeological remains within the assessment boundary, including remains possibly associated with the historic road from Bilsthorpe to Inkersall.

6.9 Residual Effects

6.9.1 The residual effects of the Scheme in relation to cultural heritage are outlined in Table 6-6 below. 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 previously unknown archaeology	Low	Local	Moderate	Slight adverse	Watching brief proposed to identify any surviving archaeology	Negligible
Setting changes to Featherstone House Farm during construction and operation	Low	Local	Minor	Slight adverse	None proposed	Slight adverse
Setting changes to Labour in Vain Cottage during construction and operation	Low	Local	Minor	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 Responses re Landscape or Visual Matters

Stakeholder	Stakeholder Comments	Scheme Response
Natural England	Landscape and Visual Impacts The consideration of landscape impacts should reflect the approach set out in the Guidelines for Landscape and Visual Impact Assessment (Landscape Institute and the Institute of Environmental Assessment and Management, 2013, 3rd edition), the Landscape Character Assessment Guidance for England and Scotland (Scottish Natural Heritage and The Countryside Agency, 2002) and good practice.	The LVIA methodology within Section 7.4 uses the Guidelines for Landscape and Visual Impact Assessment 3rd Edition (Landscape Institute, 2013).
Natural England	Access and Recreation The ES should include a thorough assessment of the development's effects upon public rights of way and access to the countryside and its enjoyment through recreation. With this in mind and in addition to consideration of public rights of way, the landscape and visual effects on Open Access land, whether direct or indirect, should be included in the ES. Natural England would also expect to see consideration of opportunities for improved or new public access provision on the site, to include linking existing public rights of way and/or providing new circular routes and interpretation. We also recommend reference to relevant Right of Way Improvement Plans (ROWIP) to identify public rights of way within or adjacent to the proposed site that should be maintained or enhanced.	There is limited land affected, none of which is access or public open land. No National Trails have been noted as being present near to any of the Schemes being considered. As such, no significant effects were anticipated and therefore the EIA has not assessed the impacts on accessibility. However, the design has still taken these into account as noted within the descriptions of each Scheme (see Chapter 2: The Scheme). Visual effects are considered within this assessment.

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, 2020c) 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.

7.4.17 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

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

7.4.19 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.

7.4.20 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.

7.4.21 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.

7.4.22 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 8m in height.

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

Significance Criteria

7.4.24 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

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

7.4.26 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-designated or designated areas of local recognition or areas of little sense of place).

Landscape sensitivity (susceptibility and value) of receptor/resource	Typical description
Negligible	Landscapes of very low importance and rarity able to accommodate change.

Source: DMRB LA 107 Table 3.22

Visual Sensitivity

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

7.4.28 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	Static views from and of major tourist attractions: Views from and of very important national/international landscapes, cultural/historical sites (e.g. National Parks, UNESCO World Heritage sites); 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); 2) Views by users of public open spaces for enjoyment of the countryside (e.g. country parks); 3) Static views from dense residential areas, longer transient views from designated public open space, recreational areas; 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; 2) Views by outdoor workers; 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; 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; 2) Views by indoor workers; 3) Views by users of recreational/formal sports facilities where the landscape is secondary to enjoyment of the sport; 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; 1) Views from industrial area, land awaiting re-development;

Sensitivity (susceptibility and value)	Typical descriptions
	2) Views from landscapes of no importance with no variety or distinctiveness.

Source: DMRB LA 107 Table 3.41

Landscape Impacts

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

7.4.30 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 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 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 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; 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 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

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

7.4.32 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

7.4.33 A site visit was undertaken by Landscape Architects from Via during January and July 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 2B).

7.4.34 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 junction and adjacent sections of road between the A614 Old Rufford Road and the unclassified Mickledale Lane, leading to the village of Bilsthorpe to the east. A bridleway (Rufford BW5) leads west from the junction along Inkersall Lane. Also within the site, to the south-east of the junction, is an agricultural field.

7.5.2 The A614 is a two-lane single carriageway, widening for a short distance either side of the junction to accommodate turning filter lanes and traffic islands. It is a busy route linking Nottingham and the A46(T) to the A1(T) and Doncaster, with a 50 mph limit imposed by gantry-mounted average speed cameras, one of which is located

270 m south of the junction.

7.5.3 Lighting columns are located along both sides of the A614. A short section of footway runs to both sides of the road immediately north of the junction, allowing access to central splitter island. A section of footway approximately 400 m long runs to the south along the east side, narrowing then terminating alongside the field and with no onward access.

7.5.4 Hedges line both sides of the A614, generally with a narrow, mown, grass verge. To the north of the junction, the condition is generally good. To the south, along the east side, the hedge is in poor condition and discontinuous, with occasional ash trees. To the west side, the hedge appears to have been laid and runs beyond a ditch, widening into a belt of scrub further south.

7.5.5 To the south-east quadrant of the junction are four two-storey, semi-detached brick built properties, likely dating from around the turn of the 20th century: No.s 1-4 Labour in Vain Cottages. This name appears to be locally bestowed on the junction itself.

7.5.6 The cottages have front gardens with drives and varied boundary features, including hedges and timber fencing. Hedges and trees form the boundary to the rear gardens, with the adjacent field.

7.5.7 Opposite the cottages, in the north-west quadrant of the junction, is The Limes, a café aimed at passing motorists and HGVs, housed in a former bungalow. A residential red brick bungalow lies immediately to the north; both front a large, unsurfaced parking and turning area with flagpoles alongside the A614.

7.5.8 The cottages are unusual in that they are of only a limited number that adjoin the length of the A614, which is otherwise open and does not run through any settlements. As such both they and the café provide a landmark feature at the junction.

7.5.9 Mickledale Lane is a single-carriageway which descends towards Bilsthorpe, with hawthorn hedges to both sides, as well as a section of beech next to No.1 Labour-in-Vain Cottages. Mown verges run along both sides, with a footway to the south. The road is not illuminated.

7.5.10 Inkersall Lane is classified as a bridleway (Rufford BW5) but is surfaced and provides access to a number of residential properties, including Inkersall Lodge (which houses kennels) and Rufford pumping station. Signs prohibiting unauthorised motor vehicles are present. The route is lined with mature trees, one of which is isolated in the car park to the café.

7.5.11 The field within the south-east of the site appeared to have been planted with a cereal crop that had been recently harvested at the time of visit. The field is featureless and slopes gently to the east; this, along with the poor condition of the hedgerow along the A614, affords an open aspect towards buildings and the village of Bilsthorpe beyond.

7.5.12 Outside the site, the character is largely agricultural, but influenced by built form in Bilsthorpe to the east. Closest to the site are large, modern, functional storage sheds and hardstanding for vehicles and load associated with an agricultural business (Strawsons Ltd) at Featherstone House Farm. A band of deciduous trees provides a degree of screening to the buildings along the eastern boundary, with a small lake located to the south.

7.5.13 Beyond the agricultural buildings, the nearest part of Bilsthorpe almost exclusively comprises housing estates built to serve workers following the opening of Bilsthorpe

colliery in the 1920s. Houses to the south date from the 1930s, with those to the north from around the 1950s onwards and include a small number of detached properties opposite Strawsons Ltd premises.

7.5.14 The wide agricultural context is one of medium-large scale rectilinear fields, mainly arable but with some free-range pig farming that has been a feature of the local area in recent years. Fields are generally bounded by hedgerows or belts of trees.

7.5.15 To the north of the site, the wooded embankment and bridge over the A614 of the former Bilsthorpe colliery railway is a prominent feature. Following closure of the mine in 1997, the line was dismantled and later converted to the multi-user Bilsthorpe Leisure Trail, linking the village with attractions in Sherwood Forest to the west.

7.5.16 Overall, the junction has a functional character, influenced by fast-moving traffic, highways signage and the large adjacent café car park. Although the wider context is dominantly agricultural, adjacent fields are intensively farmed and largely featureless. Built form, particularly from the Strawsons Ltd agricultural facilities, reinforces the modern, utilitarian influences.

Landform and Hydrology

7.5.17 The site and study area lie on a gently eastwards-sloping sides of the shallow valley of the Rainworth Water, which rises south of Mansfield, flows east then turns north near to site, on into Rufford Lake and then becoming the River Maun.

7.5.18 The junction lies at 71 m above Ordnance Datum (aOD), with the A614 rising imperceptibly to the south and a high point of 73 m aOD around Clapall Hill, before descending to Red Bridge (68 m aOD) over Rainworth Water. The fall is more visible along Mickledale Lane, which is around 62 m aOD at the lowest point, where it crosses the watercourse further downstream near Mickledale Close.

Vegetation and Land Cover

7.5.19 Aside from the hedgerows, screening blocks and avenue of trees noted above, the site lies around 1 km east of the coniferous blocks that locally dominate Sherwood Forest. Smaller areas of mixed and deciduous trees surround Inkersall Manor and along Rainworth Water at Alder Carr, the latter a designated LWS.

Land Use, Infrastructure and Settlement Pattern

7.5.20 Bilsthorpe is the nearest settlement, with the old part of the village located around 1.5 km to the south-east, centred on the Grade I Church of St. Margaret. Completion of the colliery in 1928 led to a large expansion of mineworker’s housing that now dominates the settlement.

7.5.21 Closure of the colliery in 1992 was followed by restoration of the former workings as woodland and open space alongside a business park, wind turbines and solar farms, all of which lie to the far side of the village, around 1.5 km distant.

7.5.22 Aside from farmland and woodland noted above, a further solar farm and turbine are located around 800 m south-east of the site, at Crifton Lodge.

Public Rights of Way (PRoW)

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

- PRoW Rufford BW5 (bridleway), along Inkersall Lane and linking the A614 with other recreational routes in Sherwood Forest, including Sherwood Pines and associated mountain bike trails;
- PRoW Rufford BW19 (bridleway) running north-east from Mickledale Lane and linking to the Bilsthorpe Leisure trail; and
- PRoW Bilsthorpe FP1 (footpath) along the edge of Bilsthorpe, within an area of new housing off Chewton Close.

Designations

International and National Designations

7.5.24 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

7.5.25 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 character or valued views.

Cultural Heritage Designations

7.5.26 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.

7.5.27 With reference to the Chapter 6: Cultural Heritage, there are no listed buildings within the site or study area. The nearest are located around 1.5 km to the south-east, within the historic centre of Bilsthorpe.

Tranquillity

7.5.28 Tranquillity within the immediate vicinity of the site is low, being reduced by heavy traffic, both queuing and moving. Although located within an ostensibly rural location, the influence of traffic is such that the character is more typical of an urban fringe area.

Published Landscape Character Assessments

7.5.29 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.

7.5.30 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 2B, which illustrates the published landscape character assessment boundaries.

National: Natural England, National Character Area 49 (NCA 49): Sherwood

7.5.31 The site and study area are within NCA 49 Sherwood (Natural England, 2014), which is characterised by a belt of gently rolling, well-wooded hills, with stated key characteristics relevant to the site and study area as follows:

- "*A gently rolling landform of low rounded sandstone hills, which principally coincide with an outcrop of the Permo-Triassic Sherwood Sandstone Group. The sandstone gives rise to well drained, acidic, sandy soils.*

- *Woodland is a distinctive feature of the area with a mosaic of broadleaved, mixed and coniferous woodlands, including ancient oak wood pasture and parkland, and pine plantations.*
- *Wooded horizons frame extensive areas of open arable farmland with large, geometric fields contained by low, often treeless, hawthorn hedges.*
- *Commercial agriculture, especially in the north of the character area, is focused on root crops, although pig and poultry units are also characteristic.*
- *The free draining geology and acidic soils support many areas of unenclosed lowland heathland and acid grassland often associated with the wood pasture areas, but also found on marginal agricultural land, on rail and roadsides and on restored colliery sites.*
- *A dispersed settlement pattern of small villages and farmsteads is common in the agricultural areas, with larger settlements surrounding the perimeter of the area. Characteristic building materials are local red sandstone, and red brick and pantiles.*
- *Coal Measures beneath the sandstone have been extensively mined and the industrial heritage is visible in the landscape. Disused sites are progressively being restored.*
- *The area, especially Sherwood Forest, is intrinsically linked to the internationally renowned legend of Robin Hood*."

7.5.32 Relevant Statements of Environmental Opportunity (SEO) are:

- "*Protect, enhance and promote Sherwood as a landscape of international environmental and cultural significance by securing and expanding the iconic mosaic of woods, heaths and parklands, and enhancing sustainable recreation and cultural opportunities.*
- *Consider the location and design of new development to retain local distinctiveness*."

7.5.33 Relevant stated landscape attributes are:

- *"The free draining geology and acidic soils support a rare and valuable lowland heath/acid grassland mosaic, often found within the wood pasture of the managed country parks, but also found on areas of marginal land; and*
- *Parliamentary enclosure field patterns form the framework of the agricultural landscape and medium to large fields of rectilinear pattern, divided by low treeless hawthorn hedges are characteristic, especially to the north".*

7.5.34 Landscape opportunities include:

- "*Protect, manage and expand the lowland heath / acidic grassland mosaic found in areas of marginal land, which provide valuable habitat to many rare species (including club-mosses, petty whin, dwarf gorse and bilberry)…;*
- *Manage development to reduce its impact on tranquillity, and where appropriate plant native tree species in keeping with the area, to screen the impacts of development. Protect identified existing rural areas where tranquillity and intrusion, including light pollution, are low to ensure this valued resource is maintained*
- *Strengthen the network of hedgerows, which is presently low and overly managed, to enhance the historic landscape pattern and ecological networks. Plan to increase the number of native hedgerow trees, which should be*

predominantly English and/ or sessile oak, and which are lacking in this otherwise wooded character."

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

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

- Sherwood RLCA, which runs northwards from Nottingham to the lowlands of the River Idle.

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

- PZ SH09 Old Clipstone Estate Farmlands, which covers an area from the site northwards to Edwinstowe, between Sherwood Forest and Rainworth Water.

7.5.37 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
Sherwood RLCA	The Sherwood Character Area region is entirely confined within Nottinghamshire and is characterised by a wide and diverse range of landscapes including the heartland of the historic Sherwood Forest and the extensive parklands and large estates of the Dukeries. The area, rich with historical, ecological and landscape features, is intrinsically linked to a number of historical themes including the internationally renowned Robin Hood legend. It is located between the heavily populated Magnesian Limestone Ridge and Nottinghamshire Coalfield regions to the west, and the more rural areas of the Mid-Nottinghamshire Farmlands region to the east.

PZ SH09 Old Clipstone Estate Farmlands (within Sherwood Estate Farmlands)

Key Characteristics

PZ SH09 is characterised by a gently undulating topography and comprises coniferous forestry plantations with broad-leaved margins, alongside intensive arable farming in medium regular geometric fields. Internal field boundaries are poor, with those along roads being stronger and with isolated mature trees, including oak.

The A614 is noted, with isolated farms of red brick core and modern agricultural buildings. A heathland character is apparent to road verges. Landscape condition is described as 'moderate', sensitivity is described as 'moderate' and the overall landscape strategy is 'conserve and create'.

Relevant Landscape Actions are:

Conserve the ecological diversity of small deciduous woodlands throughout the area.

Conserve and Create field boundary and road hedgerows where these have become degraded or lost.

Create opportunities for restoring areas of heath land where appropriate.

Create small deciduous woodlands where appropriate.

Value

No landscape designations.

Detracting features such as the A614 and large agricultural buildings, but visually coherent.

Clipstone Forest and Alder Carr LWS; latter is described as 'a thin canopy of mixed deciduous species over acidic community of some interest'.

Land use plan from John Sanderson 1835 plan is still recognisable in farmed areas.

Isolated vernacular farm buildings, some of which are listed.

Overall: Taking the key characteristics and indicators of value into account PZ SH09 is assessed as medium landscape value.

Future Baseline

7.5.38 The future baseline is expected to include a solar farm at Inkersall Grange Farm (application number 19/01165/FULM). This is on the edge of the study area used for the assessment and therefore is not expected to change the baseline within the study area. In the absence of the Scheme, it is considered that the site would remain as existing.

7.6 Design, Mitigation and Enhancement Measures

7.6.1 The landscape design proposals are shown in Appendix 2-2 within Volume 3B. 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 into the wider context, as far as possible, given the nature of the Scheme;
- achieve and maximise biodiversity and habitat creation 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 Mickledale Lane Junction include:

- use of species rich hedgerows of native trees and shrubs to establish new highway boundaries and integrate the junction into the landscape context;
- removal of redundant highway accesses and removal of hard surfacing along Mickledale Lane to create areas of grassland;
- use of individual and hedgerow trees along the new alignment and A614 to increase tree cover and increase integration within the landscape context of the junction;
- tree planting on the roundabout for amenity value and to filter views; and
- creation of heathland and acid grassland 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 Sherwood 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 below.

Table 7-7: Assessment of Landscape Effects in Construction

PZ SH09 Old Clipstone Estate Farmlands

Susceptibility

The pattern of elements in PZ SH09 is broadly rural but with large-scale intensively cultivated fields and influenced by human activity, including the A614 and coniferous plantations. Construction would increase human activity and directly impact landscape character within the wider rural landscape and may locally appear incongruous. However, given the context of a busy highway, susceptibility to this particular Scheme is assessed as low.

Sensitivity

Taking medium value and low susceptibility into account, PZ SH09 is assessed as low sensitivity to the Scheme in construction.

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

Changes in construction would include removal of a hedgeline; an area of roadside scrub; and a relatively small number of trees, including isolated specimens along the A614 and sections of a planted screen adjacent to the Strawsons Ltd site. There will be reprofiling and loss of arable land within a portion of a large-scale, intensively farmed field, alongside use of a further area of the field for the compound and laydown/storage. Loss or damage to existing landscape character would be of a local scale and extent, predominantly arising from the footprint of the new road. There would be an increase in the amount of activity and human influence within an open, dominantly arable landscape as a result of the presence of machinery, traffic management. However, changes would be short-term, temporary and in some cases reversible on removal of the construction activity. The geographical extent of direct change in the PZ would be localised and indirect effects on the PZ would be of limited geographical extent. Overall, there would be a minor magnitude of effect on PZ SH09 during construction.

Significance of Effect

Overall, taking the low sensitivity and minor magnitude of effect into account there would be an **adverse effect of slight significance** on PZ SH09 during construction.

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

PZ SH09 Old Clipstone Estate Farmlands

Susceptibility

Influence of transport routes on landscape character occurs in the baseline from the A614 and, to a lesser extent, the transport cafe. There is also an influence of built form and lighting from the Strawsons Ltd site. The Scheme would not increase traffic, but would intensify and extend the influence of highways elements outside the current alignment of the road.. Given the context, susceptibility to this particular Scheme in operation is assessed as low both in Year 1 and Year 15.

Sensitivity

Taking medium value and low susceptibility into account PZ SH09 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 new road and roundabout footprints and presence increased lighting and signage. Changes would be long-term and permanent. However, the addition of highway infrastructure would be of a relatively limited scale and extent within the PZ. Indirect effects on the PZ would be of localised and in the context of the existing highway. The Scheme would include addition of vegetation to replace that lost in construction, including new hedge lines, occasional tree planting and areas of species-rich grassland. These will replace areas of the existing, species-poor intensively farmed field and offset the influence of built and highways elements. In year 1 planting would remain immature and contribute little to landscape character. Overall, there would be a minor magnitude of effect on PZ SH09 during Year 1.

At Year 15, the landscape mitigation elements of hedgerow species, occasional trees and areas of species-rich grassland and wetland, more characteristic of the rural qualities of the LCA, will have matured such that they contribute positively to the landscape context of new alignment within PZ SH09. Effects from the highway elements would remain as described for Year 1 with some benefit derived from greater integration within the baseline. Balancing these factors, there would be a negligible magnitude of effect on PZ SH09 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 SH09 in operation Year 1 and a **neutral effect** at Year 15.

7.8 Visual Baseline Conditions

7.8.1 Figure 7-1 of Volume 2B 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 taken from the assessment boundary). These include:

- residents at properties on the edge of Bilsthorpe;
- residents at other individual isolated residential properties along the A614 and Mickledale Lane;
- users of various local rights of way; and
- viewers on the A614 and minor roads.

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 2B Figures 7-1 for locations, Figures 7-4 for viewpoints and Figures 7-5 for photomontages related to Viewpoints 3, 5 and 6) 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 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. Key characteristics of the viewpoint baseline are summarised inTable 7-9.

Table 7-9: Representative Viewpoints Baseline Characteristics

Photoviewpoint 1: Inkersall Lane, Rufford BW 5

Grid reference	Elevation (m aOD)	Receptor type	Approx. distance	Photoplan	Date of Visit
463648, 360948	73	Highway/ Recreational	60m	Figure 7-4-1	July 2021

Description of the baseline view

View from a lane and bridleway looking east across the A614 to Mickledale Lane, framed by the hedgerows either side of the narrow lane. The hedgerows either side of the lane channel the view across the A614 within a narrow panorama including Mickledale Lane running into the distance and elevated properties within Bilsthorpe village in the background.

Value of the View	Value
This viewpoint reflects the views available to users of Inkersall Lane. The viewpoint is not subject to any landscape designations, but the lane has an attractive enclosed character and few detractors such that there is evident amenity value, in spite of the presence of the A614. Overall, the view is ordinary and assessed as being of medium value.	**Medium**

Photoviewpoint 2: The Limes café frontage

Grid reference	Elevation (m aOD)	Receptor type	Approx. distance	Photoplan	Date of Visit
464111, 361164	73	Commercial	15m	Figure 7-4-2	July 2021

Description of the baseline view

View looking east across the A614 to Mickledale Lane and southwards along the A614. Range of view: on the left-hand side of the view is the A614 in the foreground, which gives way to Mickledale Lane running eastwards away from the viewpoint into Bilsthorpe village. A group of properties occupy the middle ground with the hedgerow and grass verge bounded corridor of the A614 receding southwards into the distance. Detracting features in the view include lamp columns and telegraph poles with overhead lines. Away from the immediate junction with Mickledale Lane, the view southwards is relatively open and rural.

Value of the View	Value
The viewpoint is not within an area subject to any landscape designations. Amenity value of the view is assessed as low due to the highway dominance and detracting elements in an ordinary view assessed as low value.	**Low**

Photoviewpoint 3: View from Bilsthorpe Leisure Trail (multi-user route/disused railway)

Grid reference	Elevation (m aOD)	Receptor type	Approx. distance	Photoplan	Date of Visit
463798, 361159	79	Recreational	150m	Figure 7-5-1	July 2021

Description of the baseline view

View looking south from the elevated disused railway towards Feather Stone House Farm, accessed via BW19 off Mickledale Lane. The viewpoint reflects the views available to users of the multi-user recreational route.

The left-hand side of the view is occupied by the buildings of Feather Stone House Farm in the middle ground and open agricultural land divided by Mickledale Lane to the right hand side, rising up to the A614, also bounded by hedgerows. The field to the south of Mickledale Lane occupies the far middleground merging with the wooded ridgeline which forms the horizon. Although both Mickledale Lane and the A614 are within the view, traffic or highway elements associated with them is not a noticeable element due to intervening vegetation.

Views of the existing A614 are obscured by mature vegetation and the agricultural outbuildings of Feather Stone House Farm and those to the south of Mickledale Lane form the main detractors in the view.

Value of the View	Value
The viewpoint is not subject to any landscape designations. It is however located on a well-used recreational route. The village centre of Bilsthorpe is nearby and accessible via PRoW. The amenity value is high is high for those reasons and although the view is partially rural, the large-scale farm buildings are detractors in an otherwise ordinary view and the value of view is assessed as low.	**Low**

Photoviewpoint 4: PRoW Rufford Bridleway 19

Grid reference	Elevation (m aOD)	Receptor type	Approx. distance	Photoplan	Date of Visit
464413, 361268	76	Recreational	510m	n/a	July 2021

Description of the baseline view

Location visited but no views of the area of the Scheme were identified and no panorama taken.

Photoviewpoint 5: Mickledale Lane

Grid reference	Elevation (m aOD)	Receptor type	Approx. distance	Photoplan	Date of Visit
464124, 360944	61	Highway/ Residential	105	Figure 7-5-2	July 2021

Description of the baseline view

View looking west along Mickledale Lane towards the A614. The viewpoint reflects the views available to users of Mickledale Lane and an oblique view for residents from the edge of Bilsthorpe.

The left-hand side of the view is formed by a mature hedge and trees at the edge of Mickledale Lane which recedes into the distance centrally within the view. To the right-hand side of Mickledale Lane a number of brick-built properties and garden frontages are set back from the highway. The hedgerow on the right-hand side of the lane leads the eye upwards to the A614 and a wooded horizon and the Limes Café.

Filters in the view include mature vegetation either side of Mickledale Lane. Detractors include highway signage, lamp columns and telegraph poles.

Value of the View	Value
The viewpoint is not subject to any landscape designations and is predominantly highway focussed within an ordinary view, enclosed and partially restricted by highway vegetation. Visual value is assessed as low.	**Low**

Photoviewpoint 6: A614.

Grid reference	Elevation (m aOD)	Receptor type	Approx. distance	Photoplan	Date of Visit
463740, 360679	69	Highway/ Residential	0m	Figure 7-5-3	July 2021

Description of the baseline view

View from the A614 looking across arable land towards Mickledale Lane and Bilsthorpe. The viewpoint reflects the views available to users of the A614 (predominantly vehicles). Apart from the A614 highway and the elevated housing in Bilsthorpe to the right-hand side of the view the view is largely agricultural in summer but with increased visibility of the agricultural buildings south of Mickledale Lane in the winter, providing a high degree of seasonal contrast.

Filters include the mature vegetation to the west of the agricultural buildings south of Mickledale Lane and hedgerows along the A614. Detractors are limited in summer but include road signage, lighting columns, telephone poles and a cantilever traffic camera as minor elements and in winter the large-scale agricultural buildings.

Value of the View	Value
The viewpoint is not subject to any landscape designations. The amenity value is reduced due to the proximity to the A614 and overall it is an ordinary view, assessed as low value.	**Low**

Photoviewpoint 7: New Road, Bilsthorpe.

Grid reference	Elevation (m aOD)	Receptor type	Approx. distance	Photoplan	Date of Visit
464270, 360760			395m	Figure 7-4-3	

Description of the baseline view

View from the New Road looking across arable land towards the Strawson agricultural buildings and Mickledale Lane, the latter being obscured by intervening buildings and vegetation along Rainworth Water. The viewpoint reflects the views available from properties on New Road (predominantly first floor).

Filters include the mature vegetation to the east of the agricultural buildings and along Mickledale Lane. The agricultural buildings are large scale and prominent and form a detractor, particularly in winter when screening vegetation is not in leaf.

Value of the View	Value
The viewpoint is not subject to any landscape designations. The amenity value is reduced due to the prominence of the agricultural buildings and overall, it is an ordinary view, assessed as low value.	**Low**

7.9 Assessment of Visual Effects

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

Photoviewpoint 1: Inkersall Lane, Rufford BW 5

Susceptibility of Receptor to Specific Change	Susceptibility
All stages: Receptors at this location comprise PRoW users and vehicle users of Inkersall Lane. The PRoW users are at the higher range of susceptibility to visual intrusion from construction/highway impacts as a result of the expectation of appreciation of views and being typically engaged in active enjoyment of the view. The A614 highway forms a minor element of the existing view. PRoW users at this location are assessed as being of moderate susceptibility to change arising from construction activity/highway modification, given an expectation of enjoyment of views. Taking the medium value of the view with the moderate susceptibility to visual intrusion of construction into account, PRoW users are assessed as being of moderate sensitivity.	**Moderate**
Sensitivity	**Sensitivity**
All stages:	**Moderate**
Nature of Effect: Size/Scale, Geographical Extent, Duration and Reversibility	
During construction: Views of activity to construct the roundabout on Mickledale Lane would be available in the far middle ground of the view. Works to close the A614/ Mickledale Lane junction would occur in the near middle ground but be limited in scale and duration compared to the majority of the wider works. The works to Mickledale Lane will include removal of the existing highway surface from the junction of the A614 towards the middleground. Localised removal of vegetation (hedgerows along Mickledale Lane) would be largely indiscernible due to the retention of intervening hedges. The introduction of traffic management/construction activity and machinery would form a very localised element during construction. Overall, construction would be viewed as a transient element by PRoW users and form a minor element in the far middle ground. 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 introduce a roundabout and increased highway infrastructure in far middle-ground views. The foreground and most of the middle ground of Mickledale Lane would be seen as a green area, following removal of the highway surface. The revised junction on Mickledale Lane would be perceived as a distant increase in highway footprint and infrastructure. The absence of vehicles using the former junction with Mickledale Lane and the reduction of highway surface would be a beneficial impact in year 1. At night there will a localised increase in visual intrusion from the additional lighting at the roundabout on Mickledale Lane and along the new section of highway to the south, albeit this will be partially seen against the lighting within Bilsthorpe. Overall, both in daytime and at night the geographical extent of the change in views from this location, including from along the PRoW, would be very limited in scale and geographical extent. Overall, the operational Scheme would result in a negligible adverse magnitude of change at this location in Year 1.	**Negligible**
Year 15 of operation: Landscape mitigation planting, including hedges and trees, within the footprint of the Scheme will 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. Effects from lighting columns and lighting at night will remain. Overall, changes in visual amenity of users, taking the reduction of vehicles queuing to join the A614 from Mickledale Lane into account would represent a neutral effect on visual amenity.	**No change**

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

Photoviewpoint 2: The Limes café frontage

Susceptibility of Receptor to Specific Change	Susceptibility

All stages: Receptors at this location comprise visitors to the cafe. The café users are at the lower range of susceptibility to visual intrusion from construction/highway as a result of being focussed on parking and then eating, rather than appreciation of the view. The A614 highway forms a major element of the existing view.	**Low**
Sensitivity Taking the low value of the view with the low susceptibility to visual intrusion of construction/highway operation into account, viewers at this location are assessed as being of low sensitivity.	**Sensitivity**
All stages:	**Low**
Nature of Effect: Size/Scale, Geographical Extent, Duration and Reversibility	
During construction: Views largely as described for VP1 but in slightly greater proximity and over a wider angle of view. Views of activity to construct the roundabout on Mickledale Lane would be available in the far middle ground of the view. Works to close the A614/ Mickledale Lane junction would occur in the fore ground but be limited in scale and duration compared to the majority of the wider works. The works to Mickledale Lane will include removal of the existing highway surface from the junction of the A614 towards the middleground. Localised removal of vegetation (hedgerows along Mickledale Lane) would be largely indiscernible due to the retention of intervening hedges. The introduction of traffic management/construction activity and machinery would form a very localised element during construction. Overall, construction would be viewed as a transient, localised, element. 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: Views largely as described for VP1 but in slightly greater proximity and over a wider angle of view. Overall, both in daytime and at night the geographical extent of the change in views from this location would be limited in scale and geographical extent and include some beneficial elements as a result of the removal of turning vehicles due to the closure of Mickledale Lane access onto the A614. Overall, the operational Scheme would result in a negligible adverse magnitude of change at this location in Year 1.	**Negligible**
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. Effects from lighting columns and lighting at night would remain. Overall, changes in visual amenity of users, taking the reduction/removal of vehicles queuing to join the A614 from Mickledale Lane into account would represent a neutral effect on visual amenity.	**No change**
Significance of Effect	**Significance**
During construction:	**Slight adverse**
Year 1 of operation:	**Slight adverse**
Year 15 of operation:	**Neutral**

Photoviewpoint 3: View from Bilsthorpe Leisure Trail (multi-user route/disused railway) Refer to Photomontage 7-5-1.

Susceptibility of Receptor to Specific Change	**Susceptibility**
All stages: Receptors at this location comprise users of a recreational route along a disused railway line, on embankment but heavily wooded for most of its proximity to the Scheme. Recreation use of the route is likely to be associated with appreciation of the view and users are at the upper range of susceptibility to visual intrusion from construction/highway infrastructure and therefore susceptibility is assessed as moderate. The majority of users will access the recreational area during the day, such that lighting effects will not be experienced. Taking the low value of the view with the moderate susceptibility to visual intrusion from the Scheme into account, viewers at this location are assessed as being of moderate sensitivity.	**Moderate**
Sensitivity	**Sensitivity**
All stages:	**Moderate**

Nature of Effect: Size/Scale, Geographical Extent, Duration and Reversibility	Magnitude
During construction: The foreground and majority of the middle ground will remain unaltered. Removal of sections of the hedgerows either side of Mickledale Lane will be visible in the right-hand side middle ground as part of the roundabout construction. Similarly, the removal of hedgerows on both sides of the A614 will be visible towards the horizon in the right hand side of the view as part of the roundabout construction on the A614.The site compound within the main area of the works will be visible on rising land, to the south of the A614 roundabout works and add to the degree of construction activity and infrastructure. The construction activity would include soil stripping and earthworks within agricultural land. Construction activity to construct the new section of offline highway and the two roundabouts will, as a result of the elevated nature of the viewpoint, be openly visible. However, due to distance the works would occupy only a small area of a wide panorama and although viewed openly the scale and extent of change in the view would be localised. The viewpoint represents a localised gap in an otherwise well enclosed route and views are therefore confined to a very limited geographical extent along the leisure trail. Given the relatively short duration and reversibility of construction activity combined with the very limited geographical extent and limited scale and extent of construction within the view there will be minor adverse magnitude of change during construction of the Scheme.	**Minor**
Year 1 of operation: The entirety of the main highway modification will be visible in the middle ground and include traffic, signage and lighting columns. Lighting columns will extend southwards along the A614 and along the new offline highway adding over 35 additional columns within this view. At night there will a localised increase in visual intrusion from the additional lighting, but the number of potential night-time viewers at this location is likely to be small. The section of highway within and adjacent to the A614 will be on embankment on the eastern edge due to the fall in topography in that direction, slightly increasing prominence. The scale and extent of change in the view will be less than described in construction (occupying a smaller footprint post construction as a result of removal of the compound and construction corridors) but be a permanent introduction of highway into the view. Adverse effects on viewers would remain of minor magnitude, being localised within a largely unchanged panorama and hence adverse effects would be slight. Refer to Photomontage 7-4-1.	**Minor**
Year 15 of operation: Hedgerow planting along the majority of the new highway will be sufficiently mature to provide some screening of the roundabouts but the orientation of the new offline highway is such that it will remain openly visible, flanked by lighting columns. In particular, the upper section of highway along the A614 will be partially screened but the taller elements including lighting columns will be present. In daytime, as in the baseline view, they are at a distance which they are not prominent and barely register in the view. Adverse effects on viewers would remain of minor magnitude.	**Minor**

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

Photoviewpoint 4: PRoW Rufford Bridleway 19

Nature of Effect: Size/Scale, Geographical Extent, Duration and Reversibility	Magnitude
No elements of the Scheme will be visible, any sky glow from lighting is unlikely to register due to the low light spill of LED. The number of night-time users of the PRoW is likely to be small. Overall, effects on visual amenity will therefore be neutral at all stages	**No change**

Significance of Effect	Significance
During construction:	**Neutral**
Year 1 of operation:	**Neutral**

Year 15 of operation: **Neutral**

Photoviewpoint 5: Mickledale Lane Refer to Photomontage 7-5-2.

Susceptibility of Receptor to Specific Change	Susceptibility
All stages: Receptors at this location comprise users of Mickledale Lane and residents adjacent to it (Fairfield Bungalow and Magnolia Cottage primarily). Resident's views from within properties would be very limited and with the exception of windows in the western gable end of Fairfield Bungalow, oblique due to the orientation of the windows in relation to the works. 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 construction or highway operation. Taking the low value of the view with the low susceptibility to visual intrusion of construction into account, highway viewers at this location are assessed as being of low sensitivity. However, residents in this location have an expectation of enjoyment of the view and while susceptibility for vehicle users is low, for residents it is assessed as moderate.	**Moderate (Residents) Low (Vehicle users).**
Sensitivity	**Sensitivity**
All stages:	**Moderate (Residents) Low (Vehicle users).**
Nature of Effect: Size/Scale, Geographical Extent, Duration and Reversibility	**Magnitude**
During construction: Vegetation removal either side of Mickledale Lane, traffic management and construction activity and machinery would be visible in the middle ground. Machinery, traffic management and removal of existing lighting columns and installation of new signage/lighting will be visible in construction of the new roundabout on Mickledale Lane, centrally in the middle ground and the removal of the existing highway surface extending into the background. The site compound and construction of the main offline highway and revised A614 online junction will be screened by intervening vegetation, along Rainworth Water, to be retained. Construction effects on visual amenity will be relatively short duration and reversible. Construction activity would be prominent but occupy a localised extent of the view for road users and be of less prominence and oblique for residents within properties and similar to road users from within the external frontages to Mickledale Lane and from the western gable end of Fairfield Bungalow. Overall, reflecting the short duration but proximity and incursion of construction and vegetation removal beyond the existing highway into fields, there will be a minor adverse magnitude of change during construction of the Scheme.	**Minor**
Year 1 of operation: The view would contain less vegetation, more lighting columns as well as a noticeable intensification of highway infrastructure associated with the roundabout. Mitigation planting would be immature and contribute little in comparison with that lost to the Scheme. At night, the lighting design and lux plans for the Scheme (Figure 8-2 in Volume 2B) indicate that the extent of illumination will be more extensive within the view compared with the existing, unlit, baseline looking westwards (lighting is present to the rear of the viewpoint). Overall, the highway footprint and traffic within it will be more extensive in the near middle ground but to the rear of the roundabout the replacement of the existing highway surface will partially offset the increased urbanisation. The majority of the new highway will remain screened by intervening vegetation along Rainworth Water, effects largely relating to the elements on Mickledale Lane. Effects at this stage will be permanent but the scale and adverse effects on viewers will be of minor magnitude for residents and highway users, comprising a modified panorama of a larger highway footprint and increased infrastructure with less vegetation. Refer to Photomontage 7-4-2.	**Minor**
Year 15 of operation: Mitigation hedgerows either side of Mickledale Lane will reduce visibility from the windows in the gable end of Fairfield Bungalow. The greening of the upper section of Mickle dale Lane will be beneficial but the adverse effects from the roundabout, signage and lighting will remain. Effects will remain minor magnitude.	**Minor**

Significance of Effect	Significance (Road users)	Significance (Residents)

During construction:	**Slight adverse**	**Slight adverse**
Year 1 of operation:	**Slight adverse**	**Slight adverse**
Year 15 of operation:	**Slight adverse**	**Slight adverse**

Photoviewpoint 6: A614 Refer to Photomontage 7-5-3.

Susceptibility of Receptor to Specific Change	**Susceptibility**
All stages: Receptors at this location comprise users of the A614 and residents of a small number of residential properties adjacent to it and Mickledale Lane. Use of "A" 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 construction or highway operation. However, it is acknowledged that some residents may be engaged in active enjoyment of the view for whom susceptibility is assessed as moderate.	**Moderate (Residents) Low (Vehicle users).**
Sensitivity	**Sensitivity**
All stages: Taking the low value of the view with the moderate susceptibility to visual intrusion of construction into account, residential viewers at this location are assessed as being of moderate sensitivity and highway users of low sensitivity.	**Moderate (Residents) Low (Vehicle users).**
Nature of Effect: Size/Scale, Geographical Extent, Duration and Reversibility	**Magnitude**
During construction: Vegetation removal, traffic management and construction activity and machinery would be visible in the vicinity of the new junction on the A614, in the fore to middle ground. Sections of hedges either side of the A614 will be removed and the agricultural field in the view will contain the construction compound and soils will be stripped to create the offline section linking to Mickledale Lane. Construction activity to construct the revised junction would therefore be prominent within the foreground for highway users. For residents adjacent to the viewpoint, views would be largely from upper floors, predominantly oblique to the main works. However, there will be views of the new Mickledale Lane Junction construction from the rear of the properties, albeit partially filtered through garden vegetation and on lower lying land. Construction would be relatively short duration and reversible of construction activity and for the small number of residents, experiencing a localised and geographically limited view there would be minor adverse magnitude of change during construction of the Scheme. Highway users would experience a transient view occupying much of the panorama to the east and openly visible, taking the duration of the view and works and scale of extent of change across the panorama into account, effects would be moderate magnitude for highway users.	**Moderate (Highway users) Minor (Residents)**
Year 1 of operation: The northern section of the offline highway would be partially in cutting, rising to embankment adjacent to the A614, offering some immediate initial mitigation of visual effects for residents. The view would contain less mature vegetation and more lighting columns as well as a prominent intensification of highway infrastructure albeit for highway users and a noticeable intensification for residents, in part due to lighting columns and lighting. Mitigation planting would be immature and contribute little in year 1. At night, the lighting design and lux plans for the Scheme (Figure 8-2 in Volume 2B) indicate that the extent of illumination will be more extensive than the baseline and introduce lighting within areas previously unlit. Although effects at this stage would be considered permanent, adverse effects on views from the existing A614 would remain moderate magnitude as a result of intensification of built infrastructure in the view. For residents the removal of traffic on Mickledale Lane, in proximity to them and the greening of the former highway is partial mitigation balanced against the more distant views of new highway and associated infrastructure such that effects will be of minor magnitude. Refer to Photomontage 7-4-3.	**Moderate (highway users) Minor (residents)**
Year 15 of operation: By year 15, mitigation hedgerows on top of the cut slopes will provide a high degree of summer screening and winter filtering of views from upper floors of the residential properties and from the A614. Other effects will remain as described in year 1 but with increased integration as a result of the highway planting a, including trees on the A614 roundabout. Consequently, effects on visual amenity would reduce to minor magnitude for highway users and remain minor magnitude for residents, largely as a result of the lighting columns and lighting.	**Minor**

Significance of Effect	Significance (Road users)	Significance (Residents)
During construction:	**Slight adverse**	**Slight adverse**
Year 1 of operation:	**Slight adverse**	**Slight adverse**
Year 15 of operation:	**Slight adverse**	**Slight adverse**

Photoviewpoint 7: New Road, Bilsthorpe.

Nature of Effect: Size/Scale, Geographical Extent, Duration and Reversibility	Magnitude
No elements of the Scheme will be visible, and although there will be increased lighting the intervening buildings form a substantial screen and the use of LED lighting indicates that any sky glow is unlikely to register. Overall, effects on visual amenity will therefore be neutral at all stages.	**No change**

Significance of Effect	Significance
During construction:	**Neutral**
Year 1 of operation:	**Neutral**
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
Sherwood RLCA	Medium	Negligible	Slight	n/a	**Slight adverse**
SH09 Old Clipstone Estate Farmlands (within Sherwood Estate Farmlands)	Medium	Negligible	Slight	n/a	**Slight adverse**
Photoviewpoint 1: Inkersall Lane, Rufford BW 5	Moderate	Minor	Slight	n/a	**Slight adverse**
Photoviewpoint 2: PRoW	Low	Minor	Slight	n/a	**Slight adverse**
Photoviewpoint 3: View from Bilsthorpe Leisure Trail (multi-user route/disused railway)	Moderate	Minor	Slight	n/a	**Slight adverse**
Photoviewpoint 4: PRoW Rufford Bridleway 19	Moderate	No change	Neutral	n/a	**Neutral**
Photoviewpoint 5: Mickledale Lane	Moderate (Residents) Low (Road users)	Minor	Slight	n/a	**Slight adverse**
Photoviewpoint 6: A614	Moderate (Residents) Low (Road users)	Moderate (Residents) Minor (Road users)	Slight	n/a	**Slight adverse**
Photoviewpoint 7: New Road, Bilsthorpe.	Moderate (Residents)	No change	Neutral	n/a	**Neutral**

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
Sherwood RLCA	Medium	Negligible	Slight	n/a	**Slight adverse**
SH09 Old Clipstone Estate Farmlands (within Sherwood Estate Farmlands)	Medium	No change	Neutral	n/a	**Neutral**
Photoviewpoint 1: Inkersall Lane, Rufford BW 5	Moderate	Negligible	Slight	n/a	**Slight adverse**
Photoviewpoint 2: PRoW	Low	Negligible	Neutral	n/a	**Neutral**
Photoviewpoint 3: View from Bilsthorpe Leisure Trail (multi-user route/disused railway)	Moderate	Minor	Slight	n/a	**Slight adverse**
Photoviewpoint 4: PRoW Rufford Bridleway 19	Moderate	No change	Neutral	n/a	**Neutral**
Photoviewpoint 5: Mickledale Lane	Moderate (Residents) Low (Road users)	Minor	Slight	n/a	**Slight adverse**
Photoviewpoint 6: A614	Moderate (Residents) Low (Road users)	Moderate (Residents) Minor (Road users)	Slight	n/a	**Slight adverse**
Photoviewpoint 7: New Road, Bilsthorpe.	Moderate (Residents)	Neutral	Neutral	n/a	**Neutral**

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
Sherwood RLCA	Medium	Negligible	Slight	n/a	**Neutral**
SH09 Old Clipstone Estate Farmlands (within Sherwood Estate Farmlands)	Medium	Negligible	Slight	n/a	**Neutral**
Photoviewpoint 1: Inkersall Lane, Rufford BW 5	Moderate	No change	Neutral	n/a	**Neutral**
Photoviewpoint 2: PRoW	Low	No change	Neutral	n/a	**Neutral**
Photoviewpoint 3: View from Bilsthorpe Leisure Trail (multi-user route/disused railway)	Moderate	Minor	Slight	n/a	**Slight adverse**
Photoviewpoint 4: PRoW Rufford Bridleway 19	Moderate	No change	Neutral	n/a	**Neutral**
Photoviewpoint 5: Mickledale Lane	Moderate (Residents) Low (Road users)	Minor	Slight	n/a	**Slight adverse**
Photoviewpoint 6: A614	Moderate (Residents) Low (Road users)	Minor	Slight	n/a	**Slight adverse**
Photoviewpoint 7: New Road, Bilsthorpe.	Moderate (Residents)	No change	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, 2020d).

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 (Baker Consultants, 2020) – found in Appendix 4-5 of Volume 3;
- Biodiversity Net Gain (BNG) Assessment (Baker Consultants, 2021a) – found in Appendix 4-2 of Volume 3; and
- Shadow Habitats Regulations Assessment (sHRA) (Baker Consultants, 2021b) – 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.

8.3 Consultation

8.3.1 A summary of the biodiversity related responses from the Scoping Opinion, which relate to the Scheme at Mickledale Lane 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	How and where addressed in the ES
Nottinghamshire County Council (Scoping Opinion)	The response received from Nottinghamshire Wildlife Trust has highlighted the need for a methodology for how impacts of changes to noise, light and disturbance are to be assessed in relation to bats and birds.	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 2B). Embedded and additional mitigation, and the assessment are reported in Sections 8.6 and 8.7.
	Biodiversity Net Gain, funding and management 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 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 2B). 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. The proposed landscape designs are specific to the character of the location.
Nottinghamshire Wildlife Trust	No methodology is proposed for how the impacts of changes to noise, light and disturbance will be assessed. For example: Bat activity surveys will be required in order to be able to assess the predicted noise changes on bat foraging activity. 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 2B). Embedded and additional mitigation, and the assessment are reported in Sections 8.6 and 8.7..

Stakeholder	Comment made	How and where addressed in the ES
	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 not applicable to the Mickledale Lane Junction as there are no SAC or SSSI within the Zone of Influence for Air Quality – refer to Chapter 5: Air Quality.
	There could also be impacts of dust on some SSSIs and LWS in close proximity to the junctions, this should also 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 day time visual inspections and evening emergence surveys undertaken at the correct times of year by suitably licensed persons.	No direct or indirect impacts to suitable bat roosting locations are anticipated, as detailed within Section 8.5, 8.6 and 8.7.
	Badgers - surveys of the whole site and adjacent land (up to 250 m) for field signs and setts.	Sub-optimal badger habitat is present within Scheme red-line boundary. Further details can be found within Ecological Appraisal (Bakers, 2020) – Appendix 4-5 of Volume 3 and Section 8.5.
	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: ▪ Habitat loss or degradation; ▪ Noise; ▪ Hydrological/hydrogeological changes; ▪ Dust, NO_x, GHG;	Noted, refer to Section 8.7 for the assessment considering these aspects where relevant.

Stakeholder	Comment made	How and where addressed in the ES
	▪ Vibration; and ▪ 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. 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 2018 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 Mickledale Lane Junction Scheme, are outlined in Table 8-2.

8.4.4 Baker Consultants Ltd was commissioned by Via to undertake the following works in relation to the Scheme:

- a desk-based study using the organisations detailed above;
- a phase 1 habitat survey undertaken in 2019, and further updated in 2020 to record the nature and extent for vegetation and habitats within and adjacent to the Scheme; and
- appraisals and targeted surveys for protected and/or notable flora and fauna.

Table 8-2: Baseline Surveys Undertaken

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.	20th February 2019, Baker Consultants Ltd	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) Full details can be found in Ecological Appraisal (Baker Consultants Ltd, 2020) – Appendix 4-5 of Volume 3
Habitats, botany and suitability for protected and	Updated Extended Phase 1 Habitat Survey, within up to 50 m from	3rd December 2020, Baker Consultants Ltd	Vegetation and habitats present were described and mapped during a walkover of the site.	JNCC (2010) Full details can be found in Ecological Appraisal (Baker

Survey Target	Survey Type and Survey Area	Date Undertaken and Consultancy	Description of Assessment Undertaken	Methodology
notable species	the Project Scheme boundaries		Habitats within the site and surrounding land were appraised for their suitability to support protected and notable species.	Consultants Ltd, 2020) – Appendix 4-5 of Volume 3
Bats	Bat Roost/Habitat Survey, within the Scheme boundaries.	During Extended Phase 1 Habitat Surveys, Baker Consultants Ltd	Habitats within the survey area were assessed for their potential to support roosting, commuting and foraging bats.	Collins, J. (ed.) (2016) Full details can be found in Ecological Appraisal (Baker Consultants Ltd, 2020) – Appendix 4-5 of Volume 3
Great Crested Newt (GCN) *Triturus cristatus*	HSI Assessment, on water bodies within 500 m of the assessment boundary	19th April 2021, Via	Waterbodies within 500 m of the Mickledale Lane Junction assessment boundary were evaluated against the GCN Habitat Suitability Index to measure the suitability of a waterbody for supporting great crested newts (GCN).	Oldham *et al.* (2000) Details found within Section 8.5.
	eDNA survey on suitable water bodies within 500 m of the assessment boundary	19th April 2021, Via	Suitable waterbodies within 500 m of the Mickledale Lane Junction assessment boundary were subject to eDNA analysis to determine the presence, or likely absence of GCN DNA.	Details found within Section 8.5.
Reptiles	Presence absence of reptiles, within and up to 50 m from the assessment boundary.	15th April 2019 – 1st May 2019 (7 survey visits undertaken), Baker Consultants Ltd April 2021 – May 2021 (7 survey visits undertaken), Via East Midlands	Target surveys aimed to establish the presence/ absence of reptiles using artificial refuges and also searching for basking animals within another suitable habitat.	Froglife (1999) Details can be found in Ecological Appraisal (Baker Consultants Ltd, 2020) – Appendix 4-5 of Volume 3 Refer to Section 8.5 for further detail

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, 2021c).

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).

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 (HMSO, 2006c).

8.4.9 In accordance with DMRB LA 115 Habitat Regulations Assessment (Highways England, 2020h), 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, 2020g); 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.

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, 2020i). 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. The modelling followed the methodology in DMRB LA 111 Noise and Vibration (Highways England, 2020e). Further detail can be found within Chapter 10: Noise and Vibration. The modelling was used to provide an indication of the noise level change as a result of the Scheme. 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, Guralnick, Cruz, Lowry and Francis, 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: ▪ European sites • Sites of Community Importance (SCIs); • Special Protection Areas (SPAs); • Potential SPAs (pSPAs); • Special Areas of Conservation (SACs); • Candidate or possible SACs (cSACs or pSACs); and • Wetlands of International Importance (Ramsar sites).

	▪ Biogenetic Reserves, World Heritage Sites (where recognised specifically for their biodiversity value) and Biosphere Reserves. ▪ 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: ▪ The loss of these populations would adversely affect the conservation status or distribution of the species at an international or European scale; or ▪ The population forms a critical part of a wider population at this scale; or ▪ The species is at a critical phase of its life cycle at an international or European scale.

UK or national importance

Sites	Sites including: ▪ Sites of Special Scientific Interest (SSSIs) or Areas of Special Scientific Interest (ASSIs); ▪ National Nature Reserves (NNRs); ▪ National Parks; ▪ Marine Protected Areas (MPAs) including Marine Conservation Zones (MCZs); or ▪ Areas which meet the published selection criteria for those sites listed above but which are not themselves designated as such.
Habitats	Habitats including: ▪ areas of UK BAP priority habitats; ▪ habitats included in the relevant statutory list of priority species and habitats; and ▪ areas of irreplaceable habitats including: ▪ ancient woodland; ▪ ancient or veteran trees; ▪ blanket bog; ▪ limestone pavement; ▪ sand dunes; ▪ salt marsh; ▪ lowland fen. ▪ 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 ▪ the population forms a critical part of a wider population at this scale; or ▪ the species is at a critical phase of its life cycle at 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: ▪ 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 regional scale; or

- the population forms a critical part of a wider regional population; or
- the species is at a critical phase of its life cycle;
- 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:
- Local Wildlife Sites (LWS);
- Local Nature Conservation Sites (LNCS);
- Local Nature Reserves (LNRs);
- Sites of Importance for Nature Conservation (SINCs);
- Sites of Nature Conservation Importance (SNCIs);
- County Wildlife Sites (CWSs).

Habitats — **Areas of habitats identified within the Nottinghamshire Local Biodiversity Action Plan.**

Species — Species including:
- 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 County or unitary authority scale; or
- the population forms a critical part of a wider County or equivalent authority area population, e.g. metapopulations; or
- the species is at a critical phase of its life cycle.
- 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:
- Local Wildlife Sites (LWS);
- Local Nature Conservation Sites (LNCS);
- Local Nature Reserves (LNRs);
- Sites of Importance for Nature Conservation (SINCs);
- Sites of Nature Conservation Importance (SNCIs);
- 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
Adverse	Permanent/irreversible damage to a biodiversity resource; and the extent, magnitude, frequency, and/or timing of an impact negatively affects the integrity or key characteristics of the resource.

Level of Impact (change)		Typical Description
Major	Beneficial	Permanent addition of, improvement to, or restoration of a biodiversity resource; and 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 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 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 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 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. 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
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 month of February 2019, when the initial extended Phase 1 habitat survey was undertaken, and in December 2020 when the updated Phase 1 habitat survey was undertaken, are not optimal to detect signs of some protected species, and annual plants will not be present. However, it is considered that sufficient information was able to be gathered during both of the surveys to determine accurate baseline conditions.

8.4.29 Two areas at Mickledale Lane were not accessible during the December 2020 updated phase 1 habitat surveys. However, these areas were visible for assessment from adjacent fence lines and sufficient information was obtained.

8.4.30 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 below. Some additional information is provided in the subsequent text. The location of designated sites can be viewed on Figure 8-1 of Volume 2B.

Table 8-6: Designated Statutory and Non-Statutory Sites located within the Mickledale Lane Junction Study Area

Name	Status	Location/ distance	Interest
Alder Carr	LWS	25 m to the south-west	Botanical – open wet woodland
Bilsthorpe Grassland	LWS	425 m to the east	Butterfly – grassland species
Sherwood Forest Area	ppSPA	600 m to the west	Nightjar and woodlark
Clipstone Forest	LWS,	900 m to the north-east	Botanical, moth, amphibian, reptiles.

Name	Status	Location/ distance	Interest
Rainworth Water	LWS	900 m to the west	A mosaic of lowland heathland, acid grassland, plantation woodland and fen habitats along Rainworth Water
Bilsthorpe Colliery	LWS	1.1 km to the east	Bird, amphibian and reptile interest – An important site for breeding wading birds
Farnsfield Disused Railway	LWS	1.5 km to the south-east	Botanical – A sizeable linear habitat of dry grassland and scrub
Cutts Wood	LWS	1.7 km to the north-east	Botanical – A mature deciduous compartment of semi-natural character
Eakring Brail Wood	LWS	1.9 km to the east	Botanical – An old woodland site retaining considerable interest in spite of large-scale replanting

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.

Habitats

8.5.4 The following habitats were recorded within and up to 50 m of the assessment boundary during the extended Phase 1 Habitat Survey undertaken in February 2019 and updated in December 2020 by Baker Consultants Ltd (Baker Consultants, 2020) – found in Appendix 4-5 in Volume 3.

Broadleaved plantation woodland

8.5.5 Approx. 6-10 m wide at boundary of Strawson Ltd land. The tree belt comprises sycamore, alder *Alnus glutinosa,* cherry *Prunus* sp., silver birch, rowan *Sorbus aucuparia,* hawthorn, field maple and ash, with ground-ivy dominating the ground layer, and climbing ivy present at the trunk of many of the trees.

Scattered trees

8.5.6 Mature lime trees to the south-west of the Lime's Café and along Inkersall Lane.

Unimproved neutral grassland

8.5.7 Species-poor grassland on the roadside verges dominated by coarse grasses including cock's-foot and false oat grass *Arrhenatherum elatius.* Few herbs are present, but bracken of bramble are locally frequent.

Arable land

8.5.8 Four arable fields are located within the survey area, two east of the A614, and two west of the A614. Three of the four arable fields had been recently harvested at the time of the Phase 1 habitat survey and therefore the ground was bare. One arable field contained sugar-beet crop, located to the west of the A614.

Buildings

8.5.9 On the north-west side of the junction, the Limes Café, its car parking facilities and a house and garden are present. To the north of the car park is an area of bare ground with scattered trees and shrubs that had been recently cleared of vegetation

and debris.

Species poor intact hedgerow

8.5.10 Four species-poor hedgerows are located within the survey area. The hedgerows are all similar, and heavily managed. Species comprise predominantly hawthorn with dog rose and hazel.

Species poor hedgerow with trees

8.5.11 Two species-poor hedgerow with trees are located within the survey area. One of the hedgerows is laid roadside, trimmed with hawthorn and ash trees present. The other hedgerow is untrimmed, 3.5 m high, narrow grass verge with extensive patches of bare, sandy ground. Trees include common lime and silver birch.

Dry ditch

8.5.12 A shallow dry ditch is present to the west of the A614 which is at the base of a species-poor hedgerow. The ditch is vegetated with species-poor neutral grassland species, and infrequent patches of bramble and hemlock.

Protected and Notable Species

8.5.13 Table 8-7 presents the protected and notable species, including invasive non-native plant species, that have been identified as present or potentially present within the assessment boundary and relevant ZoI. The baseline conditions have drawn upon various sources of information as stated in Section 8.4.

Table 8-7: Summary of Baseline Details for Protected and Notable Species within the Mickledale Lane Junction Study Area

Species	Baseline Detail
Bats	Desk Study: The desk study returned 21 records of at least four bat species within the study area including common and soprano pipistrelle Leisler's bat and Noctule. No roosts were identified within the desk study data. Field Study: None of the buildings, including retail and private dwellings, were checked for bats as they are outside of the assessment boundary. Many of the lime trees on Inkersall Lane were considered to have potential to support roosting bats, but these are located outside the assessment boundary and are unlikely to be affected by the Scheme. Two lime trees (*Tilia x europaea*) in the Limes Café car park at OSGR SK 6373 6095 and SK 6371 6095 respectively were considered to have low potential for roosting bats, because of ephemeral rot holes and die-back of some of the outer branches in the crowns. Under current proposals both these trees are not included within the assessment boundary. A mature common lime in the field corner at OSGR SK 6373 6093 was considered to have low potential because of a few rot holes in the lower limbs. This tree is not included within the assessment boundary. The hedgerow/lines of trees on Inkersall Lane and the dismantled railway line to the north of the site (outside of the assessment boundary) form a network of potential dispersal and foraging routes.
Badger	Desk Study: The desk study returned a single record of badger, a roadkill on the A614, approximately 800 m to the north. Field Study: The immediate surrounds of the junction are not particularly suitable for badger and no signs were detected during the field survey.

Species	Baseline Detail
	The dismantled railway line to the north and the habitat alongside Inkersall Lane provide suitable foraging and potential sett building habitat for badgers. Narrow tracks at opposite location through grass verges on Inkersall Lane were recorded in December 2020 at OSGR SK 6358 6095, that may indicate a mammal crossing location.
Other mammals	Desk Study: The desk study returned a single hedgehog record, at approximately 500 m distance. Field Study: The verges on Inkersall Lane provide suitable habitat and gardens of the houses next to the junction are also suitable. However, the roadside verges lack cover and the hedgerow bottoms are very open, and the site is, therefore, largely unsuitable for hedgehog.
Amphibians	Desk Study: The desk study did not return any amphibian records. Field Study: One pond is located approximately 116 m from the assessment boundary. A Habitat Suitability Index (HSI) assessment was undertaken on the April 2021 which concluded that the pond had 'poor' suitability for GCN. Additionally, eDNA analysis undertaken in April 2021 came back negative for GCN DNA, therefore it is considered that there is a likely absence of GCN from this pond.
Reptiles	Desk Study: The desk study returned a record of common lizard *Zootoca vivipara,* approximately 600 m to the north on the verge of the A614 Highway. Field Study: The grassland verges on the A614 Highway are wide and located on sandy soils with mature trees in addition to the hedgerows. Arable field are present beyond the verges. The grassland and bracken strips on Inkersall Lane and to a lesser extent on the west side of the A614 Highway provide the best quality potential habitat for common lizard because there are foraging, resting and basking opportunities. The other verges have fairly short grassland and their associated hedgerows have open bases affording little cover. Targeted surveys of suitable habitat for reptile during April and May 2021 detected the presence of common lizard. The peak count for these surveys was five common lizard. Previous surveys undertaken in April 2019 did not detect any reptiles at the site.
Birds	Desk Study: No bird records were included with data from the NGBRC. Field Study: During the Phase 1 Habitat Survey undertaken in 2019 and updated in 2020, incidental records of birds included a Black headed gull *Chroicocephalus ridibundus, a* carrion crow, kestrel *Falco Tunnunculus,* and fieldfare *Turdus pilaris* were noted. The networks of hedgerows, mature trees on Inkersall Lane and habitats associated with the dismantled railway line to the north provide potential resting, breeding and foraging habitat for a wide range of bird species, if they are present in the local area.
Invasive non-native plant species	Desk Study: Invasive non-native plant species were not identified during the desk study. Field Study: No invasive, non-native plant species were noted during the Phase 1 Habitat Survey.
Invertebrates	Desk Study:

Species	Baseline Detail
	Records returned three butterfly records from Bilsthorpe Grassland LWS Wildlife Site. Records included three species, common blue *Polyommatus icarus*, brown argus *Aricia agestis* and small copper *Lycaena phlaeas.* These are all butterflies of grassland, particularly herb-rich examples. The verges on Inkersall Lane may be able to support some butterfly species, but on the other roads the opportunities for butterflies are limited because of the lack of suitable herbs. Field Study: No incidental records of invertebrate species were observed during the field survey, but the timing was sub-optimal for this.

Importance of Ecological Features

8.5.14 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.

8.5.15 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

Statutory designated site / non-statutory 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	Plantation broadleaved woodland	Woodland provides wildlife dispersal corridors and provide connectivity to the wider landscape beneficial for fauna. Woodland may also provide suitable nesting habitat for fauna.	Local
Grassland	Unimproved neutral grassland	Nottinghamshire LBAP habitat	County
Hedgerow	Species-poor hedgerow	Habitat of Principal Importance in England. Hedgerows provide wildlife dispersal corridors and provide connectivity to the wider landscape beneficial for fauna.	Local
	Species poor hedgerow with trees	Habitat of Principal Importance in England. This habitat supports butterflies, moths and other invertebrates, birds, bats, hedgehog, hares, reptiles, amphibians and other mammals.	Local
Arable	Arable Land	Nottinghamshire LBAP habitat No notable or protected habitats. Common habitats found within the surrounding area, of limited / negligible ecological interest.	County
Ditch	Dry Ditch	Nottinghamshire LBAP habitat No notable or protected habitats. Common habitats found within the surrounding area, of limited / negligible ecological interest.	County
Legally Protected and Notable Species			

Statutory designated site / non-statutory designated site/ habitat/ species	Ecological Feature	Rationale	Importance
Bats	Foraging and Commuting bats	Seven species of bat are species of Principal Importance in England. Five species of bat including within Nottinghamshire LBAP Linear features present within assessment boundary that will be subject to small localised losses	Up to County
Birds	Common nesting bird species across the Scheme	49 species of bird are species of Principal Importance in England. 88 species of birds included within Nottinghamshire LBAP All nesting birds are protected under the Wildlife and Countryside Act 1981 (as amended) (HMSO, 1981) Hedgerows have the potential to support nesting birds	Up to County
Common Lizard	Common lizard population noted within assessment boundary	Species of Principal Importance. Protected by the Wildlife and Countryside Act 1981 (as amended) Common lizard is an LBAP species within Nottinghamshire	County

Future Baseline

8.5.16 The future baseline is expected to include a solar farm at Inkersall Grange Farm (application number 19/01165/FULM), approximately 700 m from the Scheme. This is not expected to change the baseline within the study area. In the absence of the Scheme, it is considered that the site would remain as existing.

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 protected 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 would be put in place to reduce the effects of potential significance during the construction phase on ecological habitats:

- **Loss and replacement of hedgerows**: the loss of hedgerow will be replaced and further enhanced with a species-rich hedgerow / species-rich hedgerow with trees, species comprising of common hazel *Corylus avellana,* hawthorn *Crataegus monogyna,* dogwood *Cornus sanguinea,* holly *Ilex aquifolium,* privet, *Ligustrum vulgare,* blackthorn *Prunus spinosa,* 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 with amenity grassland to the road frontage, flowering native meadow grassland, acid grassland and wet grassland / herbaceous meadow. The grassland will be sensitively managed to allow for it to be of at least moderate value, with only the visibility splays to be managed to a shortly mown sward;
- **Loss of arable land**: an area of arable land will be permanently lost as part of the Scheme development. However, some areas will be replaced with a range of new habitat types, including native embankment meadow, flowering native meadow and aggregate bedded swale;
- **Loss of broadleaved plantation woodland**: an area of plantation woodland will be permanently lost as part of the Scheme. The loss of this woodland will be mitigated for within the island of the new roundabout through the planting of birch and hazel trees; and
- The wet ditch will be realigned and maintained as per the existing wet ditch.

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

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 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.
- **Common lizard:** The provision of newly created habitat for common lizard. An open stone structure of gabion wall will be created and run the length of the entire new road, providing continuous linear habitat leading to the mineral line embankment to the north of the Scheme. The provision of refugia will also be provided in advance of commencement of construction works prior to vegetation clearance to allow reptiles to be displaced into suitable established 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-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; Chapter 10: Noise and Vibration; Chapter 11: Road Drainage and the Water Environment).

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:

- **Bats (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.
- **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.
- **Common Lizard:** To minimise any impacts to common lizard during the construction phase, a mitigation method statement will be prepared and implemented during works which will include ECoW. The mitigation method statement is likely to incorporate a translocation methodology, where reptile exclusion fencing will be installed around the working area and the reptiles will be moved from the Scheme working area to a different suitable location (receptor site).

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

Essential Mitigation - Operation

Habitats

8.6.8 Landscape design plans (Appendix 2-2 in Volume 3B) 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.

8.6.9 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.

8.6.10 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.

8.6.11 The habitat creation / enhancement within the highway boundary and habitat associated with the BNG will be funded by NCC.

Species

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

Enhancements

8.6.13 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 meadow grassland, native embankment meadow grassland and acid grassland seed mix;
- additional scattered trees with species in line with the character assessment of the area; and
- open stone structure of gabion walling beneficial for basking, cover and hibernation for common lizard and reptile pass under Mickledale Lane.

8.6.14 Further detail can be found within the landscape proposals on Appendix 2-2 in Volume 3B.

8.6.15 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 in river units.

8.6.16 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

Statutory Designated and Non-Statutory Designated Sites

Direct effects – habitat loss from vegetation clearance

8.7.3 A total of eight LWSs are located within the search area. The closest LWS is Alder Carr, located 25 m to the south-west of the Scheme. Therefore, there will be no direct habitat loss as a result of the Scheme. All other LWS's are separated from the Scheme by large arable field and main roads. Given the geographical separation of farmland areas and roads between the sites and the junction, and the localised development footprint, an adverse, direct impact on the scientific interest of the LWSs, during the construction phase, is not anticipated.

Indirect effects – dust and air emissions

8.7.4 The potential dust effects have been identified as 'high' for receptors within 50 m of the Scheme, according to the air quality assessment. As Alder Carr is 25 m to the south-west of the site, this falls within this 'high' category. Best practice mitigation measures suitable for this level of risk will be identified and set out in the CEMP for the Scheme that will be prepared by the contractor. Therefore, it is considered that the construction of the Scheme will result in a negligible impact on a receptor of County value, resulting in a neutral effect (not significant).

Habitats

Direct effects – habitat loss from vegetation clearance

8.7.5 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
Arable land	2.1 ha	County	Amenity managed grassland	0.475 ha	-0.033 ha
			Mixed scrub	0.084 ha	
			Sustainable urban drainage feature	0.113 ha	

Existing habitat	Habitat loss (ha) / (m)	Importance	New habitat	Habitat gains (ha) / (m)	Net permanent gains
			Acid grassland	0.095 ha	
			New highway	1.3 ha	
Neutral grassland	0.80 ha	Up to County	Neutral grassland verges, including wet wildflower and meadow grasslands	1.39 ha	0.59 ha
Broadleaved plantation woodland	0.02 ha	Local	Broadleaved woodland	0.05 ha	+0.03 ha
Species-poor hedgerow	540 m	Local	Native species-rich hedgerow	926 m	+386 m
Species-poor hedgerow with trees	290 m	Local	Native species-rich hedgerow with trees	263 m	-27 m
Dry Ditch	320 m		Dry ditch	349 m	29 m

Plantation broadleaved woodland

8.7.6 The construction of the Scheme will result in the temporary loss of 0.02 ha of plantation broadleaved woodland to allow for new access in and out of Strawson Ltd land and to facilitate the construction of the new road. As detailed within Section 8.6, the loss of woodland will be mitigated for and enhanced by replacing and creating a further 0.03 ha of broadleaved woodland. The species of trees include field maple *Acer camestre,* English oak *Quercus robur,* silver birch *Betula pendula* and rowan *Sirbus aucuparia.* All tree species chosen are in keeping with the local character assessment. The plantation woodland to be removed is immature, structurally uniform and has limited understory. Therefore, it is considered that the loss of plantation woodland will be mitigated for in the long-term through replacement planting, however this will take up to 15 years to establish to the same maturity and condition as some of the trees to be removed.

8.7.7 Therefore, given the additional woodland to be created, and the limited value of the plantation woodland to be temporarily lost, it is considered that once established, the loss of plantation woodland will result in a minor beneficial impact on a receptor of local value, resulting in a neutral beneficial (not significant) effect. However, during the construction of the Scheme it is considered that the loss of these trees will result in a moderate adverse impact on a receptor of local value, resulting in a slight adverse effect (not significant).

Unimproved neutral grassland

8.7.8 Approximately 0.8 ha of unimproved neutral grass verges will be lost as part of construction. The verges are ‘weedy’ with common species indicative of disturbance rather than sustained grassland management. However, following completion of the

construction works, this site would be subject to re-instatement and additional creation of 0.59 ha of neutral grassland verges, including wet wildflower and meadow grassland, as detailed within the landscape design. It is considered that in the long-term the proposed embedded mitigation will result in a moderate beneficial impact on a receptor of local value, resulting in slight beneficial (not significant) effect.

8.7.9 It will take approximately 10 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 effect (not significant).

Arable land

8.7.10 An area of approximately 2.1 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 associated with this habitat. The area will be replaced with a new road, amenity grassland, acid grassland, flowering native meadow grassland, native embankment meadow, hedgerow with trees, wetland / wet grassland areas and a stone filled gabion cages providing a mosaic of habitat types considered to provide ecological benefits. Therefore, it is considered that once these habitat types have been established, this would constitute a moderate beneficial impact on a receptor of County value, resulting in a slight beneficial effect (not significant).

8.7.11 It will take up to approximately 15 years for the replacement / created habitats to mature and reach its desired condition. As the arable land is of low ecological interest, it is considered that the loss of this habitat in the short-term would result in a minor impact on a receptor of County value, resulting in a neutral effect (not significant).

Species-poor hedgerow

8.7.12 Approximately 540 m of species-poor hedgerow would be temporarily lost as part of the Scheme. The landscape design includes the replacement and additional creation of 386 m of species-rich hedgerow. Each new hedgerow planted will be species rich 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, further details can be found within the landscape design. It is considered that once established, this would constitute a moderate beneficial impact on a receptor of local value, resulting in a slight beneficial effect (not significant).

8.7.13 It will take approximately 12 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.

Species-poor hedgerow with trees

8.7.14 Approximately 290 m of species-poor hedgerow with trees would be lost as part of the Scheme. The landscape design includes approximately 263 m of species-rich hedgerow with trees to be planted to compensate the loss of habitat. Therefore, construction will result in the permanent loss of 27 m of species-poor hedgerow with trees. Each new hedgerow planted will be species rich 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, further details can be found within the landscape design. It is considered that once established, this would constitute a minor adverse impact on a receptor of local value, resulting in a negligible effect (not significant).

8.7.15 It will take approximately 20 years for the replacement 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.

Dry Ditch

8.7.16 A dry ditch is located along the arable field, to the west of the A614. This ditch will be re-aligned along the new boundary, post-construction, resulting in an additional 29 m of ditch being created. As this will be replaced on a like-for-like basis and further increased, it is considered that this would constitute to a negligible impact on a receptor of local value, resulting in a neutral effect (not significant).

Species

Bats

Direct effect – habitat loss

8.7.17 Two lime trees in the Limes Café car park (SK 6373 6095 and SK6371 6095) were considered to have low potential for roosting bats, and a mature common lime in the field corner at SK6373 6093 was considered to have low potential for roosting bats. These trees will not be affected by the works, therefore no change is anticipated on this receptor of up to County value, resulting in a neutral effect (not significant).

8.7.18 There will be a small and localised loss of hedgerows and patches of plantation woodland belt which provide some suitable bat foraging and dispersal habitat. However, the hedgerows are subject to high levels of artificial lighting from both street lighting and industrial farming units. The landscape design mitigates the loss of these hedgerows by reinstating and further enhancing post development. Additionally, it is considered that the loss of small sections of tree belt are unlikely to lead to fragmentation of suitable commuting habitat. 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

8.7.19 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 and 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 up to County value, resulting in a neutral effect (not significant).

8.7.20 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 fluctuations 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

8.7.21 Suitable nesting habitat is available for common bird species across the assessment boundary. Without mitigation, there is the potential for direct mortality of nesting/ breeding birds through clearance of suitable vegetation.

8.7.22 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

8.7.23 As discussed above, precise information on the construction works is not available and 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 be a negligible impact on a receptor of up to County value, resulting in a neutral effect (not significant).

Common lizard

Direct effects – habitat loss

8.7.24 As detailed within Section 8.6 a method statement will be produced in relation to common lizard which will present a best practice working approach which will ensure that construction works do not inadvertently harm common lizards. Therefore, it is considered that the construction works would have a negligible impact on common lizard, resulting in a negligible impact on a receptor of County value, resulting in a neutral effect (not significant).

Indirect effects – noise impacts

8.7.25 As discussed above, precise information on the construction works is not available and the time of writing this chapter. However, given the mitigation measures detailed, and the temporary nature of the construction, it is considered that the Scheme would result in a negligible impact to a receptor of County value, resulting in a neutral effect (not significant).

Operation

Species

Bats

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

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. Therefore, taking into account the mitigation proposed, it is considered that the Scheme operation will constitute a negligible impact on a receptor of local 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 2B 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 (DMRB, 2020). The lighting extent proposed is greater than the current lighting in place for Mickledale due to the construction of the new road. The lighting Scheme causes the following habitats to become illuminated to greater than 1 lux:

- arable land;
- broadleaved plantation woodland;
- grassland verge; and
- species-poor intact hedgerow.

8.7.30 It is considered that the broadleaved plantation woodland and species-poor intact hedgerow provide some low-quality isolated habitat that may be utilised by foraging and commuting bats. The broadleaved woodland is subject to additional artificial lighting due to the adjacent agricultural buildings. Additionally, the hedgerow is currently subject to artificial lighting to the east and west, leaving only 250 m of unlit hedgerow under the existing lighting scheme. It is therefore considered that due to the small area and habitat types that are likely to be impacted by the lighting for the Scheme, and as the surrounding area is of sub-optimal bat habitat; 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).

8.7.31 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 to determine the changes in noise levels during the operational phase for both the day time and night-time. Noise contour plans are detailed in Figures 8-3 and 8-4 in Volume 2B. A total of 46 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 decrease in noise by a maximum of 0.5 dB with the introduction of the Scheme, and nine receptors where an overall increase in noise levels by a maximum of 5.5 dB. Two receptor locations are subject to an increase in 5.5 dB and 5.1 dB, both which are directly adjacent to the new highway boundary, within arable habitat which is sub-optimal bat foraging / commuting habitat. The remaining seven are subject to a maximum increase of 2.5 dB which is considered to have negligible effects on bats (Barber, Crooks, Fristrup, 2009). As the increase in noise levels is restricted to sub-optimal bat habitat, it is considered that the increase in noise will constitute a minor adverse impact on a receptor of up to County value, resulting in a neutral effect (not significant).

Birds

8.7.32 The operation of the Scheme has the potential to affect birds through direct mortality and habitat degradation, and behavioural changes as a result of increased noise and lighting levels.

8.7.33 Certain birds, for example thrush species and game birds, are at a higher risk of collision as they fly at low height. Collision occurs where hedgerows and other woodland habitat directly adjoins the carriageway. The Scheme incorporates verges and other habitat types directly adjacent to the carriageway, offsetting any suitable habitat directly adjoining the carriageway, which will reduce the risk of direct mortality.

8.7.34 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.

8.7.35 Noise modelling data was obtained for the Scheme to determine the changes in noise levels during the Operational phase. A total of 46 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 decrease in noise by a maximum of 0.5 dB with the introduction of the Scheme, and nine receptors where an overall increase in noise levels by a maximum of 5.5 dB. Two receptor locations are subject to an increase in 5.5 dB and 5.1 dB, both of which are directly adjacent to the new highway boundary. The increase in noise levels result in the overall noise levels to be higher during the operation of the Scheme, which has the potential to cause stress response in some bird species. However, as the noise levels do not exceed 70 dB it is considered that the fitness levels of some bird species will not be impacted.

8.7.36 Therefore, it is anticipated that the increase in overall noise levels immediately adjacent to the Scheme will result in a minor adverse impact on a receptor of up to County value, resulting in a neutral effect (not significant).

Common Lizard

8.7.37 Mitigation measures detailed in the landscape design include a gabion hibernaculum running across the length of the new highway. This will be made up of large – medium aggregate which will create numerous internal voids within which reptiles can use to seek refuge and hibernate. Additionally, this wall will provide connectivity to the adjacent arable field and mineral line, all of which contain further suitable common lizard habitat. The noise levels along the new highway have an overall noise level of approximately 59.5 dB, the existing habitat where the common lizard population are present has an overall noise level of 67 dB, therefore the noise levels during the operational phase is not considered to have an adverse impact. Therefore, given the mitigation measures provided, and the negligible impact on noise levels, it is considered that the Scheme would result in a negligible impact on a receptor of up to County value, resulting in a neutral effect (not significant).

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						
Air quality impact to Alder Carr LWS	County	Increase in dust and reduction in air quality	Negligible	Neutral effect (not significant)	No additional mitigation required	Neutral effect (not significant)
Loss of unimproved neutral grassland	County	Temporary loss of 0.8 ha of unimproved neutral grassland, with an additional 0.59 ha of grassland to be reinstated / created post construction	Moderate adverse	Slight adverse (not significant)	No additional mitigation required	Slight adverse (not significant)
Loss of arable land	County	Permanent loss of 2.1 ha of arable land, with the creation of habitat mosaic post construction	Minor adverse	Neutral effect (not significant)	No additional mitigation required	Neutral effect (not significant)
Dry ditch	County	Realignment and additional creation of 29 m of ditch	Negligible	Neutral effect (not significant)	No additional mitigation required	Neutral effect (not significant)
Loss of plantation broadleaved woodland	Local	Loss of 0.02 ha of plantation woodland, with the like for like replacement and creation of a 0.03 ha of plantation woodland	Moderate adverse	Slight adverse (not significant)	No additional mitigation required	Slight adverse (not significant)
Loss of species-poor hedgerow	Local	Loss of 540 m of species-poor hedgerow, with the replacement and creation of a further 386 m of species rich hedgerow.	Moderate adverse	Slight adverse (not significant)	No additional mitigation required	Slight adverse (not significant)
Loss of species-poor hedgerow with trees	Local	Permanent loss of 27 m of species-poor hedgerow with trees	Moderate adverse	Slight adverse (not significant)	No additional mitigation required	Slight adverse (not significant)
Loss of suitable bat habitat	Up to County	Loss of suitable roosting habitat	No change	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
Loss of suitable bat habitat	Up to County	Loss of suitable foraging / dispersal habitat	Negligible	Neutral effect (not significant)	No additional mitigation required	Neutral effect (not significant)
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 common lizard habitat	County	Injury / mortality during habitat clearance	Negligible	Neutral effect (not significant)	No additional mitigation required	Neutral effect (not significant)
Noise impacts on common lizard	County	Disturbance to common lizard	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)

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
Changes in noise levels (bats)	Up to County	Habitat degradation / behavioural patterns	Minor adverse	Neutral effect (not significant)	No additional mitigation required	Neutral effect (not significant)
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)	Up to County	Habitat degradation / behavioural patterns / stress response / fitness	Minor adverse	Neutral effect (not significant)	No additional mitigation required	Neutral effect (not significant)
Common lizard	County	Habitat degradation due to operational noise	Negligible	Neutral effect (not significant)	No additional mitigation required	Neutral effect (not significant)

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 2B, and Appendix 9-1 of Volume 3B. This assessment has followed the methodology within DMRB LA 109 Geology and Soils Revision 0 (Highways England, 2019b).

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 The following consultation responses are considered to be relevant to the geology and soils assessment:

Table 9-1 Summary of Relevant Consultation Responses

Consultee	Comments	Where Addressed
Nottinghamshire County Council (Scoping Opinion)	*Risks to Source Protection Zone 1 and associated groundwater abstraction need to be fully considered. Particular attention is drawn to the need for the drainage design to take account of the highly sensitive nature of groundwater beneath the site. A controlled waters risk assessment will be required.*	Risks to the SPZ and groundwater have been considered in this chapter Section 9.7.
Environment Agency	*"It is very important that the drainage schemes are considered thoroughly within the EIA given the highly sensitive nature of the groundwater beneath the site.* *Chapter 10 indicates that areas of infilled land may exist at the site. These areas will be investigated in a Phase 2 site investigation that is planned for the scheme. This will include a controlled waters risk assessment.* *We are satisfied with the proposed EIA scope but must stress the importance of considering risks to Source Protection Zone 1 (and associated groundwater abstraction) that is present within the proposed scheme."*	Section 9.7 and Section 9.8. The drainage strategy is within the Flood Risk Assessment (Appendix 4-3 of Volume 3).
Natural England	*"2.4. Regionally and Locally Important Sites* *The ES should thoroughly assess the impact of the proposals on non-statutory sites, for example Local Wildlife Sites (LoWS), Local Nature Reserves (LNR) and Regionally Important Geological and Geomorphological Sites (RIGS). Natural England does not hold comprehensive information on these sites. We therefore advise that the appropriate local biological record centres, nature conservation organisations, Local Planning Authority and local RIGS group should be contacted with respect to this matter."*	Consultation with Nottinghamshire Biological and Geological Records Centre (Table 9-2: External Sources of Information). Section 6.5 – Baseline Conditions.

Consultee	Comments	Where Addressed
	"4. Land use and soils *Impacts from the development should be considered in light of the Government's policy for the protection of the best and most versatile (BMV) agricultural land as set out in paragraph 170 and 171 of the NPPF. We also recommend that soils should be considered under a more general heading of sustainable use of land and the valuing of the ecosystem services they provide as a natural resource, also in line with paragraph 170 of the NPPF.* *Soil is a finite resource that fulfils many important functions and services (ecosystem services) for society; for instance as a growing medium for food, timber and other crops, as a store for carbon and water, as a reservoir of biodiversity and as a buffer against pollution. It is therefore important that the soil resources are protected and used sustainably. The Natural Environment White Paper (NEWP) 'The Natural Choice: securing the value of nature' (Defra, June 2011), emphasises the importance of natural resource protection, including the conservation and sustainable management of soils and the protection of BMV agricultural land.* *Development of buildings and infrastructure prevents alternative uses for those soils that are permanently covered, and also often results in degradation of soils around the development as result of construction activities. This affects their functionality as wildlife habitat, and reduces their ability to support landscape works and green infrastructure. Sealing and compaction can also contribute to increased surface run-off, ponding of water and localised erosion, flooding and pollution.* *Defra published a Construction Code of Practice for the sustainable use of soils on construction sites (BSI, 2009b). The purpose of the Code of Practice is to provide a practical guide to assist anyone involved in the construction industry to protect the soil resources with which they work."*	Soil and agricultural land classification (ALC) survey. Section 9.8 – Additional Mitigation

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 East Midlands Ltd 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 3B, Appendix 9-1.

9.4.2 The report is referenced as follows:

- Via East Midlands Ltd (2021). Mickledale Lane, Bilsthorpe, Nottinghamshire. Phase 1 – Geo-Environmental Desk Study.

9.4.3 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 site. The final report was not available at the time of writing; however, the initial findings of the ALC survey have been used to inform the geology and soils assessment.

9.4.4 To further inform the baseline conditions, additional consultation has been carried out with the following stakeholders, agencies and on-line resources:

Table 9-2: External Sources of Information

Stakeholder / Agency	Details
British Geological Survey (BGS)	GeoIndex Onshore (BGS, 2021a) – information on 1:50,000 geology, faults and artificial ground. 1:50,000 geological map series (BGS, 1996). 113 Ollerton. Solid and Drift (British Geological Survey, 1996).
Cranfield Soil and Agrifood Institute (2021)	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. Information on historic landfill sites (EA, 2021a). Information on authorised landfill site boundaries, (EA, 2021f).
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.

9.4.5 An intrusive ground investigation will be carried out prior to construction. The investigation will include contamination testing and environmental risk assessments for human health, controlled waters and off-site receptors. The results of the investigation will be used to develop appropriate mitigation strategies, including measures to deal with contaminated soils or groundwater that may be encountered during construction.

9.4.6 Based on the site history and Scheme, the intrusive geo-environmental ground investigation is not considered to be a pre-requisite for undertaking the geology and soils assessment.

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 has been taken into account in the assessment, where relevant.

9.4.9 The study areas are shown in Volume 2B, 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 of 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 9-3 and Table 9-4, 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 9-3. 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 9-3 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). 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). 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. Site protected under EC or UK legislation (SAC, SPA, SSSI, Ramsar site, salmonid water). 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. Groundwater that locally supports GWDTE. 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). ALC grade 3a or LCAc grade 3.1.
	Contamination – human health	High sensitivity land use such as public open space.

[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
	Contamination – surface water	Watercourse having a WFD classification shown in a RBMP and Q95 <1.0 m^3/s. Species protected under EC or UK legislation.
	Contamination – groundwater	Principal Aquifer providing locally important resource or supporting a river ecosystem. Groundwater that supports a GWDTE 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). 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. 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. 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 ≤0.001m^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 9-4. 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 9-4 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. 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. 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. 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. Calculated risk of pollution from a spillage ≥2% annually (spillage assessment). Loss or extensive change to a fishery. Loss of regionally important public water supply. Loss or extensive change to a designated nature conservation site. Reduction in water body WFD classification.
	Contamination – groundwater	Loss or, or extensive change to, an aquifer. Loss of regionally important water supply. Potential high risk of pollution to groundwater from routine runoff – risk score >250 (Groundwater quality and runoff assessment). Calculated risk of pollution from spillages ≥2 % annually (Spillage assessment). Loss of, or extensive change to GWDTE or baseflow contribution to protected surface water bodies. Reduction in water body WFD classification.
Moderate	Geology	Partial loss of geological feature / designation, potentially adversely affecting the integrity. Partial loss of / damage to key characteristics, features or elements.

Magnitude of impact (change)	Description	Typical examples
	Soils	Physical removal or permanent sealing of 1 ha – 20 ha of agricultural land. 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).
	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)). 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. Calculated risk of pollution from spillages ≥1 % annually and <2 % annually. Partial loss in productivity of a fishery. Degradation of regionally important public water supply or loss of major commercial / industrial / agricultural supplies. Contribution to reduction in water body WFD classification.
	Contamination – groundwater	Partial loss or change to an aquifer. Degradation of regionally important public water supply or loss of significant commercial / industrial / agricultural supplies. Potential medium risk of pollution to groundwater from routine runoff – risk score 150-250. Calculated risk of pollutant from spillages ≥1 % annually and <2 % annually. Partial loss of the integrity of GWDTE. Contribution to reduction in water body WFD classification.
Minor	Geology	Minor measurable change in geological feature / designation attributes, quality or vulnerability. 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)). Significant contamination is unlikely with a low risk to human health. 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. Calculated risk of pollution from spillages ≥0.5 % annually and <1 % annually. Minor effects on water supplies.

Magnitude of impact (change)	Description	Typical examples
	Contamination – groundwater	Potential low risk of pollution to groundwater from routine runoff – risk score <150. Calculated risk of pollution from spillages ≥0.5 % annually and <1 % annually. Minor effects on an aquifer, GWDTEs, abstractions.
Negligible	Geology	Very minor loss or detrimental alteration to one or more characteristics, features or elements of geological feature / designation. Overall integrity of resource not affected.
	Soils	Physical removal or permanent sealing of <1 ha of agricultural land. 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). 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 using the sources described above. 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 existing junction and surrounding roads will be partially in use during construction of the Scheme. Therefore, road-

users are included as receptors during the construction phase.

9.4.28 It is assumed that the Scheme will not include the development of new land uses that could result in additional significant 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 on completion of the Project.

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 (CL: AIRE. 2011) 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 3B) identified a moderate risk of natural ground stability hazards from compressible deposits (alluvium) immediately to the east of the site and potential risks from areas of deep made ground, if present. The site is also located within an area affected by deep coal mining. 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 In accordance with DMRB LA 109, potential effects related to impacts on future mineral resources do not form part of the geology and soils assessment. 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 9-3.

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 3B).

9.5.3 The site elevation is approximately 70.0 m to 71.0 m aOD at the existing junction of the A614 / Old Rufford Road and Mickledale Lane. The following changes in elevation were recorded within the assessment boundary, moving away from the existing junction:

- To the north, Old Rufford Road falls slightly in elevation, to 70.5 m aOD at the northern extent of the site.
- To the south, Old Rufford Road rises slightly in level to 73.0 m aOD, then falls back to an elevation of 71.0 m aOD at the southern extent of the site. A steep ditch runs along the western edge of the road and partial ditch areas run along the eastern side of the road.
- To the east, Mickledale Lane falls to an elevation of approximately 62.5 m aOD at the north-eastern extent of the site.
- To the south-west, the agricultural field rises in elevation from east to west through the site area. The ground elevation of the field at Old Rufford Road is approximately 73.0 m aOD, rising to approximately 76.0 m aOD at the western boundary of the site.

- To the south-east, the agricultural field falls in elevation from west to east through the site area. There is a steep drop of 1.0 m – 2.0 m from Old Rufford Road to the field. The field slopes downwards to a level of 63.0 m aOD in the north-eastern corner of the site and 66.0 m aOD in the south-eastern corner of the site.
- At the eastern boundary of the site, there is track running in a south-west to north-east direction. The track is relatively flat, with a gradual fall in elevation to the north-eastern corner of the site. The track is roughly level with the field and is approximately 2.0 m to 3.0 m higher than an industrial estate to the east. A steep slope runs along the eastern side of the track.

9.5.4 The topographic data indicates that the ground elevation through the site area falls from west to east, with locally flatter areas representing the on-site roads and footpaths cutting through the natural topography. Steep drops in level are encountered from Old Rufford Road into the field to the east, and from the eastern assessment boundary into a flatter lying developed area, which is largely off-site.

9.5.5 In the wider surrounding area, the ground level continues to rise to the west. Ground levels also locally rise to the east, south-east and south-west of the site, with lower lying areas in between. To the north of the site, the ground forms a valley following a river northward, at approximately 60.0 m aOD.

Published Geology

9.5.6 A summary of the geological setting of the site, based on BGS mapping sources (Section 9.4) is presented in Table 9-5 Summary of Published Geology.

Table 9-5 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 Scheme, shallow deposits of made ground are expected to be present across much of the study area.
Superficial deposits	No superficial deposits are mapped within the site boundaries. Deposits of alluvium are shown within the study area, to the east and south of the site, following a surface watercourse. These deposits comprise clay, silt, sand and gravel.
Bedrock Geology	The published BGS geological mapping identifies the bedrock geology within the site boundaries and the surrounding study area as the Sherwood Sandstone Group, Chester Formation. The Chester Formation is described as pinkish red or buff-grey, medium to coarse grained, pebbly, cross-bedded, friable sandstone.
Faults	No faults are mapped within the study area.

Geological Features

9.5.7 No designated regionally important geological sites (RIGS) or local geological sites (LGS) have been identified within the study area. This is based on the MAGIC application and information from the Nottinghamshire Biological and Geological Records Centre.

Hydrogeology

9.5.8 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 alluvium, to the east and south of the site, is classified as a Secondary A Aquifer. The bedrock geology (Chester Formation) underlying the site is classified as a Principal Aquifer. The main direction of groundwater flow within the Principal Aquifer is likely to be eastward towards the River Trent (which is approximately 16 km east of the site). However, based on the topography of the study area, shallow groundwater could locally be flowing towards the site from the east and west, and migrating northward.
Groundwater vulnerability	Groundwater vulnerability is classed as medium in relation to the limited superficial deposits within the study area (alluvium). 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)	SPZ are defined around large and public potable groundwater abstraction sites. Zone 1 of a SPZ (inner protection zone) for a public water supply is located within the study area, approximately 350 m west of the site. The western part of the study area is located within Zone 2 (outer zone) of a SPZ. This includes the western half of the site. The eastern part of the study area, including the eastern half of the site, is located within Zone 3 (total catchment area) of a SPZ. The site is also located within a Drinking Water SgZ for groundwater, with the exception of the eastern margins of the site. This is related to the public water supply to the west of the site. Drinking Water SgZ are established around public water supplies where additional pollution control measures are needed. This indicates that groundwater pumping is likely to be drawing groundwater from the Principal Aquifer underlying the site towards the public water supply.
Groundwater abstractions	Information from the Environment Agency identifies five current groundwater abstractions for public water supply within 1 km of the site. The exact locations have not been provided; however, the Envirocheck report also includes records related to the same cluster of five boreholes, within the SPZ Zone 1. The closest borehole is approximately 450 m north-west of the site. In addition, the Environment Agency information and Envirocheck report include records for three groundwater abstractions for general agriculture within 1 km of the site. The records relate to spray irrigation, approximately 750 m west of the site and abstractions for spray irrigation and vegetable washing approximately 890 m south of the site. No private groundwater abstractions have been identified by Newark and Sherwood District Council within 1 km of the site.
Discharge consents to groundwater	Information on discharge consents is based on the Envirocheck report only. The Envirocheck report indicates that there are seven discharge consents to groundwater within 1 km of the assessment boundary. These relate to sewage and trade discharges to land / soakaways.

Hydrogeological Feature	Description
	The closest discharge consent is located approximately 140 m east of the site.
Groundwater levels	Groundwater levels at the site are not known. The site lies within an area with limited potential for groundwater flooding to occur. There is potential for groundwater flooding of property situated below ground level near the southern area of the site, indicating that shallow groundwater could be present.
Permeability	Based on the anticipated geology at the site, the natural geology and soils are expected to be highly permeable.

9.5.9 The baseline information indicates that the groundwater receptors within the study area have a very high environmental sensitivity.

9.5.10 Further details on the hydrogeological conditions at the location of the Scheme are presented in Chapter 11: Road Drainage and the Water Environment.

Hydrology

9.5.11 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	No surface water features have been identified on-site, apart from a drainage ditch running along the western side of the A614 / Old Rufford Road. The nearest off-site surface water feature is Rainworth Water, which is located approximately 50 m south of the site, flowing east. Old Rufford Road crosses the river on a bridge. The river then flows to the north-east, approximately 150 m east of the site. Rainworth Water has a Q95 of 0.12 m^3/s. A HEWRAT assessment has been carried out (see Chapter 11: Road Drainage and the Water Environment).
Surface water features – non-linear	A pond is identified on historical mapping approximately 30 m to the south of the site from 1986 onwards. This is assumed to be a balancing pond for surface water runoff. The pond is located at the southern extent of the agricultural industrial estate in a former forested area and drains into Rainworth Water. Another pond feature is located on Rainworth Water, approximately 630 m west of the site. Isolated ponds are also located within the wider study area, to the north-east and south of the site.
Surface water quality	Rainworth Water recorded a GQA Grade C (fairly good) for river quality in 2000 at a monitoring point to the east of the site. The site lies within the Idle River Operational Catchment. Rainworth Water from Source to Gallow Hole Dyke water body had a ‘moderate’ ecological status in 2019. The 2015 ecological objective for the water body was also ‘moderate’.
Drinking Water Surface Water Safeguard Zones (SgZ)	No Drinking Water SgZ for surface water are located within 2 km of the site.

Hydrological Feature	Description
Surface water abstractions	Information from the Environment Agency indicates that there are three current surface water abstractions within 1 km of the site, to the north-east, east and south-east. These relate to spray irrigation (general agriculture). The closest abstraction is recorded approximately 100 m east of the site. The Envirocheck report also indicates that there is an abstraction located approximately 860 m west of the site. This is related to spray irrigation (general agriculture). It is possible that this abstraction is no longer active, as it is not included within the Environment Agency data; however, no end date is supplied in the Envirocheck report.
Discharge consents to surface water	Information on discharge consents is based on the Envirocheck report only. The closest discharge consent is located approximately 85 m east of the site. This was related to discharge of surface water from a storm tank on the sewerage network and was revoked in 2000. A total of 16 records of discharge consents are related to sewage discharges to Rainworth Water at Bilsthorpe Sewage Treatment Works, between 430 m and 570 m north-east of the site. At least eight of the consents are reported to be revoked. No other discharge consents have been identified within 1 km of the assessment boundary.
Pollution incidents to controlled waters (up to 1999)	The Envirocheck report includes 11 incidents within 1 km of the site. All were Category 3 (minor) incidents. The closest incident was approximately 140 m east of the assessment boundary in 1997, involving oils (diesel) and impacting Rainworth water.
Substantiated pollution incidents register (from 1999)	The Environment Agency has provided information on substantiated pollution incidents in the last five years. Two incidents were located within 1 km of the assessment boundary. The closest incident was approximately 110 m north-west of the site. The incident was Category 3 (minor) incident to land and was caused by an illegal waste site. The Envirocheck report includes one incident prior to 2015 within 1 km of the site. This was a Category 1 (major) incident in relation to water impact and a Category 3 (minor) incident in relation to air impact. The pollutant was diesel (including agricultural). The incident occurred approximately 145 m east of the site in 2008, impacting Rainworth Water.
Surface water flooding	The indicative floodplain map for the area, presented in the Envirocheck report, shows that the site is classified as Flood Zone 1. This means that the site is not within an area identified to be at risk of flooding from rivers or sea without defences. No risk of flooding from surface water is identified on-site. The land to the south, south-east and east of the site locally lies within a linear area at risk of flooding from rivers or sea without defences (Flood Zone 3), surrounding Rainworth Water and the adjacent balancing pond feature. Areas of low (1000-year return), medium (100-year return) and high (30-year return) risk of surface water flooding, are also indicated along Rainworth Water and the balancing pond feature. The Flood Zone 3 area and an area at low risk of surface water flooding cross the A614 / Old Rufford to the south of the assessment boundary.

9.5.12 As Rainworth Water has a WFD status and a Q95 of 0.12 m^3/s, the environmental sensitivity of this watercourse is high.

9.5.13 The balancing pond to the south-east of the site is adjacent to Rainworth Water and discharges into the river. Therefore, the sensitivity of this feature is also considered

to be high.

9.5.14 Other local ponds and ditches in the wider area have been excluded as potential receptors from the geology and soils assessment. These features are considered to be at very low risk due to their distance from the site.

9.5.15 Further details on the hydrological baseline conditions at the location of the Scheme are presented in Chapter 11: Road Drainage and the Water Environment.

Historical and Current Land Uses

9.5.16 The baseline conditions related to historical and current land uses and their potential land contamination effects are summarised in Table 9-8 below.

Table 9-8 Historical and Current Land Uses

Identified Land Use	Description
Residential	Four semi-detached houses with gardens are located immediately south-east of the existing junction, on Old Rufford Road, beyond which is agricultural land to the east and south. Houses have been present at this location since at least 1919. The houses are outside the assessment boundary.
Highways	Roads have been present running through the site from north to south and from east to west since pre-1900. The existing junction is located in the north-western corner of the site. The A614 / Old Rufford Road runs north to south through the site. Mickledale Lane runs west to east through the north-eastern area of the site. Inkersall Lane runs west from the junction and is off-site. Old Rufford Road and Mickledale Lane are largely bordered with grass verges and hedges through the site area, with occasional trees. Inkersall Lane is bordered with mature trees on both sides. A bituminous hardstand covered footpath is present on the western side of Old Rufford Road, to the south of the junction and continues to the east of the junction along Mickledale Lane. A bus stop with bituminous hardstand covered footpath is located on the northern side of Mickledale Lane. Service junction boxes and service covers are located immediately south-east of the existing junction, at the corner of Old Rufford Road and Mickledale Lane. An overhead electricity cable crosses Old Rufford Road immediately south of the existing junction. Overhead lines also run along the western verge of Old Rufford Road, to the south of the junction and across Old Rufford Road to each of the houses located to the south-east of the existing junction.
Agriculture	The site area includes most of an agricultural field located immediately to the south-east of the existing junction and east of Old Rufford Road. The only area of the field not included within the assessment boundary comprises an irregular area within the northern half of the field, to the south-east of the existing junction. The site also encroaches into a field on the northern side of Mickledale Lane. The site includes part of a field on the western side of Old Rufford Road. An aerial image from 1999 shows pig pens on this field, which are not currently present. Forested areas are located in the southern part of the study area.
Industrial estate	A small agricultural industrial estate is located on the farm, at the eastern boundary of the site. The industrial estate comprises a number of buildings with hardstanding areas used for parking and yard areas. The main use is expected to be related to processing and packing of agricultural produce (e.g. vegetables and cereals). Rainworth Water is located immediately east of the industrial estate. A footpath runs between the field and the industrial estate. The site includes the footpath and the edge of the industrial estate in the northern half of the site.

Identified Land Use	Description
	The industrial estate was constructed on an existing farm property by 1986. A tank is shown within the industrial estate, approximately 50 m east of the site on the 1986 map. It is not known if the tank is still present. The Envirocheck mapping shows a drop in ground elevation between the edge of the site and the industrial estate. Information obtained from the landowner indicates that there is a soil bund along this boundary of the industrial estate.
Café	The Limes Café and car park is located immediately north-west of the existing junction, beyond which is agricultural land. The car park is unpaved, with some gravel cover. A building has been present in this location since at least 1955.
Mining and quarrying	The site is located in an area historically used for deep coal mining, with the former Bilsthorpe Colliery to the north-east. There are no former collieries within the study area; however, there is potential for historical use of colliery spoil in made ground deposits within the study area. The potential risks from mine gas within the study area are likely to be low due to the depth of the coal seams (approximately 500 m and 830 m below ground level). A railway line (Bilsthorpe Colliery Branch), with embankments and a bridge had been constructed approximately 150 m north of the assessment boundary by 1938, running from west to east. The historical maps identify this as a mineral railway until 2006. Bilsthorpe Colliery closed in 1997. There is a disused railway bridge over the A614 / Rufford Road. The former railway line, running west to east is now used as a public footpath.
Garage / petrol station	A petrol filling station and garage business is located approximately 200 m east of the site.
Waste sites and infilled land	No registered or historical landfill or waste transfer sites have been identified within 250 m of the site. However, an anaerobic digestion facility (<75,000 tonnes / year) is located 369 m south-east of the site. The facility is registered to Featherstone House Farm. The Envirocheck report includes one record of potentially infilled land (water) within the study area. This is located approximately 150 m east of the site.
Designated sites	No designated sites are indicated within the study area. However, the site is located within a SSSI Impact Risk Zone, related to several SSSIs to the west, including Sherwood Forest Golf Course, Clipstone Heath, Strawberry Hill and Rainworth Heath. The site is located within a nitrate vulnerable zone (NVZ).

9.5.17 The baseline information in Table 9-8 identifies the following potential sources of contamination at the site:

- made ground associated with the existing highway construction and surrounding developments;
- made ground associated with possible historical deposition of colliery spoil from Bilsthorpe Colliery;
- hardstanding materials containing coal tar and other potential contaminants;
- spills and leaks of fuels / oils from vehicles utilising the roads on site;
- agricultural land uses (e.g. fertilisers, pesticides, herbicides, leaks and spills);
- agricultural industrial estate adjacent to the east, including tank;
- spills and leaks from the petrol station off-site to the east;

- mineral railway off-site to the north; and
- historical pollution incidents off-site (e.g. illegal waste site).

9.5.18 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, surrounding roads and farm businesses;
- current and future residents in the surrounding area;
- current and future users of the adjacent café; and
- current and future consumers of agricultural products (e.g. crops, meat products).

Soil Resources and Agricultural Land Classification

9.5.19 The baseline conditions related to ALC and soil resources are summarised in Table 9-9 Soil Resources and ALC.

Table 9-9 Soil Resources and ALC

Resource	Description
Soil Types	The soils within the study area are largely described as freely draining, slightly acid sandy soils, with low fertility and low carbon. This type of soil is vulnerable to leaching of nitrate and pesticides to groundwater and erosion under arable and vegetable crops, where sloping.
	Soils associated with Rainworth Water, at the eastern and southern extents of the study area are described as naturally wet, very acid, sandy and loamy soils of very low fertility and medium carbon. This type of soil is also vulnerable to leaching of nitrate and pesticides to groundwater and is vulnerable to wind erosion during dry weather.
Agricultural soils	The site includes a total area of 4.51 ha of agricultural land, comprising: ▪ Approximately 3.55 ha immediately to the east of Old Rufford Road; ▪ Approximately 0.74 ha immediately west of Old Rufford Road; and ▪ Approximately 0.22 ha immediately north of Mickledale Lane. Part of the existing fields would be included within the permanent works, comprising a new roundabout on Old Rufford Road and a road running through the field to the east, between Old Rufford Road and Mickledale Lane. The area of permanent loss to construct the Scheme is estimated to be approximately 2.69 ha. This would include approximately 0.17 ha identified for woodland habitat creation. The remainder (1.82 ha) would be used for the temporary works and could be returned to agricultural use. However, it is noted that the field to the east of old Rufford Road would be divided by the Scheme and may therefore have a reduced value / usefulness as agricultural land. The field to the east of Old Rufford Road is largely classed as Grade 3a on the MAGIC application, which is considered to be BMV agricultural land. Small areas of Grade 3b land are located at the northern and southern extents of the field. The soil resources and ALC survey carried out for the site has confirmed that the agricultural land within the site area is mainly Grade 3a. Areas of Grade 2 and small areas of Grade 3b are also present.

9.5.20 Based on the desk study information and initial survey findings, indicating that BMV land is present within the site area, the environmental sensitivity of the soil resources is assessed to be high.

Future Baseline

9.5.21 The future baseline is expected to include a solar farm at Inkersall Grange Farm (application number 19/01165/FULM), approximately 700 m from the Scheme. This is not expected to change the baseline within the study area. The future baseline is expected to be 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: Prior to commencing construction works, re-usable topsoil and / or subsoil from areas of 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. Construction traffic will use designated traffic routes within the work sites to prevent unnecessary compaction and degradation of soil resources. 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.	The mitigation measures will be determined within a soil resources plan. The plan will be based on the findings of the soil resources and agricultural land quality survey and will be implemented by the appointed contractor. An earthworks strategy (or equivalent document) will be produced by the designer. This will be implemented by the contractor. 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. The works will be carried out in accordance with the Defra “Code of Practice for the Sustainable Use of Soils on Construction Sites” (BSI, 2009b), BS 3882:2015 “Specification for Topsoil and Requirements for Use”, BS 8601:2013 “Specification for Subsoil and Requirements for Use” and the CL:AIRE guidance “The Definition of Waste: Development Industry Code of Practice” (2011).
Human health	Mitigation measures will include the following: Identification and assessment of unexpected areas of contamination. Removal of contamination hotspots, if identified. Dust control measures, to mitigate inhalation risks (e.g. damping down).	Prior to commencing construction works on site, a CEMP and SWMP / MMP will be prepared by the appointed contractor. This will be implemented by the contractor on-site. A contamination watching brief will be prepared and implemented by the

Receptor	Mitigation	Design / Implementation
	Excavated materials will be stockpiled separately based on soil type, to prevent mixing of contaminated materials with uncontaminated materials. Spill control measures will be used, such as dedicated areas for fuel storage and refuelling, bunded tanks, impermeable bases / trays. Emergency spill response procedures and reporting will be in place throughout the construction phase of the project.	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: Spill control measures will be used, such as dedicated areas for fuel storage and refuelling, bunded tanks, impermeable bases / trays. Emergency spill response procedures and reporting will be in place throughout the construction phase of the project. The watercourses to the south and south-east of the site (balancing pond and Rainworth Water) will be protected from surface water runoff related to the construction works and temporary storage area. This could require, for example, an exclusion zone between the storage area and the watercourses, dedicated areas to store hazardous materials further away from the watercourses and barriers to prevent uncontrolled runoff.	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. 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 measures required to protect controlled waters. 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
Soils	Adverse	Permanent loss of approximately 2.69 ha of agricultural land, in total.
		Temporary loss of approximately 0.82 ha of agricultural land during construction.
Contamination - human health - 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. The following potential sources of contamination have been identified: ▪ Made ground on-site. ▪ Hardstanding materials containing coal tar and other potential contaminants. ▪ Spills and leaks of fuels / oils from vehicles utilising the roads on-site.

Receptor Type	Type of Effect	Description
		▪ Agricultural runoff (e.g. fertilisers, pesticides, herbicides, leaks and spills). ▪ Potentially infilled land to the east. ▪ 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 construction compounds, 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.
		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	None identified.	None identified.	Negligible	No change	No change	No
Soils	Use of agricultural land for temporary compounds, storage and access during construction of the Scheme.	Permanent damage to agricultural land during construction works.	High	Minor (adverse)	Moderate adverse (due to potential unnecessary loss of soil resources)	Yes
		Temporary loss of approximately 1.82 ha of agricultural land, compared with the existing baseline.	High	Minor (adverse)	Slight adverse (due to short duration)	No
	Use of agricultural land within the permanent works for the Scheme.	Permanent loss of approximately 2.69 ha of Grade 3a agricultural land, compared with the existing baseline.	High	Moderate (adverse)	Moderate adverse (due to relatively limited loss of mainly Grade 3a land)	Yes
Contamination – human health	Soil and groundwater contamination (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 compounds).	Very high	Negligible (adverse)	Slight adverse (due to potential for permanent contamination impact from construction works).	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)
		Impacts on users of surrounding businesses from ingestion of contaminated particulates, dermal contact with soils and / or inhalation of contaminated dust / particles.	Medium	Negligible (adverse)	Slight adverse (due to short duration and low potential for contamination).	No
		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 adjacent residents from inhalation of ground gas or vapours in indoor air that may have migrated from the site during construction.	Very high	Negligible (adverse)	Slight adverse (due to short duration and low potential for ground gas)	No
		Impacts on users of surrounding businesses from inhalation of ground gas or vapours in indoor air that may have migrated from the site during construction.	Medium	Negligible (adverse)	Slight adverse	No
Contamination – surface water	Soil and groundwater contamination (see Table 9-11).	Impacts on the on-site drainage ditch from surface water run-off and / or migration of contaminated groundwater.	Low	Moderate (adverse)	Slight adverse	No
		Impacts on Rainworth Water and adjacent balancing pond from surface water run-off and / or migration of contaminated groundwater.	High	Minor (adverse)	Slight adverse (due to distance from the site)	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)
Contamination – groundwater	Soil and groundwater contamination (see Table 9-11).	Impacts on Principal Aquifer / SPZ 1 from leaching of contaminated soils, surface water run-off and / or migration of contaminated groundwater.	Very high	Minor (adverse)	Moderate adverse (due to distance from SPZ 1)	Yes
		Impacts on off-site Secondary A Aquifer from leaching of contaminated soils, surface water run-off and / or migration of contaminated groundwater.	Very high	Negligible (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
Soils	Adverse	The operation of the Scheme could potentially result in increased damage to agricultural soils to the south-east of the existing junction, due to the use of a new road running through the field.
Contamination - human health - controlled waters	Adverse	The operation of the Scheme could potentially result in increased pathways for existing ground contamination from the identified potential sources (see Table 9-11) to migrate to receptors. For example: ▪ increased infiltration of groundwater through areas of contaminated ground; and ▪ migration of ground gas or contaminated groundwater through new service conduits or buried structures.
		Future contamination impacts from the highway land use could be more widespread than the current conditions (e.g. spills and leaks from vehicles on the road). This is due to the expansion of the junction with a new roundabout on Old Rufford Road and a new road section crossing an existing field.
		The new road section could potentially increase physical damage to agricultural soils within the site area; for example, from erosion.
	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 likely significant 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.	Negligible	No change	Neutral	No
Soils	Damage to agricultural soils from new road in eastern area (e.g. erosion, loss of nutrients).	Impacts on agricultural land through future damage.	High	Minor (adverse)	Slight adverse (due to limited area of agricultural land)	No
Contamination – human health	Soil and groundwater contamination (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.	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.	Very high	No change	Neutral	No
		Impacts on future consumers of agricultural produce (e.g. contaminated crops or meat products).	Very high	Minor (adverse)	Moderate adverse (due to small area affected)	Yes
		Impacts on users of surrounding businesses from ingestion of contaminated particulates, dermal contact with soils and / or inhalation of contaminated dust / particles.	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 future road users from inhalation of ground gas or vapours.	Low	No change	Neutral	No
		Impacts on adjacent residents from inhalation of ground gas or vapours migrating from the Scheme.	Very high	Negligible (adverse)	Slight adverse	No
		Impacts on users of surrounding businesses from inhalation of ground gas or vapours that have migrated from the Scheme.	Low	Negligible (adverse)	Neutral (due to low sensitivity of receptors and low potential for ground gas sources)	No
Contamination – surface water	Soil and groundwater contamination (see Table 9-13)	Impacts on the on-site drainage ditch from surface water run-off and / or migration of contaminated groundwater.	Low	Minor (adverse)	Slight adverse (due to expansion of the junction to the east)	No
		Impacts on Rainworth Water and adjacent balancing pond from surface water run-off and / or migration of contaminated groundwater.	High	Minor (adverse)	Slight adverse (due to distance from the Scheme)	No
Contamination – groundwater	Soil and groundwater contamination (see Table 9-13).	Impacts on Principal Aquifer / SPZ 1 from leaching of contaminated soils, surface water run-off and / or migration of contaminated groundwater.	Very high	Moderate (adverse)	Moderate adverse (due to distance from SPZ 1)	Yes

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 off-site Secondary A Aquifer from leaching of contaminated soils, surface water run-off and / or migration of contaminated groundwater.	Very high	Negligible (adverse)	Slight adverse (due to proximity of the Scheme to the aquifer)	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. 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 aquifer 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.

9.8.2 The permanent loss of 2.69 ha of Grade 3a agricultural land to construct the Scheme cannot be mitigated. The area of loss is considered to be acceptable in the context of the benefits of the Scheme and the relatively small area affected, which is significantly below the threshold for which consultation with Natural England would be required (20 ha).

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: Residual Effects.

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, apart from the permanent loss of agricultural land in the eastern area of the site. 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
Permanent damage to agricultural land during construction.	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 approximately 1.82 ha of agricultural land, compared with the existing baseline.	High	Loss or damage to soil resources within the assessment boundary.	Minor (adverse)	Slight adverse	See Table 9-15 for additional mitigation.	Slight adverse
Permanent loss of approximately 2.69 ha of mainly Grade 3a agricultural land, compared with the existing baseline.	High	Loss or damage to soil resources within the assessment boundary.	Minor (adverse)	Moderate adverse	No additional mitigation proposed.	Moderate adverse
Construction impacts on adjacent residents from ingestion of contaminated particulates, dermal contact with soils and / or inhalation of contaminated dust / particles.	Very high	Contamination impacts on human health receptors within the study area.	Negligible (adverse)	Slight adverse	No additional mitigation proposed.	Slight adverse
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 compounds).	Very high	Human health impacts from consumption of contaminated crops / meat.	Negligible (adverse)	Slight adverse	No additional mitigation proposed.	Neutral
Construction impacts on users of surrounding businesses from ingestion of contaminated particulates, dermal contact with soils and / or inhalation of contaminated dust / particles.	Medium	Contamination impacts on human health receptors within the study area.	Negligible (adverse)	Slight adverse	No additional mitigation proposed.	Slight adverse
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 site area.	Negligible (adverse)	Slight adverse	No additional mitigation proposed.	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 proposed.	Slight adverse

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 users of surrounding businesses from inhalation of ground gas or vapours in indoor air that have migrated from the site (construction).	Medium	Contamination impacts on human health receptors within the study area.	Negligible (adverse)	Slight adverse	No additional mitigation proposed.	Slight adverse
Construction impacts on the on-site drainage ditch from surface water run-off and / or migration of contaminated groundwater.	Low	Contamination impacts on surface water receptor within the assessment boundary.	Moderate (adverse)	Slight adverse	See Table 9-15 for additional mitigation.	Neutral
Construction impacts on Rainworth Water and adjacent balancing pond from surface water run-off and / or migration of contaminated groundwater.	High	Contamination impacts on surface water receptors within the study area.	Minor (adverse)	Moderate adverse	See Table 9-15 for additional mitigation.	Neutral
Construction impacts on Principal Aquifer / SPZ 1 from leaching of contaminated soils, surface water run-off and / or migration of contaminated groundwater.	Very high	Contamination impacts on groundwater receptors within the study area.	Minor (adverse)	Moderate adverse	See Table 9-15 for additional mitigation.	Slight adverse
Construction impacts on off-site Secondary A Aquifer from leaching of contaminated soils, surface water run-off and / or migration of contaminated groundwater.	Very high	Contamination impacts on groundwater receptors within the study area.	Negligible (adverse)	Slight adverse	See Table 9-15 for additional mitigation.	Neutral
Impacts on agricultural land through future damage during operation.	High	Damage to soil resources within the assessment boundary.	Minor (adverse)	Slight adverse	No additional mitigation proposed due to small area affected.	Slight adverse
Impacts on future consumers of agricultural produce (e.g. contaminated crops or meat products) during operation.	Very high	Human health impacts from consumption of contaminated crops / meat.	Minor (adverse)	Moderate adverse	See Table 9-15 for additional mitigation.	Neutral
Impacts on adjacent residents from inhalation of ground gas or vapours migrating from the Scheme during operation.	Very 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
Impacts on the on-site drainage ditch from surface water run-off and / or migration of contaminated groundwater during operation.	Low	Contamination impacts on surface water receptors within the study area.	Minor (adverse)	Slight adverse	See Table 9-15 for additional mitigation.	Neutral
Impacts on Rainworth Water and adjacent balancing pond from surface water run-off and / or migration of contaminated groundwater during operation.	High	Contamination impacts on surface water receptors within the study area.	Minor (adverse)	Slight adverse	See Table 9-15 for additional mitigation.	Neutral
Impacts on Principal Aquifer / SPZ 1 from leaching of contaminated soils, surface water run-off and / or migration of contaminated groundwater during operation.	Very high	Contamination impacts on groundwater receptors within the study area.	Moderate (adverse)	Moderate adverse	See Table 9-15 for additional mitigation.	Slight adverse
Impacts on off-site Secondary A Aquifer from leaching of contaminated soils, surface water run-off and / or migration of contaminated groundwater during operation.	Very high	Contamination impacts on groundwater receptors 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, 2020e).

10.1.2 This chapter should be read in conjunction with Figures 10-1 to 10-3 within Volume 2B.

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 in Volume 2B 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) (DfT, 1988);

- BS 5228-1&2:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites (BSI, 2009a); and
- BS 7385-2:1993 Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from ground borne vibration (British Standards, 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 on Figure 10-1 in Volume 2B. 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, 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 a link is provided to the most recent noise mapping carried out in England which includes the roads around Mickledale Lane Junction Scheme. 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) (HMSO, 2006a) 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 two 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 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 95 NSRs were identified within the 300 m study area and eight 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 444 NSRs were identified within the 600 m study area and includes a non-residential receptor: Bilsthorpe Village Hall.

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 on Figure 10-1 in Volume 2B.

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 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 (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75	Existing ambient noise level
Evenings (19:00 – 23:00 weekdays) (13:00 – 23:00 Saturdays) (07:00 – 23:00 Sundays)	55	60	65	Existing ambient noise level
Night-time (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 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 (HMSO, 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.

- 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 There are four residential properties which lie immediately adjacent to the south-east corner of the existing junction fronting onto the A614 Old Rufford Road. To the north-west corner of the junction is The Limes Café and a further residential receptor set back from the roadside by approximately 35 m with an intervening informal car/ lorry parking area associated with the neighbouring café.

10.5.2 There is a large commercial premise located approximately 200-400 m south-east of the junction with the edge of Bilsthorpe village approximately 400 m to the east of the junction.

10.5.3 The existing noise climate at the nearest properties is likely to be dominated by traffic noise, with those located further east on the edge of Bilsthorpe village dominated by distant road traffic and occasional commercial and agricultural activity noise.

10.5.4 An LWS (Bilsthorpe Grassland) is located within the Scheme study area (located south-east of the study area).

10.5.5 No NIAs were identified through the Extrium, England Noise and Air Quality Viewer (Extrium, 2018) within 600 m of the Mickledale Lane Junction Scheme.

10.5.6 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
1 Labour in Vain Cottage, NG22 8TH, Bilsthorpe	65 - 69.9	65.0	70 - 74.9	69.7	60 - 64.9	60.1
Limes Café, NG22 8TH, Bilsthorpe	55 - 59.9	59.6	60 - 64.9	61.2	50 - 54.9	52.7

10.5.7 The results obtained from the Scheme developed noise model for Mickledale Lane Junction show noise levels at the validation points are within the Defra Noise Level range for $L_{Aeq,16hr}$ and L_{den}. For L_{den} the noise modelling results are either within the Defra noise level range or within less than 1 dB(A). As such, the Scheme developed noise model is considered 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	443	1	443	1
	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 $LA_{10,18hr}/L_{night}$ (beneficial)	0.1 - 2.9	Negligible	0		0	
	3.0 - 4.9	Minor	0		0	
	5 - 9.9	Moderate	0		0	
	> 10	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 The new junction will be located further south of the existing junction remote from the four properties located on the south-east corner of the existing junction. The

section of Mickledale Lane between the A614 and the new road junction to the east will be converted to a footpath with no vehicle access available onto the A614. The changes will result in a marginal reduction in traffic flows adjacent to the four receptors located on the south-east corner of the existing junction.

10.6.2 As a consequence of the new roundabouts on the A614 and Mickledale Lane, there will be localised reductions in traffic speed on the approaches to the new junctions.

10.7 Assessment of Likely Significant Effects

Construction

Construction Noise

10.7.1 At this stage, precise information on the construction works are 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)	4	1	1	1	1	2	22	20	43

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 five NSRs within 25 m of the assessment boundary, with further three NSRs at approximately 50, 75, and 100 m (respectively) with the remaining NSRs (87 in total) all located more than 100 m from the Scheme 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: 1 Labour in Vain Cottage, NG22 8TH, Bilsthorpe	65.5	65	70	Less than 10 m	80.1 - 83.5 dB(A)	10.1 - 13.5 dB(A)	Major
R2; 2 Labour in Vain Cottage, NG22 8TH, Bilsthorpe	65.4	65	70	Less than 10 m	80.1 - 83.5 dB(A)	10.1 - 13.5 dB(A)	Major
R3: 3 Labour in Vain Cottage, NG22 8TH, Bilsthorpe	65.2	65	70	Less than 10 m	80.1 - 83.5 dB(A)	10.1 - 13.5 dB(A)	Major
R4: 4 Labour in Vain Cottage, NG22 8TH, Bilsthorpe	64.9	65	70	Less than 10 m	80.1 - 83.5 dB(A)	5.6 - 13.5 dB(A)	Major
R5: The Limes, NG22 8TH, Bilsthorpe	56.8	55	65	10 - 25 m	72.2 - 83.5 dB(A)	7.2 - 10.6 dB(A)	Major
R6: Fairfield Bungalow, NG22 8RF, Bilsthorpe	56.0	55	65	25 - 50 m	64.6 – 75.6 dB(A)	0.0 – 10.6 dB(A)	Minor - Major
R7: Magnolia Cottage, NG22 8RF, Bilsthorpe	55.6	55	65	50 - 75 m	60.2 – 68.0 dB(A)	0.0 – 3.0 dB(A)	Minor - Moderate
R8: Fairfield Farm House, NG22 8RF, Bilsthorpe	54.6	55	65	75 - 100 m	57.1 – 63.6 dB(A)	0	Minor

10.7.3 Table 10-10 considers the eight closest NSRs and indicates potential for a major impact from the construction noise activities at up to six receptors, five of which are located on A614 Old Rufford Road (Labour in Vain cottages and The Limes) due to

the proximity of the NSRs to the construction works boundary. However, while there will be some works taking place near these properties to accommodate changes to the existing Mickledale Lane Junction, the majority of the works will be focused on the new roundabout to the south on the A614 and the new road linking to Mickledale at distances in excess of 100 m, indicating that the impacts from the construction noise will be negligible to minor for the majority of the time.

10.7.4 The magnitude of noise impact is predicted to range between minor to major adverse at Fairfield Bungalow and minor to moderate adverse at Magnolia Cottage when plant is operating at the nearest works boundary (Table 10-10). However, again, most of the time the construction works will occur at much greater distances with a likely lower corresponding magnitude of impact for the majority of the works. The impacts from the construction noise will be negligible to minor for the majority of the time.

10.7.5 The remaining receptors which are located at distances in excess of 75 m are expected to experience negligible to minor adverse effects, throughout the construction phase.

10.7.6 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.

10.7.7 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 up to seven NSRs as identified in Table 10-10.

10.7.8 Should evening working be required, there is potential for major impacts to extend to NSRs located up to 100 m from the works boundary and moderate impacts up to around 150 m from the works boundary, depending on the pre-existing ambient noise levels at the NSR.

10.7.9 Should night-time working be required, there is potential for major impacts to extend to NSRs located up to 200 m from the works boundary and moderate impacts up to around 300 m from the works boundary, depending on the pre-existing ambient noise levels at the NSR and precise location of work activities. Though, it is likely at these distances, many would experience much lower levels of noise due to intervening screening effects.

10.7.10 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

10.7.11 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.

10.7.12 Vibration levels during works using vibratory rollers have been estimated in accordance with the procedures set out in BS 5228-2 Table E.1.

10.7.13 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.

10.7.14 The typical sources of ground vibration include hydraulic breakers and vibratory rollers during the road construction phases.

10.7.15 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.

10.7.16 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).

10.7.17 Six receptors are located within 50 m of works, where a large vibratory roller could be in use and five located within 20 m of works where a medium sized towed roller could be in use.

10.7.18 The magnitude of the potential vibration annoyance impact is considered moderate adverse to these human receptors.

10.7.19 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.

10.7.20 The remaining residential dwellings inside the construction study area are located further than 50 m of the main construction works and so only negligible to minor adverse effects are expected to occur at these receptors.

Operation

10.7.21 Detailed predictions have been carried out for a total of 444 receptors identified within the study area (which includes a non-residential NSR: Bilsthorpe Village Hall).

10.7.22 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

10.7.23 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	13	0	13	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	32	0	44	0
Decrease in noise level dB $LA_{10,18hr}/L_{night}$ (beneficial)	0.1 - 0.9	Negligible	398	1	386	1
	1.0 - 2.9	Minor	0	0	0	0
	3.0 - 4.9	Moderate	0	0	0	0
	> 5	Major	0	0	0	0

10.7.24 During the daytime in the opening year of 2023, the majority of NSRs within the 600 m calculation area (89.9%) are predicted to experience a negligible beneficial impact (0.1 - 0.9 dB decrease) due to traffic noise from the implementation of the Scheme, 7.2 % of receptors are predicted to experience no change in traffic noise levels, and 2.9 % of receptors a negligible adverse impact (0.1 - 0.9 dB increase).

10.7.25 During the night-time in the opening year of 2023 the results are similar when compared to day-time, with the majority of NSRs within the 600 m calculation area (87.2 %) predicted to experience a negligible beneficial impact (0.1 - 0.9 dB decrease) due to traffic noise from the implementation of the Scheme, 9.9 % of receptors are predicted to experience no change in traffic noise levels, and the remaining 2.9 % of receptors a negligible adverse impact (0.1 - 0.9 dB increase).

10.7.26 In the short-term, the overall trend is for a negligible beneficial impact due to the introduction of Scheme. This is likely to be primarily due to the location of the new junction further south from the NSRs on the A614 Old Rufford Road and lower speed limit on Mickledale Lane.

10.7.27 The maximum increase of traffic noise levels at any NSR location is 0.4 dB(A) for the day and night-times, with a corresponding maximum decrease of 0.7 dB(A) for the day and night-time receptors.

10.7.28 Noise contours illustrating the predicted short-term (DMOY vs DSOY) noise level change within the 600 m study area are presented on Figures 10-2 and 10-3 in Volume 2B.

Long-term

10.7.29 For long-term impacts as a result of the Scheme, a comparison is made between the DMOY and DSFY (Table 10-12).

Table 10-12: Long-term traffic noise levels changes with the Scheme (DMOY VS DSFY).

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	363	1	357	1
	3.0 - 4.9	Minor	0	0	0	0
	5.0 - 9.9	Moderate	0	0	0	0
	> 10	Major	0	0	0	0
No Change	0	No Change	33	0	40	0
Decrease in noise level dB $LA_{10,18hr}/L_{night}$ (beneficial)	0.1 - 2.9	Negligible	47	0	46	0
	3.0 - 4.9	Minor	0	0	0	0
	5.0 - 9.9	Moderate	0	0	0	0
	> 10	Major	0	0	0	0

10.7.30 During the daytime and night-time in the DMOY vs DSFY, most 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 (81.9 % and 80.9 %, respectively). The largest increase for the daytime noise levels is 1.1 dB(A), and 1.0 dB(A) for the night-time period.

10.7.31 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.

10.7.32 The remaining receptors are expected to experience either no change or a negligible beneficial noise impact from the Scheme in the long-term.

10.7.33 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. In addition, any beneficial impacts from the implementation of the Scheme are also not significant.

Operational traffic noise – above SOAEL

10.7.34 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	0	2

Scenario	Day ($LA_{10,18hr}$)	Night (L_{night})
DSOY	0	0
DMFY	0	3
DSFY	0	2

10.7.35 For daytime, the results of the assessment did not identify any receptor above SOAEL threshold (68 dB (A)) for all the scenarios developed (DMOY, DSOY, DMFY, and DSFY).

10.7.36 For night-time traffic noise levels, the assessment indicates the Scheme could result in small noise reductions at two receptors (located on A614 Old Rufford Road) experiencing traffic noise levels above SOAEL (55 dB L_{night}) reducing noise levels to below SOAEL (55dB L_{night}).

10.7.37 Similarly, In the long-term, the assessment indicates the Scheme could result in a reduction of one receptor (located on A614 Old Rufford Road) experiencing traffic noise levels above SOAEL (55 dB L_{night}).

10.7.38 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.

10.7.39 It is also demonstrated that the Scheme also complies with the aims of the Noise Policy Statement for England (NPSE) (Defra, 2010) 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

10.7.40 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 Principal 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; and
- 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 15 m of receptors.

10.8.2 There is also the potential for additional attenuation of noise from construction activities through the use of 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 7no. receptors	Up to Major	Significant Adverse	BPM & Temporary screening where feasible	Significant Adverse

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 Vibration	High	Temporary 6no. receptors	Up to Major	Significant Adverse	BPM	Significant Adverse
Construction Noise	High	Temporary 88no. receptors	Negligible - Minor	Not Significant	-	Not Significant
Construction Vibration	High	Temporary 2no. receptors	Negligible to Minor	Not Significant	-	Not Significant
Operational Traffic	High	Long-term. Local across study area (444 NSRs)	Negligible Adverse to Negligible Beneficial	Not Significant	-	Not Significant

11. ROAD DRAINAGE AND THE WATER ENVIRONMENT

11.1 Introduction

11.1.1 This chapter presents the assessment of the likely significant effects of the Scheme on road drainage and water environment. The water environment assessment considers water quality, groundwater, flood risk and drainage.

11.1.2 Hydromorphological impacts were scoped out as there are no direct works to watercourses with this Scheme.

11.1.3 A qualitative assessment of groundwater level and flow only has been undertaken at this stage since no cuttings or significant excavations are included within the design.

11.1.4 The assessment has followed the approach within DMRB LA 113 Road Drainage and the Water Environment (Highways England, 2020f). This chapter cross-refers to Chapter 9: Geology and Soils and Chapter 8: Biodiversity where appropriate.

11.1.5 This chapter should be read in conjunction with Figures 11-1 and 11-2 in Volume 2B and Appendices 11-1 and 11-2 in Volume 3B. The FRA can be found in Appendix 4-3 of Volume 3.

11.2 Legislation and Policy

11.2.1 Relevant water environment legislation and policy can be viewed in Chapter 11: Road Drainage and the Water Environment in Volume 1.

11.3 Consultation

11.3.1 Table 11-1 notes the responses from the Scoping Opinion relating to the water environment at Mickledale Lane Junction.

Table 11-1: Scoping Opinions

Consultee	Comment	Response
NCC (Scoping Opinion)	NCC advise that a Flood Risk Assessment and surface water drainage strategy are required as part of any EIA for the Scheme.	The FRA is included in Appendix 4-3 of Volume 3. This includes the drainage strategy document.
Environment Agency	The Environment Agency draws attention to controlled water protection. The site overlies Chester Sandstone Formation, which are Secondary A and Principal Aquifers respectively. Zone 1 of an SPZ (inner protection zone) for a public water supply is located within the study area, approximately 150 m west of the Scheme junction. Most of the site is located within a Drinking Water Safeguard Zone for groundwater. This relates to the public water supply to the west of the Scheme. A Phase 2 site investigation will include a controlled waters risk assessment.	A preliminary risk assessment for controlled waters has been undertaken based on the preliminary conceptual model within Appendix 9-1 in Volume 3B. A controlled waters risk assessment would be undertaken in advance of construction work. Chapter 9: Geology and Soils also includes assessment of the Phase 2 geo-environmental ground investigation.

11.4 Assessment Methodology

Baseline Conditions

11.4.1 Establishment of the baseline conditions has involved reference to existing data sources, consultation with statutory bodies and other organisation, and field surveys. These sources are described in more detail in the following sections.

11.4.2 A desk study has been undertaken to establish baseline information, this included a review of the following data sources:

- Environment Agency data requests, received January 2021 (Environment Agency Reference EMD-191101) (EA, 2021e);
- online OS (OS, 2021) and aerial maps (Bing, 2021);
- Met Office (2021) website;
- British Geological Survey Geoindex website (BGS, 2021b);
- Cranfield University's 'Soilscapes' website (Cranfield University, 2021);
- Environment Agency Catchment Data Explorer website (EA, 2021b);
- Environment Agency Flood Map for Planning website (EA, 2021c);
- Environment Agency Water Quality Archive (EA, 2021d);
- Environment Agency Areas Susceptible to Groundwater Flooding website (AStGwF) (GOV.UK, 2021a);
- Highways England Drainage Data Management System (HADDMS) (Highways England, 2021).;
- Humber River Basin District RBMP (Defra, 2016);
- Nottinghamshire County Council Preliminary Flood Risk Assessment (PFRA) (NCC, 2011);
- Greater Nottingham Strategic Flood Risk Assessment Addendum (SFRA) (AECOM, 2017); and
- details of private water supplies were supplied by NSDC Environmental Health Department.

Field Surveys

11.4.3 A field survey was undertaken on 1st July 2021 by a surface water quality specialist and hydromorphologist in warm dry summer conditions following several days without rain. Thus, the watercourses were at low flow conditions and it was possible to see bedforms and features. The aim of the site walkover was to identify water receptors in the study area and to assess them in terms of their character, hydromorphology, and their connectivity to the Scheme in the context of the surrounding topography and receptors (e.g. nearby sites of ecological importance).

11.4.4 No water quality monitoring has been undertaken. There has been no aquatic ecology surveys undertaken. The ecological desk study undertaken by Bakers (Appendix 4-5 of Volume 3) recorded no amphibian records due to lack of standing water.

Study Area

11.4.5 For the purposes of the water resource (flow and quality) assessment, a study area of approximately 1 km around the Scheme boundary has been considered, in order

to identify surface and groundwater bodies that could reasonably be affected by direct impacts associated with the Scheme (i.e. there is a pathway between the Scheme and the waterbody).

11.4.6 Consideration has also been given to any attributes of surface water or groundwater bodies or water dependent ecological sites outside this study area, as pollutants can propagate downstream. Professional judgment has been applied to identify the extent to which such features are included.

11.4.7 The flood risk study area comprises the Environment Agency flood zones along the watercourses that may be affected by the Scheme. The Environment Agency designates flood risk zones on the basis of the annual probability of a flood event to occur as follows:

- Zone 1 is less than 0.1% annual probability of flood risk (i.e. a very low risk of flooding).
- Zone 2 between 0.1 - 1% annual probability of flood risk (i.e. a low risk of flooding).
- Zone 3 is more than 1% annual probability of flood risk (i.e. a medium risk of flooding).

11.4.8 The flood risk study area includes the extents of watercourses, 1 km upstream and 1 km downstream of the crossing locations.

Methodology for Determining Construction and Operational Effects

Assessment of routine road runoff and accidental spillages

11.4.9 An assessment of the potential impacts of routine runoff on surface waters has been undertaken following the Highways England Water Risk Assessment Tool (HEWRAT version 2.0.4, 2020) (Highways England, 2020h) methodology as described within DMRB LA 113, and available for download from the HADDMS website.

11.4.10 HEWRAT was developed for this purpose and the methodology behind it has been derived from a collaborative research programme undertaken by Highways England (now National Highways) and the Environment Agency, which investigated the effects of routine road runoff on receiving waters and their ecology. The assessment helps to determine the risk of routine runoff pollution, spillage risk to the receiving water body and what treatment measures are required to mitigate this risk. The HEWRAT quantitative assessment is included within Section 11.7 of this ES.

11.4.11 Appendix D of DMRB LA 113 has been used to assess the risk of pollution of a watercourse from a serious road traffic accident. This method is contained within the HEWRAT tool. This method combines various risk factors, including the volume of traffic flows in a 24-hour period, the percentage of heavy goods vehicles, and the risk attributed to different types of road, to determine the probability of an accident resulting in a serious pollution incident. The acceptable standard is measured as a return period with 1 in 100 years (i.e. the probability of an event occurring in any given year is 1%), as the minimum threshold for non-sensitive water environments. This increases to 1 in 200 years for sensitive receptors (for example SSSIs). The assessment is presented within Section 11.7 of this ES.

Future Maintenance

11.4.12 Consideration was given to the activities associated with the likely future maintenance and management of the Scheme and whether these have the potential to result in significant effects on the water environment. Following a review of the likely maintenance activities (not including road safety in adverse weather

conditions), it was concluded that there will be limited potential of such effects to occur, and that these activities are comparable with standard maintenance operations already being undertaken elsewhere on the road network. Accordingly, the effects associated with this phase of the Scheme are scoped out of the assessment and are not considered further.

Evaluation of receptor importance

11.4.13 The importance of potentially affected water environment features has been established using a four-point scale (low, medium, high, very high) developed on the basis of Table 3.70 within DMRB LA 113. This four-point scale is presented in Table 11-2. Note that the criteria presented in DMRB LA 113 do not include navigation. Bespoke criteria for navigation have been included in Table 11-2based on professional judgement.

11.4.14 For the purpose of this assessment, receptor ‘importance’ has been identified rather than receptor ‘value’. This is because when considering the water environment, the availability of dilution means that there can be a difference in the sensitivity and importance of a water body. For example, a small drainage ditch of low conservation value and biodiversity with limited other socio-economic attributes can be very sensitive to impacts, whereas an important regional scale watercourse, that could have conservation interest of international and national significance and support a wider range of important socio-economic uses, is often less sensitive by virtue of its ability to assimilate discharges and physical effects. Irrespective of importance, all controlled waters in England are protected by law from being polluted.

11.4.15 Within Table 11-2, receptor importance is also included for flood risk. The FRA has been prepared for the Scheme in accordance with NPPF requirements.

Future Maintenance

11.4.16 Consideration was given to the activities associated with the likely future maintenance and management of the Scheme, and whether these have the potential to result in significant effects on the water environment. Following a review of the likely maintenance activities (not including road safety in adverse weather conditions), it was concluded that there will be limited potential of such effects to occur, and that these activities are comparable with standard maintenance operations already being undertaken elsewhere on the road network. Accordingly, the effects associated with this phase of the Scheme are scoped out of the assessment and are not considered further.

Table 11-2: Criteria to determine receptor importance

Importance[1]	Type of Receptor				
	Groundwater	Surface water	Hydromorphology[2]	Flood Risk[3]	Navigation
Very High	Principal Aquifer providing a regionally important resource and/or supporting a site protected under UK legislation Ecology and Nature Conservation Groundwater locally supports GWDTE* SPZ 1	Watercourse having a WFD classification shown in a RBMP and Q95 > 1.0 m^3/s. Site protected/ designated under UK legislation Ecology and Nature Conservation.	Unmodified, near to or pristine conditions, with well-developed and diverse geomorphic forms and processes characteristic of river type	Essential infrastructure or highly vulnerable development.	Corridor is a navigation route of principal importance (e.g. used daily by a large number and a wide range of vessels and purposes)
High	Principal Aquifer providing locally important resource or supporting river ecosystem. Groundwater supports a GWDTE SPZ 2	Watercourse having a WFD classification shown in a RBMP and Q95 m^3/s <1.0 m^3/s. Species protected under EC or UK legislation Ecology and Nature Conservation.	Conforms closely to natural, unaltered state and would often exhibit well-developed and diverse geomorphic forms and processes characteristic of river type, with abundant bank side vegetation. Deviates from natural conditions due to direct and/or indirect channel, floodplain, and/or catchment development pressures	More vulnerable development	Corridor is a navigation route of high importance (e.g. used frequently by a large number of vessels)
Medium	Aquifer providing water for agricultural or industrial use with limited connection to surface water. SPZ 3	WFD not having a WFD classification shown in a RBMP and Q95 >0.001 m^3/s.	Shows signs of previous alteration and/or minor flow regulation but still retains some natural features or may be recovering towards conditions indicative of the higher category	Less vulnerable development	Corridor is a navigation route of medium importance (e.g. intermittently used by a small number of craft)
Low	Unproductive strata	Watercourses not having a WFD classification shown in a RBMP and Q95 $\leq$0.001 m^3/s.	Substantially modified by past land use, previous engineering works or flow regulation and likely to possess an artificial cross-section (for example trapezoidal) and would probably be deficient in bedforms and bankside vegetation. Could be	Water compatible development	Corridor is rarely used for navigation or is non-navigable

Importance[1]	Type of Receptor				
	Groundwater	Surface water	Hydromorphology[2]	Flood Risk[3]	Navigation
			realigned or channelised with hard bank protection, or culverted and enclosed. May be significantly impounded or abstracted for water resources use. Could be impacted by navigation, with associated high degree of flow regulation and bank protection, and probable strategic need for maintenance dredging. Artificial and minor drains and ditches would fall into this category.		

1 Professional judgement is applied when assigning an importance category to all water features. All controlled waters are protected from pollution under the Environmental Permitting (England and Wales) Regulations 2016 (HMSO, 2016) and the Water Resources Act 1991 (as amended) (HMSO, 1991), and future WFD targets also need to be considered.

2 Based on the water body 'Reach Conservation Status' presently being adopted for HS2 and developed from the Environment Agency conservation status guidance (Environment Agency, 1998a, 1998b). DMRB LA 113 provides advice on hydromorphological assessment but does not provide criteria for determining hydromorphological receptor importance.

3 Vulnerable development, less vulnerable development and water compatible development are defined in the NPPF.

* GWDTE: Groundwater Dependent Terrestrial Ecosystems

Magnitude of Impact

11.4.17 The magnitude of impact on the water environment has been established using the criteria outlined in Table 3.71 of LA 113. These impacts take into consideration the extent that the Scheme would directly or indirectly affect the identified water receptors. The identification of impacts takes account of all embedded and essential mitigation measures described in Section 11.6 of this chapter and Chapter 2: The Scheme in this document.

Table 11-3: Criteria to determine magnitude of impact

Magnitude of Impact	Criteria	Description
Major Adverse	Results in a loss of attribute and/or quality and integrity of the attribute.	Surface water: ▪ Failure of both acute-soluble and chronic sediment related pollutants in HEWRAT and compliance failure with Environment Quality Standard (EQS) values. ▪ Calculated risk of pollution from a spillage >2% annually (spillage assessment). ▪ Loss or extensive change to a fishery. ▪ Loss of regionally important public water supply. ▪ Loss or extensive change to a designated nature conservation site. ▪ Reduction in water body WFD classification.
		Groundwater: ▪ Loss of, or extensive change to, an aquifer. ▪ Loss of regionally important water supply. ▪ Potential high risk of pollution to groundwater from routine runoff – risk score >250 (Groundwater quality and runoff assessment). ▪ Calculated risk of pollution from spillages >2% annually (Spillage assessment). ▪ Loss of, or extensive change to GWDTE or baseflow contribution to protected surface water bodies. ▪ Reduction in water body WFD classification. ▪ Loss or significant damage to major structures through subsidence or similar effects.
		Flood Risk: ▪ Increase in peak flood level >100 mm.
Moderate Adverse	Results in effect on integrity of attribute, or loss of part of attribute	Surface Water: ▪ Failure of both acute-soluble and chronic sediment-bound pollutants in HEWRAT but compliance with EQS values. ▪ Calculated risk of pollution from spillages >1% annually and <2% annually. ▪ Partial loss in productivity of a fishery. ▪ Degradation of regionally important public water supply or loss of major commercial/industrial/agricultural supplies. ▪ Contribution to reduction in water body WFD classification.

Magnitude of Impact	Criteria	Description
		Groundwater: ▪ Partial loss or change to an aquifer. ▪ Degradation or regionally important public water supply or loss of significant commercial/industrial/agricultural supplies. ▪ Potential medium risk of pollution to groundwater from routine runoff – risk score 150-250. ▪ Calculated risk of pollution from spillages >1% annually and <2% annually. ▪ Partial loss of the integrity of GWDTE. ▪ Contribution to reduction in water body WFD classification. ▪ Damage to major structures through subsidence or similar effects or loss of minor structures. Flood Risk: ▪ Increase in peak flood level > 50mm.
Minor Adverse	Results in some measurable change in attribute's quality or vulnerability.	Surface Water: ▪ Failure of either acute soluble or chronic sediment related pollutants in HEWRAT. ▪ Calculated risk of pollution from spillages >0.5% annually and <1% annually. ▪ Minor effects on water supplies. Groundwater: ▪ Potential low risk of pollution to groundwater from routine runoff – risk score <150 ▪ Calculated risk of pollution from spillages >0.5% annually and <1% annually ▪ Minor effects on an aquifer, GWDTEs, abstractions and structures. Flood Risk: ▪ Increase in peak flood level >10mm.
Negligible	Results in effect on attribute, but of insufficient magnitude to affect the use or integrity.	Surface Water: ▪ No risk identified by HEWRAT (pass both acute-soluble and chronic-sediment related pollutants). ▪ Risk of pollution from spillages <0.5%. Groundwater: ▪ No measurable impact upon an aquifer and/or groundwater receptors and risk of pollution from spillages <0.5%. Flood Risk: ▪ Negligible change in peak flood level <+/- 10mm.
Minor beneficial	Results in some beneficial effect on attribute or a reduced risk of negative impact occurring.	Surface Water: ▪ HEWRAT assessment of either acute soluble or chronic-sediment related pollutants becomes pass from an existing site where the baseline was a Fail condition. ▪ Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is <1% annually). Groundwater: ▪ Calculated reduction in existing spillage risk by 50% or more to an aquifer (when existing spillage risk <1% annually).

Magnitude of Impact	Criteria	Description
		▪ Reduction or groundwater hazards to existing structures. ▪ Reductions in waterlogging and groundwater flooding. Flood Risk: ▪ Creation of flood storage and decrease in peak flood level (>10mm).
Moderate beneficial	Results in moderate improvement of attribute quality	Surface Water: ▪ HEWRAT assessment of both acute-soluble and chronic-sediment related pollutants becomes pass from an existing site where the baseline was a fail condition. ▪ Calculated reduction in existing spillage by 50% or more (when existing spillage risk >1% annually). ▪ Contribution to improvement in water body WFD classification. Groundwater: ▪ Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is >1% annually). ▪ Contribution in improvement in water body WFD classification. ▪ Improvement in water body catchment abstraction management strategy (CAMS) (or equivalent) classification. ▪ Support to significant improvements in damaged GWDTE. Flood Risk: ▪ Creation of flood storage and decrease in peak flood level (>50mm).
Major beneficial	Results in major improvement of attribute quality	Surface Water: ▪ Removal of existing polluting discharge or removing the likelihood of polluting discharges occurring to a watercourse. ▪ Improvement in water body WFD classification. Groundwater: ▪ Removal of existing polluting discharge to an aquifer or removing the likelihood of polluting discharges occurring. ▪ Increased recharge to an aquifer. ▪ Improvement in water body WFD classification. Flood Risk: ▪ Creation of flood storage and decrease in peak flood level (>100mm).
No change		No loss or alteration of characteristics, features, or elements; no observable impact in either direction.

Significance Criteria

11.4.18 The approach to deriving the effects significance from receptor value and magnitude of impacts is based on the significance matrix set out in the DMRB LA 104 and reproduced in Table 4-3 in Chapter 4: Assessment Methodology in Volume 1. The matrix combines receptor importance with magnitude of impact. Where the significance of effect is represented by two descriptors (for example large/very large), professional judgement based on knowledge and experience of similar schemes has been used to determine which of the significance descriptors applies to the effect being assessed.

11.4.19 The matrix has been used to guide the identification and assessment of effects on water resources; 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. The negligible environmental value (sensitivity) is not included as the importance of receptors for the water environment does not include receptors of negligible importance.

11.4.20 Effects that are anticipated to be moderate, large or very large are considered to be significant.

Assumptions and Limitations

11.4.21 The assessment has been based on the current drainage design drawings (see Appendix 2-2 of Volume 3). This has been designed to manage surface water runoff that drains to the Rainworth Water catchment. It is assumed from the drawing there will be no significant cut/fill required for the construction and operation of the Scheme. There will be no new outfalls constructed into the receiving water course, Rainworth Water. The existing outfalls will be used.

11.4.22 Baseline conditions have been completed using data held and maintained by third parties, and is assumed to be accurate, up to date and appropriate for use.

11.4.23 The assessment has been undertaken using available data and Scheme design details as available in November 2021.

Baseline Conditions

Topography, Land Use and climate

11.5.1 The area around Mickledale Lane Junction is characterised by land sloping towards the east and Featherstone House Farm. The land is at approximately 73 m aOD on the A614 and is of similar height in the areas to north and south of the roundabout. The proposed link road is on land of decreasing height to approximately 65 m aOD at the proposed new junction with Mickledale Lane. To the east of Featherstone Farm is a watercourse, Rainworth Water, flowing northwards towards the River Maun.

11.5.2 In the west of the study area, the land rises towards the Clipstone Forest. The village of Bilsthorpe lies to the east of the study area. Approximately 200 m north of the current Mickledale Lane / A614 Junction is an old railway line which crosses over the A614.

11.5.3 Based on the Meteorological Office website (Met Office, 2021), the nearest weather station is located at Watnall 27 km to the south-east of the Scheme. Using the data from this weather station, it is estimated that the study area experiences an average of 710 mm of rainfall per year, with it raining more than 1 mm on 124 days per year, which is average for the UK. The wettest months of the year are October to December with over 65 mm rain per month.

Surface water

11.5.4 The study area for the Scheme falls within one WFD (HMSO, 2015) water body catchment; “Rainworth Water from Source to Gallow Hole Dyke” (GB104028052940) which is part of the Idle River operational catchment of the Humber River Basin Management Plan.

11.5.5 Rainworth Water flows through the study area passing eastwards under the A614

approximately 100 m south of the southern extent of the Scheme. The watercourse turns northwards and flows to the east side of Featherstone House Farm, approximately 170 m eastwards of the new link road to Bilsthorpe village.

11.5.6 According to the Environment Agency Catchment Data Explorer website (Environment Agency, 2021b), it is currently at Moderate Ecological Status (2019, with a target status of Moderate by 2015 which it has met). Reasons for not achieving Good status are stated as water industry (continuous sewage discharges), agriculture and rural land management (poor livestock management, nutrient management and land drainage) and urban and transport (transport drainage). This has led to failures for mercury and its compounds, and polybrominated diphenyl ethers (PDBE). Within the physico-chemical elements, phosphate levels noted as being Poor and Ammonia Moderate.

Table 11-4: WFD Classifications for study area waterbody.

Parameter	Rainworth Water from Source to Gallow Hole Dyke
Designation	River
WFD Catchment	Rainworth Water from Source to Gallow Hole Dyke
ID	GB104028052940
Hydromorphological Designation	Not designated artificial or heavily modified
Area	5954.299 ha
Length	10.898 km
Overall Status (2019)	Moderate
Ecological Status	Moderate
Chemical Status	Fail
Overall Waterbody Objective	Moderate by 2015

11.5.7 No further waterbodies with hydraulic continuity were identified from a review of OS mapping or the site survey. There may be minor drainage ditches that remain unknown which have been assessed generically.

11.5.8 During a review of baseline information no known socio-economic uses of the Rainworth Water were noted. Rainworth Waste Water Treatment Works is located approximately 4 km upstream.

11.5.9 From the Environment Agency Water Quality Archive website, there is a data point on Rainworth Water at Red Bridge (National Grid Reference (NGR) 463910, 360380), located to the south of the Scheme, adjacent to downstream of the surface water pond. 257 samples have been taken between 2000 and 2021.

Table 11-5 Summary of Water Quality Data from Rainworth Water at Red Bridge (August – October 2021)

Determinand	Unit	August	September	October	Average
pH		7.81	7.81	7.65	7.75
Temperature of Water	°C	16.4	14.50	13.3	14.7

Determinand	Unit	August	September	October	Average
Ammoniacal Nitrogen as N	mg/l	0.09	0.038	0.031	0.159
Nitrogen, Total Oxidised as N	mg/l	17	17	19	17.7
Nitrate as N	mg/l	17	17	19	17.7
Nitrite as N	mg/l	0.045	0.031	0.029	0.035
Ammonia un-ionised as N	mg/l	0.00171	0.00063	0.00033	0.00089
Alkalinity to pH 4.5 as $CaCO_3$	mg/l	70	78	65	71
Orthophosphate, reactive as P	mg/l	91	82.8	85.7	86.5
Oxygen, Dissolved, % Saturation	%	91	82.8	85.7	86.5
Oxygen, Dissolved as O_2	mg/l	8.88	8.42	8.95	8.75
		Average 2016-2017	**Average 2003-2004**		
Carbon, Dissolved Organic	mg/l	5.54	n/a		
Copper, dissolved	µg/l	3.16	n/a		
Calcium, dissolved	mg/l	49.6	n/a		
Hardness, total as $CaCO_3$	mg/l	n/a	209.5		

11.5.10 There are no river flow gauges in the immediate vicinity of the Scheme. A flow gauge is located 10 km downstream on the River Maun at Whitewater Bridge which is noted under the Ollerton Roundabout baseline (UK Centre for Ecology and Hydrology, 2021c). As this Scheme is a lot further upstream, the flow at Mickledale Lane would be less than that monitored at Whitewater Bridge (catchment area of 157 km^2, with a Q95 of 0.494 m^3/sec). The catchment area for Rainworth Water is approximately 40 km^2 for a point where the watercourse passes under Mickledale Lane. Using a pro-rata approach, a Q95 of 0.12 m^3/sec has been estimated for the flow of Rainworth Water.

11.5.11 There are four ponds located within the study area, as detailed in Table 11-6.

Table 11-6: Ponds within 1km of Mickledale Lane Junction

Pond number and location	Grid reference
1: isolated field pond 400m north-east of the Mickledale Lane Junction	X: 464093 Y: 361385
2: isolated pond at Letterbox Farm 800m north-east of the Mickledale Lane Junction	X: 464476 Y: 361559
3: Potential balancing pond 125m east of the southern extent of Option 2 (approximately 300m south of the southern extent of Option 1)	X: 463798 Y: 360364
4: isolated pond 450m south-east of the southern extent of Option 2 (approximately 700m south of the southern extent of Option 1)	X: 463587 Y: 359648

Water resources

11.5.12 The location of surface water, and groundwater abstractions, details of pollution incidents, and discharge consents were obtained from the Environment Agency. Details of Private Water Supply (PWS) abstractions have been requested from the NSDC, and it was confirmed that no PWS abstractions are located within 2 km of Mickledale Lane Junction.

11.5.13 The study area is located within Nitrate Vulnerable Zone S335 (River Idle from River Ryton to River Trent NVZ).

11.5.14 The study area from the link road westwards lies within a Drinking Water Safeguard Zone (Groundwater). The waterbody ID is GB40401G301500 (“Idle Torne PT Sandstone Nottinghamshire & Doncaster” groundwater body), and the main pressure is nitrate. This is centred on an abstraction source located 500 m to the west of the junction.

11.5.15 There are no Drinking Water Protected Areas for surface water and no surface water Drinking Water Safeguard Zones in the study area.

11.5.16 There are nine abstractions in the area (both surface and groundwater). These are listed in Table 11-7 below, and shown in Figure 11-1 in Volume 2B. One abstraction which is not listed, or shown, is the groundwater abstraction for public water supply located within the study area, for which the Source Protection Zone is listed. The information supplied by the Environment Agency does not list abstraction locations for such abstractions.

Table 11-7: Abstractions

No on Figure	Surface water or Groundwater	Licence Number	Usage
1	Groundwater	03/28/64/0199/2/R02, 1 km to the south	Spray irrigation – Direct
2	Groundwater	03/28/64/0199/2/R02, 1 km to the south	Vegetable Washing
3	Surface water	03/28/70/0030, Rainworth water to south-east of Scheme	Spray irrigation – Direct
4	Surface water	03/28/70/0030, Rainworth Water adjacent to site	Spray irrigation – Direct
5	Surface water	03/28/70/0030, Rainworth Water downstream	Spray irrigation – Direct
6	Surface water	03/28/70/0042, Rainworth Water upstream	Spray irrigation – Storage

No on Figure	Surface water or Groundwater	Licence Number	Usage
7	Surface water	03/28/70/0042, Rainworth Water upstream	Spray irrigation – Storage
8	Surface water	03/28/70/0043	Spray irrigation – Direct
9	Groundwater	03/28/70/0088/2/R02, Inkersall Farm	Spray irrigation – Direct

11.5.17 There is one discharge consent within the area, this is to surface water located outside of the study area. This is 1.2 km northwards for a discharge from Bilsthorpe Sewage Treatment Works.

Hydromorphology

11.5.18 Under the WFD, 'Rainworth Water Source to Gallow Hole Dyke' (GB104028052940) is described as not designated artificial or heavily modified, at Moderate Ecological Status with the hydromorphological supporting elements described as 'Supporting Good' potential overall. Within this category the hydrological regime does not support 'Good' status, but the hydromorphology does.

11.5.19 The field survey was undertaken to scope the potential watercourses affected, in order to inform designs of any outfall and watercourse crossings / alterations to existing structures, and to identify potential opportunities for mitigation or enhancements. The only watercourse identified in close proximity to the site was Rainworth Water. This is described further in Appendix 11-1 of Volume 3B.

Nature Conservation and Aquatic ecology

11.5.20 No records for protected aquatic species were returned from the Nottinghamshire Biological and Geological Records Centre (NBGRC). Further information is contained within Chapter 8: Biodiversity.

Geology, Hydrogeology and Soils

11.5.21 Groundwater is a protected resource and its vulnerability to pollution is classified depending on the geology of the area (which determines the aquifer status) and the leaching potential of overlying soils (which determines how easily pollution from above ground sources may filter through to the aquifer).

11.5.22 The current groundwater levels across the Scheme are unknown, however, regionally it is likely to be providing baseflow to local watercourses.

11.5.23 From the geology and soils baseline (Chapter 9: Geology and Soils), there are no superficial deposits mapped within the area. There are some areas of superficial alluvial deposits (clay, silt, sand and gravel) associated with Rainworth Water. The bedrock geology is the Sherwood Sandstone Group, Chester Formation (pinkish red or buff-grey, medium- to coarse-grained, pebbly, cross-bedded, friable sandstone). Whilst no made ground is shown on the geological mapping it is expected that made ground would be present across much of the study area due to the development history of the study area.

11.5.24 The Sherwood Sandstone bedrock is designated as a Principal Aquifer, with the areas of superficial alluvium designated as a Secondary A Aquifer. The Scheme also lies within an area of medium to high groundwater vulnerability.

11.5.25 The Scheme lies within the WFD groundwater body “Idle Torne – PT Sandstone Nottinghamshire & Doncaster” (GB40401G301500). This has an overall status of Poor (2019). The status is Poor for quantitative and chemical aspects. The objective is for Poor by 2015, due to the unfavourable balance of costs and benefits.

11.5.26 Zone 1 of a SPZ (inner protection zone) is located within the study area, approximately 330 m west of the Scheme. The western part of the study area is located within Zone 2 (outer zone) of a SPZ. The eastern part of the study area is located within Zone 3 (total catchment area) of a SPZ.

11.5.27 From the Soilscapes website, the Scheme is situated on freely draining slightly acid sandy soils, with an area of naturally wet very acid sandy and loamy soil in the area of alluvial deposits for Rainworth Water.

11.5.28 There are records of boreholes in the study area. The closest is located 200 m north of Rainworth Water and 100 m south of the Scheme. A borehole labelled SK66SW77 was drilled at NGR 463704, 360420 (BGS ID 235282. This borehole was formed to prove the yard/ Blackshale Seam for Rufford Colliery in March 1986. The borehole proved the Triassic Bunter Pebble (Sherwood Sandstone Group) beds from the surface to 135 m depth. A second borehole formed in the area of the public water supply abstraction, SK66SW8, at NGR 463338, 360991 (BGS ID 235209). This encountered 45 cm of soil deposits overlying the Sherwood Sandstone Group. There was no data on groundwater levels recorded.

Road Drainage

11.5.29 The current road drainage for the scheme consists of kerbs and carrier drains on Mickledale Lane discharging to the east. The routine road drainage of the A614 is towards the south, based on the topography, and consists of kerb offlets on the western side of the A614 into an existing roadside ditch.

11.5.30 The existing impermeable area on the A614 is 3,026 m^2 and 623 m^2 within the proposed Catchment 1 and Catchment 2a areas within the drainage design.

Water Dependent Designated Ecological Sites and Relevant Protected Species

11.5.31 The local designated ecological sites within the study area are noted in Chapter 8: Biodiversity and are summarised in Table 8-6: Designated Statutory and Non-Statutory Sites located within the Mickledale Lane Junction Study Area.

11.5.32 With exception to Alder Carr LWS, the reasons for designation do not have water dependent habitats or known associated species. The reasons for designation of Alder Carr LWS includes open wet woodland. This is located alongside Rainworth Water, south-west of the Scheme.

Flood Risk

Fluvial Flooding

11.5.33 The Environment Agency Flood Map for Planning (GOV.UK, 2021b) shows the Scheme is within Flood Zone 1. Land and property in Flood Zone 1 is considered to have a low probability of flooding from rivers or the sea. There is a small corridor of land nearby, approximately 500 m from the Scheme, shown in Flood Zone 3 (a high probability of flooding from rivers or the sea) associated with Rainworth Water as it crosses through Bilsthorpe but this does not impact the Scheme.

Historical flooding

11.5.34 There is no known historical flooding in this area.

Surface water

11.5.35 The Environment Agency Risk of Flooding from Surface Water map (GOV.UK, 2021b) indicates that the risk of surface water flooding at Mickledale Lane Junction is generally classed as very low to low.

11.5.36 A 'Low' risk means that each year the area has a chance of flooding from surface water of between 0.1% and 1%. A 'Very low' risk means that each year the area has a chance of flooding of less than 0.1%. The map explains that flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast. In addition, local features can greatly affect the chance and severity of flooding.

Artificial sources

11.5.37 indicates that the Scheme is not within an area at risk of flooding from reservoirs, and there are no other artificial sources of flooding in the vicinity.

Flooding from Groundwater

11.5.38 The BGS 1:50,000 Groundwater Flood Susceptibility Map (BGS, 2021c) shows consolidated bedrock aquifers (chalk, sandstone etc.) and superficial deposits. The mapping does not take account of the chance of flooding from groundwater rebound[4]. It shows the proportion of each 1 km grid square where geological and hydrogeological conditions indicate that groundwater might emerge.

11.5.39 Mickledale Lane Junction is located within an area designated as a Principal Aquifer. The BGS mapping suggests there is a limited potential for groundwater flooding to occur. Within the area there it is potential groundwater flooding of property situated below ground level in the area of Rainworth water west and north of the Scheme but not within the Scheme area. Thus, risk of flooding from groundwater emergence at this site is considered to be low.

Tidal flooding

11.5.40 Due to the location of the study area there is considered to be no risk of flooding from tidal sources.

Flooding from drains and sewers

11.5.41 The surface water flooding map indicates the risk of flooding from surface water to be low or very low, it can also be inferred that that risk of flooding from surface water sewers is likely to be low.

Future Baseline Conditions

11.5.42 Within the area there is one planning application which has been granted planning consent that would be operational before the start of construction for the Scheme. This is located 700 m south-west from the Scheme. This will be operational at the time of opening of the Scheme. The installation and operation of the Inkersall Grange Solar Farm will consist of a 132 kV electrical substation, associated infrastructure, and photovoltaic cells. The site is located upstream within the Rainworth Water catchment area. The site is expected to conform to current environmental laws, and would therefore not have an adverse effect on Rainworth Water watercourse.

Opening year baseline (2026)

11.5.43 The surface WFD waterbodies have currently met their current target objectives, and are unlikely to be improved before 2026. Therefore, their importance is expected to stay the same in the opening year baseline. The baseline within the opening year for groundwater is expected to be largely the same as the current

[4] Groundwater rebound is the recovery of groundwater levels from the switching off of legacy coal mine pumping systems.

baseline.

11.5.44 Climate change is predicted to alter the future fluvial flood risk and thus it is important that it is taken into account by FRA. Climate change resilience has been accounted for within the proposed drainage strategy with a 40% climate change allowance.

Design year baseline (2037)

11.5.45 The design year is 15 years after the traffic base year of 2023. The surface WFD waterbodies have currently met their current target objectives for 2025. It is possible that these could be improved by the 2037 design year. However, using the current DMRB LA 113 criteria, an improvement of WFD classification would not change the importance of the surface waterbodies. Therefore, their importance is expected to stay the same in the design year baseline. The baseline within the design year for groundwater is expected to be largely the same as the current baseline.

11.5.46 Climate change is predicted to alter the future fluvial flood risk and thus it is important that it is taken into account by FRA. Climate change resilience has been accounted for within the proposed drainage strategy with a 40% climate change allowance.

Importance of Receptors

11.5.47 The key local water resources receptors within the study area are summarised in Table 11-8.

Table 11-8 Key local water resource receptors within the study area

Receptor Name	Receptor Type	Importance	Justification
Rainworth Water	Water quality	High	Rainworth Water is a WFD waterbody, classified as being of Moderate potential. A flow gauge 10 km downstream has been used to estimate a Q95 flow of 0.12 m^3/s (i.e. <1.0 m^3/s) based on a using a proportional approach of the catchment area. This watercourse will be affected by sewage discharges, agricultural and urban and transport.
	Hydromorphology	High	Rainworth Water is not designated as artificial or heavily modified, with the hydromorphology of the watercourse supporting good status.
	Flood risk	Low	There are areas of Flood Zone 2/3 associated with Rainworth Water. These areas are undeveloped and consists of open space (water compatible) and agricultural land (less vulnerable).
Local ponds	Water quality	Medium	Various ponds are situated within the study area.
Idle Torne – PT Sandstone Nottinghamshire & Doncaster WFD groundwater body	Groundwater	Very High	The bedrock is a Principal Aquifer: which may support water supply and/ or river base flow on a strategic scale. The Poor WFD status should not detract from the resource's importance.

Floodplain Sensitivity for Impact Assessment

11.5.48 Most of the Scheme area for works is within Flood Zone 1, with a small area of Flood Zone 3. The majority of the area of the Scheme construction is undeveloped, (less vulnerable).

11.5.49 There are no areas within flood warning and flood alert areas. Given this, sensitivity of this area for impact assessment purposes would be low.

11.5.50 The criteria in Table 11-2 do not provide examples of importance for other forms of flood risk, and so the importance is based on the existing baseline risk described earlier in this chapter. For this impact assessment, the importance of non-fluvial flood risk is as follows:

- flooding from surface water is considered mainly low importance;
- flooding from groundwater sources is considered to be low importance; and
- flooding from artificial sources is considered to be of low importance.

Design, Mitigation and Enhancement Measures

11.6.1 This section describes how potential environmental impacts have been, or would be avoided, prevented, reduced or offset through design and / or management during the construction phase processes and operational designs. These mitigation measures are embedded within the design and are thus taken into account by the impact assessment in the initial prediction of effects.

Embedded Mitigation

Construction Mitigation

11.6.2 The risk of significant, acute pollution to watercourses is greatest during the construction stages of the project, particularly works within and adjacent to water bodies. Pollution may arise directly from spillages of oil or other polluting chemical substances, or from site runoff containing high levels of suspended solids from hard standing, other sealed surfaces (including compacted earth), and washed off from construction machinery or from the direct disturbance of river bed and banks.

11.6.3 Prior to construction starting on site, a Construction Environmental Management Plan (CEMP) will be prepared by the Principal Contractor. The CEMP would outline the measures necessary to avoid, prevent and reduce adverse effects where possible upon the local surface water and groundwater environment.

11.6.4 The CEMP will need to be reviewed, revised and updated as the project progresses towards construction to ensure all potential impacts and residual effects are considered and addressed as far as practicable, in keeping with available good practice at that point in time. The principles of the mitigation measures set out below are the minimum standards that the Principal Contractor will implement. However, it is acknowledged that for some issues, there are multiple ways in which they may be addressed. In addition, the methods of dealing with pollutant risk will need to be continually reviewed on site and adapted as construction works progress in response to different types of work, weather conditions, and locations of work.

11.6.5 The CEMP will be standard procedure for the Scheme and will describe the principles for the protection of the water environment during construction. It will include a section on control measures to protect the water environment. This will provide greater detail regarding the mitigation to be implemented to protect the water environment from adverse impacts during construction.

Good Practice Guidance

11.6.6 The following relevant GPPs have been released to date on the NetRegs website (Netregs, 2021) and are listed below. While these are not regulatory guidance in England where the UK government website outlines regulatory requirements, it remains a useful resource for best practice.

- GPP 1: Understanding your environmental responsibilities – good environmental practices;
- GPP 2: Above ground oil storage;
- GPP 3: Use and design of oil separators in surface water drainage systems;
- GPP 4: Treatment and disposal of wastewater where there is no connection to the public foul sewer;
- GPP 5: Works and maintenance in or near water;
- GPP 8: Safe storage and disposal of used oils;
- GPP 13: Vehicle washing and cleaning;
- GPP 19: Vehicles: Service and Repair;
- GPP 20: Dewatering underground ducts and chambers;
- GPP 21: Pollution Incident Response Plans;
- GPP22: Dealing with spills; and
- GPP26: Safe storage – drums and intermediate bulk containers.

11.6.7 Where new GPPs are yet to be published, previous Pollution Prevention Guidance (PPGs) still provide useful advice on the management of construction to avoid, minimise and reduce environmental impacts, although they should not be relied upon to provide accurate details of the current legal and regulatory requirements and processes. Construction phase operations would be carried out in accordance with guidance contained within the following PPG:

- PPG6: Working at construction and demolition sites (Gov.uk, 2012);
- PPG7: Safe storage – the safe operation of refuelling facilities (Gov.uk, 2011); and
- PPG18: Managing fire water and major spillages (Gov.uk, 2000).

11.6.8 Additional good practice guidance for mitigation to protect the water environment can be found in the following key CIRIA documents and British Standards Institute documents:

- British Standards Institute (2009) BS6031:2009 Code of Practice for Earth Works (incorporating corrigendum No. 1)(BSi, 2009);
- British Standards Institute (2013) BS8582 Code of Practice for Surface Water Management of Development Sites (BSi, 2013);
- C753F (2015) The SuDS Manual (second edition) (CIRIA, 2015a) (CIRIA, 2015);
- C741 (2015) Environmental good practice on site guide (fourth edition) (CIRIA, 2015);
- C648 (2006) Control of water pollution from linear construction projects, technical guidance (CIRIA, 2006);

- C609 (2004) Sustainable Drainage Systems, hydraulic, structural and water quality advice (CIRIA, 2004); and
- C532 (2001) Control of water pollution from construction sites – Guidance for consultants and contractors (CIRIA, 2001).

Managing Construction Site Runoff

11.6.9 The measures outlined below, which will be included in the CEMP within a section on control measures to protect the water environment, will be required for the management of fine sediments in surface water runoff as a result of the construction activities:

- Reasonably practicable measures will be taken to prevent the deposition of fine sediment or other material in, and the pollution by sediment of, any existing waterbody, arising from construction activities. The measures will accord with the principles set out in industry guidelines including the CIRIA report 'C532: Control of water pollution from construction sites' (CIRIA, 2001). Measures may include use and maintenance of temporary lagoons, tanks, seeding / covering of earth stockpiles, earth bunds, straw bales and sandbag walls, proprietary measures (e.g. lamella clarifiers or contained chemical treatment) and fabric silt fences or silt screens as well as consideration of the type of plant used.
- A temporary drainage system will be developed to prevent runoff contaminated with fine particulates from entering surface water drains without treatment. This will include identifying all land drains and water bodies on the site and ensuring that they are adequately protected using drain covers, sandbags, earth bunds, geotextile silt fences, straw bales, or proprietary treatment (e.g. lamella clarifiers). Discharge to such water bodies (directly or indirectly) will only be made with the permission of the Environment Agency and with the necessary treatment measures implemented.
- Where possible, earthworks will be undertaken during the drier months of the year and will avoid periods of wet weather (if possible) to minimise the risk of generating runoff contaminated with fine particulates. However, it is likely that some working during wet weather periods will be unavoidable, in which case mitigation measures will be implemented to control fine sediment laden runoff.
- To protect waterbodies from fine sediment runoff, topsoil/subsoil will be stored a minimum of 20m from any water body on flat lying land (and further if the ground is sloping, subject to ono site risk assessment on observational monitoring) and not within the fluvial floodplain. Where this is not possible, and it is to be stockpiled for longer than a two-week period, the material will either be covered with geotextile mats, seeded to promote vegetation growth. In all situations, runoff from the stockpile will be prevented from draining to a watercourse without prior treatment.
- Appropriately sized runoff storage areas for the settlement of excessive fine particulates in runoff will be provided. It is likely that treated water will then be pumped under a temporary Water Activity Permit from the Environment Agency or to a water treatment works as agreed with the sewerage undertaker.
- Mud deposits will be controlled at entry and exit points to the site using wheel washing facilities and / or road sweepers operating during earthworks activities or other times as considered necessary.
- Equipment and plant are to be washed out and cleaned in designated areas within the site compound where runoff can be isolated for treatment before discharge to surface water drainage under appropriate consent and / or agreement with Environment Agency, or otherwise removed from site for appropriate disposal at a licensed waste facility.

- Debris and other material will be prevented from entering surface water drainage, through maintenance of a clean and tidy site, provision of clearly labelled waste receptacles, grid covers and the presence of site security fencing.
- The CEMP section on the water environment will include details of pre, during and post-construction water quality monitoring. This will be based on a combination of visual observations, frequent in situ testing using water quality probes, and periodic sampling for laboratory analysis

Managing Construction Site Runoff - Spillages

11.6.10 The measures outlined below will be implemented to manage the risk of accidental spillages on site and potential conveyance to nearby waterbodies via surface runoff or land drains. The measures relating to the control of spillages and leaks will be included in the water section of the CEMP and adopted during the construction works:

- Fuel will be stored and used in accordance with the Control of Substances Hazardous to Health Regulations 2002 (HMSO, 2002), and the Control of Pollution (Oil Storage) (England) Regulations 2001 (HMSO, 2001). Special care will be taken with the delivery and use of concrete and cement as it is highly corrosive and alkaline.
- Fuel and other potentially polluting chemicals will either be in self bunded leak proof containers or stored in a secure impermeable and bunded area (minimum capacity of 110% of the capacity of the containers).
- Any plant, machinery or vehicles will be regularly inspected and maintained to ensure they are in good working order and clean for use in a sensitive environment. This maintenance is to take place off site if possible or only at designated areas within the site compound. Only construction equipment and vehicles free of all oil/fuel leaks will be permitted on site. Drip trays will be placed below static mechanical plant.
- All washing down of vehicles and equipment will take place in designated areas and wash water will be prevented from passing untreated into watercourses.
- All refuelling, oiling and greasing will take place above drip trays or on an impermeable surface which provides protection to underground strata and watercourses, and away from drains as far as reasonably practicable. Vehicles will not be left unattended during refuelling.
- As far as reasonably practicable, only biodegradable hydraulic oils will be used in equipment working in or over watercourses.
- All fixed plant used on the site will be self-bunded.
- Mobile plant is to be in good working order, kept clean and fitted with plant 'nappies' at all times.
- A Pollution Prevention Plan will be prepared and included alongside the CEMP. Spill kits and oil absorbent material will be carried by mobile plant and located at high risk locations across the site and regularly topped up. All construction workers will receive spill response training and toolbox talks.
- The site will be secure to prevent any vandalism that could lead to a pollution incident.
- Construction waste / debris are to be prevented from entering any surface water drainage or water body.

- Surface water drains on roads or within the construction compound will be identified and, where there is a risk that fine particulates or spillages could enter them, the drains will be protected (e.g. using covers or sandbags).
- Suitable facilities for concrete wash water (e.g. geotextile wrapped sealed skip, container or earth bunded area) will be adequately contained, prevented from entering any drain, and removed from the site for appropriate disposal at a suitably permitted waste facility.
- Water quality monitoring of potentially impacted watercourses will be undertaken to ensure that pollution events can be detected against baseline conditions and can be dealt with effectively.

11.6.11 In addition, any site welfare facilities will be appropriately managed, and all foul waste disposed of by a licensed contractor to a suitably permitted facility.

Operation Mitigation

Drainage design and treatment trains

11.6.12 The drainage design is presented in Appendix 2-2 of Volume 3. This has been designed to manage surface water runoff that drains to Rainworth Water.

11.6.13 The drainage design comprises pipework with a two rectangular buried attenuation tanks close to Mickledale Lane for attenuating any increase of flows as a result of increased impermeable area. A 40% climate change allowance has been included within the drainage calculations for the attenuation tank. The drainage drawing shows 3 main catchments, with catchment area 2 being sub-divided into 2a and 2b. The proposed catchments have the following areas and characteristics:

- Catchment 1 (red on the drawing): proposed 2,507 m^2 impermeable area, and 4,367 m^2 permeable area. This catchment includes the construction of a new realigned replacement ditch on the western side of the A614. This ties into the existing ditch on the west of the A614. This is assumed to discharge to Rainworth Water approximately 250m south of the southern extent of construction;
- Catchment 2a (yellow on the drawing): proposed 2,568 m^3 impermeable area and 28,825 m^2 permeable area discharging into the northern side of the new link road. This includes catchpits, and gullies, with carrier drains directing flow to a tank with approximately 677 m^3 of storage. Flow is then passed through a flow control device before discharging to the existing road drainage on Mickledale Lane;
- Catchment 2b (green on the drawing): proposed 4,501 m^3 impermeable area and 7,290 m^2 permeable area discharging into the southern side of the new link road. This includes catchpits, and gullies, with carrier drains directing flow to a tank with approximately 447 m^3 of storage. Flow is then passed through a flow control device before discharging to the existing road drainage on Mickledale Lane; and
- Catchment 3: no storage is required as there will be significantly less discharge into the existing highway drainage.

11.6.14 Rainworth Water passes under the A614 and Mickledale Lane in a concrete box culvert. The watercourse has been historically modified and remains artificially straight. No crossings, diversions or additional discharge to Rainworth Water is proposed as part of the Scheme.

11.6.15 Without attenuation increased flows may result in bank erosion, increased sediment loading, greater flooding and increased pollution to the receiving Rainworth Water.

The specific treatment approach adopted for each road catchment has been designed to reflect the extent of flow attenuation required.

11.6.16 Drainage from the Scheme will tie into the existing drainage at the site on the west of the A614, and will tie into the existing road drainage on Mickledale Lane. There are no new outfalls to watercourses or WFD watercourse Rainworth Water. The design of the new ditch on the west side of the A614 will be designed to minimise any adverse impacts on processes within the receiving ditch.

11.6.17 SuDs are the preferred attenuation solution as they provide several functions, including minimising the risk and impact of flooding in addition to potentially providing a degree of treatment for pollutants (e.g. suspended solids, metals and hydrocarbons). SuDS can take the form of filter drains and ditches. Within the proposed design Catchment area 1 discharges to the existing drainage ditch parallel to the A614 on the western side. As part of the Scheme the existing straight length of ditch is increased in length to curve round the roundabout. This length of drainage ditch provides the opportunity for water quality mitigation before the runoff water discharges to Rainworth Water.

11.6.18 It is anticipated that the new drainage systems proposed for the Scheme will be designed to prevent and or minimise the risk of groundwater contamination from contaminated surface water runoff.

11.6.19 The FRA concluded that no mitigation is required within the design for all sources of flooding. For Catchment 2, the surface water drainage will discharge into attenuation tanks on the eastern side of the link road, which will then discharge into the existing highway drainage network. The flow from the attenuation tanks will be discharged via flow control chambers to the existing network drainage.

Watercourse Crossings, Realignments, Diversions and Culverts

11.6.20 The design of the Scheme ensures no works to be taken place in parts of the road network which crosses Rainworth Water. There will be no diversions or construction of new culverts.

Relevant Permits, Consents and Licences

11.6.21 Temporary discharges of ‘unclean’ runoff may also require a water activity permit under the Environmental Permitting (England and Wales) Regulations 2016 from the Environment Agency, also where exemptions do not apply.

11.7 Assessment of Likely Significant Effects

11.7.1 The prediction of impacts and the assessment of effects (and their significance) during the construction and operation of the Scheme on the water environment within the study area has taken account of the embedded and essential mitigation measures presented in Section 11.6.

11.7.2 Based on the baseline data, as assessed against Table 11-2, the local water resources receptors within the study area have been attributed an importance level. These are tabulated in Table 11-8.

Construction

Surface Water Quality

11.7.3 Where construction works are undertaken in close proximity to, within, over or under water bodies, close to existing land drains providing a pathway to surface watercourses or ponds, or on steeper terrain angled towards a waterbody, there is the potential for direct adverse effects on water quality. This is due to deposition or spillage of soils, sediments, oils, fuels, or other construction chemicals which could

be spilt on site. There may also be indirect water quality impacts from works further from water bodies via existing land drains/ sewers.

11.7.4 Whilst there is no requirement for works close to or directly within any watercourses for the Scheme, aside from highways ditches, which are intrinsically linked to road drainage and are not water receptors requiring assessment in their own right. However, there would be the potential for conveyance of spills and fine sediment during any works to highway drains and the existing drainage system to result in indirect impacts to Rainworth Water through hydrological connectivity via the existing drainage system, and the ditch labelled 'drain' on OS mapping.

11.7.5 Construction works for the Scheme has the potential to cause reduction in water quality through sediment disturbance from site clearance and excavation, mobilisation of any existing ground contamination, and the risk of chemical spillages from plant, equipment and materials.

11.7.6 During construction all works would be carried out in accordance with the mitigation measures set out in the CEMP (see Section 11.6), and any discharges to surface water of 'unclean runoff' would require a Water Activity Permit from the Environment Agency. The conditions attached to any such consent, and to limits on oils, suspended solids and other pollutants, would be adhered to.

11.7.7 Implementation of standard mitigation measures as defined within the CEMP would help avoid or reduce any potential adverse effects on surface water quality impacts during construction. Given that there are no surface watercourses within the Scheme boundary aside from highway drains, plus the fact that mitigation measures are in place to prevent runoff laden with fine sediment and chemical spillages, it is considered that the magnitude of impact of construction works on Rainworth Water which is of high importance would be negligible. This gives a temporary slight adverse effect (not significant) for Rainworth Water.

Groundwater flow and quality

11.7.8 Excavations and other construction activities have the potential to intercept groundwater or perched groundwater levels and could create pathways for contaminants near the surface to the underlying groundwater body. Furthermore, wherever construction works are undertaken, there is potential for spillages or leakages of oil, fuel or other liquid chemicals to contaminate the ground, and subsequently leach into underlying groundwater causing pollution and potentially making the water unfit for use. The risk is likely to be significant in locations where there is naturally high groundwater and abstractions.

11.7.9 There was no groundwater level available on the BGS logs in the local vicinity of this site. From Chapter 9: Soils and Geology, the regional groundwater is likely to be flowing towards the east, with local effects of topography and the River Rainworth. In addition, there will be drawdown of groundwater within the aquifer associated with pumping extraction from the public water supply borehole located 500 m west of the current Mickledale Lane / A614 junction.

11.7.10 The Scheme is an at-grade junction and link road, therefore, there is a minimal requirement for cut and fill to be carried out. A replacement shallow ditch will be constructed on the western side of the A614 road / new roundabout to replace the existing straight ditch.

11.7.11 The construction of the attenuation tanks will require excavation in an area of the Scheme adjacent to Mickledale Lane. In this area the topography has a shallow slope to the east and the Rainworth Water crossing of the road. There is potential for excavation in this area to intercept a local groundwater table within the alluvial deposits associated with Rainworth Water. This could require temporary dewatering

during construction.

11.7.12 With the implementation of mitigation measures contained within the CEMP, it is considered that the magnitude of impact on groundwater quality during construction for the Scheme would be negligible. As groundwater is a very high importance receptor, this results in a slight effect (not significant).

Potential risk of flooding from fluvial sources during construction

11.7.13 The construction of the Scheme would involve work in Flood Zone 1. There will be no works within highway ditches close to Rainworth Water. As such, the magnitude of flooding from these sources during construction, on site and further downstream, is negligible resulting in a slight adverse effect (not significant).

Potential risk of flooding from surface water sources during construction

11.7.14 The Scheme is in general at a low risk from surface water flooding. During the works, existing surface flow paths may be disrupted and altered due to site clearance, earthworks, and excavation work. The exposure and compaction of bare ground and the construction of new impermeable surfaces may increase the rates and volume of runoff and increase the risk from surface water flooding. However, with the implementation of standard construction methods and mitigation measures (see Section 11.6), this risk can be effectively managed. As such, the impact of flooding from these sources on construction workers is negligible resulting in a neutral effect (not significant).

Potential risk of flooding from drainage infrastructure and artificial sources during construction

11.7.15 The Scheme is at low risk of flooding from sewers and artificial sources. As such, with the implementation of the measures outlined in the CEMP and WMP, flooding from these sources is considered to be negligible, resulting in a neutral effect (not significant).

Potential risk of flooding from groundwater sources during construction

11.7.16 The Scheme is potentially at low risk of flooding from groundwater sources. Excavations have the potential to encounter and liberate groundwater in some areas, potentially leading to groundwater flooding. With the implementation of the measures outlined in the CEMP, a negligible magnitude of impact is predicted resulting in a neutral effect (not significant).

Operation

Surface Water and Groundwater Quality: Routine Road Runoff

11.7.17 The Scheme would result in an overall increase in impermeable area of approximately 5,900 m^2 in the area of the roundabout where pollutants (including hydrocarbons, heavy metals and sediments) can accumulate and be washed into the receiving watercourse, Rainworth Water, as routine road runoff, if not treated. The drainage design proposes to tie the proposed A614 drainage into the existing ditch on the western side of the A614 south of the Scheme, and into the highway drainage within Mickledale Lane. Both of these drain to Rainworth Water. This would occur through two existing outfalls and so there would be no direct works to watercourses.

11.7.18 Catchment 1, the A614, discharges to a ditch prior to discharges to the Rainworth Water, which is the same as the existing situation. Ditches are SuDS features which provide water quality mitigation for both soluble metals and any sediments in suspension in routine road runoff on their pathway towards discharge to Rainworth Water.

11.7.19 Catchments 2 and 3 do not contain SuDS features, but contain kerbs and gullies

which discharge via two attenuation tanks, with hydrobrake outflow control to tie into the existing highway drainage on Mickledale Lane.

11.7.20 The HEWRAT assessment was undertaken to determine the effectiveness of the drainage strategy in providing treatment for pollutants in routine road runoff and accidental spillages. This is a method for assessing the impact of routine runoff on receiving surface waters by considering the copper and zinc content of the runoff (as proxies for dissolved metal pollutants typically found in highway runoff), together with the potential for chronic sediment-bound impact on the receiving watercourse. Appendix 11-2 in Volume 3B contains the detail of the HEWRAT assessment.

11.7.21 The results indicate that the outfall passes the assessment for soluble acute impacts (relating to dissolved copper and dissolved zinc) and chronic sediment impact with and without the mitigation of ditches within Catchment 1 drainage for the proposed Scheme layout. Assessment of Catchment 1 has been carried out separately to Catchment 2/3, also cumulative assessment of both outfalls has been carried out due to the outfalls being into the same watercourse 900 m apart.

11.7.22 However, because the ambient copper concentration in the receiving watercourses is currently high (3.16µg/l), the assessment of annual average copper against the environmental quality standard fails for the combined outfall to the Rainworth Water. However, the addition of road drainage has only increased the ambient copper concentration by 0.04µg /l over and above that already monitored within the Rainworth Water by the Environment Agency (at 3.16µg /l).

11.7.23 The use of the Metals Bioavailable Assessment Tool has been used to determine the concentration of dissolved copper which is bioavailable. The calculations show the amount of bioavailable copper in the Rainworth Water is 0.15 µg /l. This passes the assessment, as a concentration of over 1 µg /l would fail the annual EQS concentration for dissolved copper.

11.7.24 Overall, this results in a negligible magnitude of impact on a high value receptor, resulting in a slight adverse (not significant) effect.

Groundwater quality: routine road runoff

11.7.25 Weighting factors are applied to each of these components in the assessment to reflect the fact that some of these components have a greater or lesser influence on the magnitude of the risk to groundwater. For example, in most circumstances, the depth of the unsaturated zone has a greater influence on risk than unsaturated zone clay content, and so is weighted more heavily. The component score for each parameter is established (low risk = score 1, medium risk = score 2, high risk = score 3) and the relevant score multiplied by the weighting factor to provide total scores for each category. The total category scores are summed to give an overall risk score, with a lowest score of 100 and highest of 300. Scores below 150 show a low risk of impact to groundwater, scores of 150-250 show medium risk to groundwater, and scores over 250 indicate a high risk to groundwater. Full details of the assessment approach can be found in DMRB LA 113.

11.7.26 Results of the groundwater assessment for the ditch adjacent to the A614, tributary of Rainworth Water, are shown in Table 11-9. Best estimations of the assessment components have been made using available geology and borehole information. The assessment indicates a medium risk to groundwater. However, as described above the drainage design includes treatment measures in the form of a ditch, which is a SuDS feature. This provides a degree of treatment, prior to the outfall to the Rainworth Water. Furthermore, drainage occurs to this watercourse under the existing situation, and the proposed improvement Scheme actually decreases impermeable area being directed to this ditch from 3,026 to 2,507m^2.

11.7.27 On the basis, the impact on groundwater from routine road runoff is considered negligible. This results in a slight adverse effect (not significant) on groundwater as a very high importance receptor.

Table 11-9: Routine Road Runoff - Groundwater Assessment

Component Number	Property	Weighting Factor	Site Data	Component Score
1	Traffic Flow	10	<50,000	>10,000 to <50,000
2	Rainfall Depth	10	< 740 mm rainfall	Cold-dry
3	Drainage Area Ratio	10	<50	Lincoln (Standard Annual Average Rainfall 600mm)
4	Infiltration Method	15	Continuous – shallow linear, unlined ditch	Rainworth Water = 0.12 m^3/s
5	Unsaturated zone	40	Depth to water >5 to <15m bgl	From GI
6	Flow type	40	Mixed Fracture and intergranular flow	Geology baseline, alluvial deposits overlying sandstone
7	Unsaturated zone clay content	10	1 – 15% clay minerals	Alluvial deposits
8	Organic carbon	15	<1%soil organic matter	Alluvial deposits
9	Unsaturated zone soil pH	10	pH in range 5-8	Typical result
Overall risk Score		160		
Risk Level		Medium		

Accidental Spillages

11.7.28 The HEWRAT tool described in DMRB LA 113 also provides a method that gives an indication of the risk of an accidental spillage resulting in a serious pollution incident on a receiving water body, and guides the need for spillage containment measures. Where the risk is greater than the allowable standard (1 in 100 year return period), spillage containment measures should be built into the drainage designs to reduce the risk. The data used within the assessment has been tabulated in Table 11-10 below.

11.7.29 For the Scheme, the probability that a spillage would cause a pollution incident has been calculated for the outfall to the ditch that discharges to Rainworth Water. This includes road lengths draining to each outfall, and modelled traffic data.

Table 11-10: Data used within the HEWRAT spillage risk assessment

Parameter	Value	Source
AADT (2037 Design Year, two way) / % HGV (Do Minimum)	A614 north: 18491 / 5.6% A614 south : 20133 / 5.5% Mickledale Lane: 3495 / 5.6 % Inkersall Lane: 264 / 5.3%	AECOM Traffic data

Parameter	Value	Source
AADT (2037 Design Year, two way) / % HGV (Do Something)	A614 north: 20885 / 7.4% A614 south : 22491 / 7.8% Mickledale Lane: 3653 / 8.2 % Inkersall Lane: 271 / 9.6%	AECOM Traffic data
Length of Road	A614: 100m with no junction, and 400m with roundabout (100m to north, 100m to south, and 200m of roundabout) Mickledale Lane: 200m 'with junction'	Measured from Magic Maps
Road Type / urban or rural	A road / Rural trunk road	OS Map
Spillage Risk Factor	0.29 for no junction, 3.09 for the roundabout and 0.93 with side road	Spillage Factor from HEWRAT Spillage Risk Tool
Emergency Response Time	20-60 mins	Estimated from distance to local large town

11.7.30 For the Do Something scenario in the design year, the traffic flows increases which leads to a 0.0004, or 1 in 2315 years risk that a spillage would result in a significant pollution incident.

11.7.31 This is less than the 1% which is considered acceptable. The risk is therefore considered acceptable for the outfall to Rainworth Water without mitigation. Based on these results, and when taking into account the risk reducing benefits of the proposed drainage system, it is considered that there would be negligible impacts on surface water quality from accidental spillages as a result of the Scheme.

A negligible impact to Rainworth Water high importance receptor results in a slight adverse effect (not significant) from accidental spillages to Rainworth Water.

Surface Water Quality: Surface De-icing

11.7.32 During cold periods, which typically occur between October and April each year when temperatures are around 4°C or less, de-icing salts would likely be applied (when required) to the Scheme road network to maintain a safe driving surface and to help clear away any snow fall. The application of de-icant salts tends to be intermittent and can be very variable between years depending on how many cold days there are and the duration. During this time, highway runoff (that may also include snow melt) may contain sodium chloride (NaCl) and lesser amounts of clay, cyanide, sediment, and several metals. De-icing salts can also be corrosive to metals and may potentially increase the mobilisation of heavy metals in sediments. Similarly, NaCl can potentially trigger the release into solution of accumulated nutrients and heavy metals absorbed to suspended solids.

11.7.33 Generally, it is considered that because de-icing salts are used only infrequently and in the colder months, over short periods and with frequent higher flows in between in which to dilute and disperse 'salty' water, and when flora tends to have

died back and fauna less active and dormant, as such, significant long-term adverse effects are not likely to occur. SuDS systems may also provide some dilution of salt, although they are not generally considered to reduce salinity and there is a risk that the 'salty' water can re-mobilise metals deposited in the sediments.

11.7.34 While de-icing salts have often been linked to detrimental impacts to aquatic ecosystems, and macroinvertebrates in particular (Bent, 2009), there are also numerous scientific reports indicating that road salts do not induce significant acute negative responses on macroinvertebrate communities, but that responses are variable at the species level, where different tolerances are observed (Fleetwood, 2017 and Blasius *et al,* 2002). These latter studies considered short-term/pulsed exposures of road salt on macroinvertebrate communities where there were short residence times for the de-icant. It was considered that salt could accumulate and have more detrimental impacts in more restricted-flow systems leading to potential chronic effects on fauna.

11.7.35 As a broad indication of spreading rates, the Highways Winter Maintenance: A Practical Guide (Institute of Civil Engineers, 2000) suggests 10 to 20g/m^2 of salt in a precautionary salting, increasing to 20-40g/m^2 prior to snowfall or rain followed by freezing. Given that there are existing outfalls to the watercourses in the study area, it is expected that the aquatic communities of these watercourses may already be adapted to seasonal exposure to de-icant salts. It is anticipated that effects from de-icing salts would be greatest where receiving waterbodies are small and have limited dilution. However, Rainworth Water is of sufficient size in this area to provide dilution.

11.7.36 The NCC Gritting map (NCC, 2021a) shows A614 is part of the main routes for gritting. While the Scheme increases the impermeable area at Mickledale Lane Junction area by 5,927m^2 in comparison to the existing situation, this is not considered of significant area in the context of the local catchment area. Additionally, the flow from the A614 catchment area will be directed through the roadside ditch, and the flow from the new link road will be directed through two attenuation tanks to be constructed close to Mickledale Lane. Flow from this tank will be directed through a flow control chamber. As such, on balance there is considered to be a negligible magnitude of impact to water quality from surface de-icing in comparison to the existing situation, resulting in a slight adverse effect (not significant) to Rainworth Water.

Groundwater flow

11.7.37 While there would be potential for groundwater flows to be intercepted during construction excavations for the Scheme, once the Scheme is operational and the ground re-profiled, the magnitude of impact to groundwater flow, given that the Scheme is to be constructed at grade is negligible. As such, given that the groundwater body is of very high importance, and the magnitude of the impact is negligible, the significance of effect is slight adverse (not significant).

Flood Risk Effects

Potential increased risk of fluvial flooding

11.7.38 The Scheme is located within Flood Zone 1. The importance for fluvial flood risk is considered to be low. The drainage of the scheme will be to ensure there is no increase in runoff from the site, therefore, no change in the flooding potential for Rainworth Water. As a result, the impact of the scheme is considered to be negligible, resulting in a neutral effect (not significant).

Potential increased risk of surface water flood risk

11.7.39 The Scheme area is considered to be at low risk from surface water flooding, and is

therefore of low importance. The drainage of the scheme will be to ensure there is no increase in runoff from the site, therefore, no change in the flooding potential for Rainworth Water. As a result, the impact of the scheme is considered to be negligible, resulting in a neutral effect (not significant).

Potential increased risk of flooding from groundwater

11.7.40 The risk of flooding from groundwater sources is considered to be low importance. There are no areas of the design where significant cut and fill is required as the new roundabout junction and link road are at grade. Therefore, there is considered to be no change in the groundwater flooding potential of the area. As a result, the impact of the scheme is considered to be negligible, resulting in a neutral effect (not significant).

Potential increased risk of flooding from artificial sources and sewers

11.7.41 The Scheme area is considered to be at low risk from surface water flooding, and that from artificial sources. This is therefore considered to be of low importance. The drainage of the scheme will be to ensure there is no increase in runoff from the site, therefore, no change in the flooding potential from surface water or that from artificial sources. As a result, the impact of the scheme is considered to be negligible, resulting in a neutral effect (not significant).

Additional Mitigation

11.8.1 No additional mitigation is considered to be required.

Residual Effects

11.9.1 The residual effects of the Scheme in relation to road drainage and the water environment are outlined in Table 11-11 below. No significant residual effects are expected.

Table 11-11: Residual Effects

Description of Effect	Sensitivity of Receptor	Magnitude of Impact	Initial Classification of Effect (with embedded mitigation)	Additional Mitigation	Residual Effect Significance
Construction					
Surface water quality (Rainworth Water)	High	Negligible	Slight	Not required	Slight adverse
Groundwater flow and quality	Very high	Negligible	Slight	Not required	Slight adverse
Flooding from fluvial sources	Low	Negligible	Neutral	Not required	Neutral
Flooding from surface water sources	Low	Negligible	Neutral	Not required	Neutral
Flooding from drainage and artificial sources	Low	Negligible	Neutral	Not required	Neutral
Flooding from groundwater	Low	Negligible	Neutral	Not required	Neutral
Complete and Operational					
Surface water quality – routine run-off (Rainworth Water)	High	Negligible	Slight	Not required	Slight adverse
Surface water quality – de-icing (Rainworth Water)	High	Negligible	Slight	Not required	Slight adverse
Groundwater quality	Very high	Negligible	Slight	Not required	Slight adverse
Groundwater flow	Very high	Negligible	Slight	Not required	Slight adverse
Accidental spillages (River Maun)	High	Negligible	Slight	Not required	Slight adverse
Flooding from fluvial sources	Low	Negligible	Neutral	Not required	Neutral
Flooding from surface water sources	Low	Negligible	Neutral	Not required	Neutral
Flooding from drainage and artificial sources	Low	Negligible	Neutral	Not required	Neutral
Flooding from groundwater	Low	Negligible	Neutral	Not required	Neutral

12. CLIMATE

Introduction

12.1.1 This chapter reports the findings of an assessment of the likely significant effects on climate as a result of the proposed improvements at Mickledale Lane Junction. It also considers the impacts of climate change on the proposed Scheme. The overall Project summary detailing the cumulative impacts of the all the junctions in the Project are detailed in Volume 1, Chapter 12: Climate.

12.1.2 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.

12.1.3 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.

Legislation and Policy

12.2.1 Information relating to relevant climate legislation and policy can be viewed in Volume 1, Chapter 12: Climate.

Consultation

12.3.1 A summary of the climate related responses from the Scoping Opinion, which relate to the Scheme at Mickledale Lane Junction, is included in Table 12-1.

Table 12-1: Comments raised in Scoping Opinion

Stakeholder	Comment raised	Response and where addressed in the ES
Nottinghamshire County Council	As part of the greenhouse gas 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 greenhouse gas emissions	During operation it is anticipated that the operation of associated

Stakeholder	Comment raised	Response and where addressed in the ES
	identified by Nottinghamshire Wildlife Trust should be noted.	road, signalling and maintenance (including 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 greenhouse gas emissions related to the Scheme are modelled as per the methodology in Section 12.4.

Greenhouse Gas Assessment Methodology

12.4.1 The GHG emissions calculation methodology is based upon a lifecycle assessment. Lifecycle stages and the activities applicable to the Scheme are presented in Table 12-2 below. This approach is consistent with the principles set out in DMRB LA 114.

Table 12-2 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 Transport of construction materials (where these are not included in embodied GHG emissions) Transport of construction workers Disposal of any waste generated during the construction processes	GHG emissions from energy (electricity, fuel, etc.) consumption for plant and vehicles, generators on site. Fuel consumption from transport of materials to site (where these are not included in embodied GHG emissions) GHG emissions from fuel use for worker commuting GHG emissions from disposal of waste and GHG emissions from fuel consumption of transportation of waste

Baseline Conditions

12.4.2 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.

12.4.3 The baseline for the Scheme does not include decommissioning or operational GHG emissions therefore the baseline is effectively zero.

Study Area

12.4.4 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.

12.4.5 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.

12.4.6 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.

12.4.7 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).

12.4.8 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).

12.4.9 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).

12.4.10 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

12.4.11 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.

12.4.12 Direct and indirect emissions sources from different lifecycle stages of the development are detailed in Table 12-2.

Significance Criteria

Sensitivity of Receptor

12.4.13 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

12.4.14 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.

12.4.15 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.

12.4.16 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 12-3. 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 12-4.

Table 12-3 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 12-4 Significance of GHG Emissions

Magnitude	Significance of Effect
High	Major adverse (significant)
Low	Minor adverse (not significant)

12.4.17 GHG emissions have been assessed against the relevant UK carbon budgets in which they arise to determine the magnitude of 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. The UK Carbon Budgets are detailed in Table 12-5.

Table 12-5 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

12.5 Climate Change Vulnerability (CCV) Assessment Methodology

12.5.1 The CCV assessment has followed the method detailed in the DMRB LA 114. This was completed in liaison with the project 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).

12.5.2 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 12-6.

Table 12-6 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.
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.

Climatic Parameter	Scoped in or out	Rationale for inclusion conclusion
Wind	Out	The impacts of wind on receptors in the surrounding environment are likely to be no worse relative to baseline conditions.

Baseline Conditions

12.5.3 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

12.5.4 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

12.5.5 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 proximately 54 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.

12.5.6 Construction phase receptors may include the workforce, plant, machinery and materials.

Methodology for Determining Operational Effects

12.5.7 The CCV assessment has addressed the resilience of the proposed development 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.

12.5.8 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.

12.5.9 Climate change projections for the operational phase are produced using UKCP18 data (Met Office, 2020a).

Significance Criteria

12.5.10 The likelihood and consequences to project receptors were assessed according to Table 12-7 and Table 12-8 as per DMRB LA 114.

Table 12-7 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

Likelihood	Description (probability and frequency of occurrence)
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 12-8 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.

12.5.11 The significance of each climatic impact has been evaluated using the matrix detailed in Table 12-9. Any significant conclusions are based on and incorporate confirmed design and mitigation measures, as described by DMRB LA 114.

Table 12-9 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

12.5.12 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

12.5.13 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:

12.5.14 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;
- it is assumed that the compaction of fill had no associated embodied carbon that was not already included;
- topsoil assumed in situ therefore no associated embodied carbon; and
- it is assumed that the ditch had no associated embodied carbon.

12.5.15 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 assumed to be fill, aggregate and sand; and
- disposal of topsoil assumed to be off-site.

12.5.16 Fuel use on site (construction):

- the fuel use on site is based on an assumption that is calculation based on project value; and
- the project 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).

12.5.17 Material Transport (construction):

- assumed a single trip distance of 50 km.

12.5.18 Land use change:

- scoped out.

12.5.19 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.

12.5.20 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.

12.5.21 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.

12.5.22 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).

12.5.23 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.

12.6 Baseline Conditions

GHG Assessment

12.6.1 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).

12.6.2 As detailed within 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

12.6.3 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, 21 km from Mickledale Lane Junction) for the period 1981-2010. These data are listed in Table 12-10.

Table 12-10 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

12.6.4 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 12-11.

Table 12-11 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

12.6.5 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.

12.6.6 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.

12.6.7 Projected temperature and precipitation variables are presented in Table 12-12 and Table 12-13 respectively. UKCP18 probabilistic projections have been analysed for the 25 km grid square in which the scheme is located. These figures are expressed as temperature/precipitation anomalies in relation to the 1981-2000 baseline.

12.6.8 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 GHG emissions continue to grow unmitigated.

12.6.9 The Scheme's design life is 60 years. The projected climate variables presented in Table 12-12 and Table 12-13 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.

12.6.10 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 12-12 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)	+2.7 (+1.2 to +4.3)
Mean summer air temperature anomaly at 1.5 m (°C)	+1.2 (+0.4 to +2.1)	+2.2 (+0.9 to +3.6)	+3.3 (+1.1 to +5.7)
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 +2.5)	+2.5 (+0.8 to +4.4)	+3.8 (+1.1 to +6.7)
Minimum winter air temperature anomaly at 1.5 m (°C)	+4.4 (-5.1 to +1.9)	+1.6 (+0.3 to +3.0)	+2.4 (+0.7 to +4.3)

Table 12-13 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	-1.8	-1.5

	Climate Period		
	2020-2039	2040-2059	2060-2079
	(-3.2 to +5.8)	(-8.5 to +5.3)	(-7.0 to +4.2)
Summer precipitation rate anomaly (%)	-7.1 (-27.5 to 14.4)	-19.3 (-41.7 to +3.4)	-26.4 (-55.9 to +3.6)
Winter precipitation rate anomaly (%)	+4.4 (-5.1 to +14.4)	+7.8 (-5.1 to +21.1)	+13.7 (-2.4 to +30.4)

12.7 Design, Mitigation and Enhancement Measures

GHG Emissions

12.7.1 Mitigation measures would be implemented to reduce lifecycle emissions across the Scheme as shown in Table 12-14.

Table 12-14 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. 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: • using materials with lower embodied GHG emissions and water consumption; • using sustainably sourced materials; and • 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: ▪ Agreements with material suppliers to reduce the amount of packaging or to participate in a packaging take-back scheme; ▪ Implementation of a ‘just-in-time’ material delivery system to avoid materials being	Detailed design and SWMP

Lifecycle Stage	Mitigation Measures	Delivery Mechanism
	stockpiled, which increases their risk of damage and disposal as waste; ▪ Attention to material quantity requirements to avoid over-ordering and generation of waste materials; ▪ 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; ▪ Segregation of waste at source where practical; and ▪ 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: ▪ waste arisings will be prevented and designed out where possible; ▪ 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 ▪ 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

12.7.2 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 12-15.

Table 12-15 Embedded climate change vulnerability mitigation measures

Lifecycle Stage	Mitigation Measures	Delivery Mechanism
Construction	The construction contractor would develop and implement a plan to prevent or reduce the likelihood of climatic hazards affecting construction staff and assets.	CEMP, SWMP and Site Safety Plan
	Net gain of biodiversity through retained, enhanced or created habitats through landscaping	Landscape Proposals and BNG strategy (see BNG Report (See Appendix 2-2 in Volume 3B and Volume 3 Appendix 4-2)
Operation	The Proposed 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)

Lifecycle Stage	Mitigation Measures	Delivery Mechanism
	A range of measures would be put in place to improve the resilience of the scheme to climate change during the scheme operation, including maintenance plans for drainage systems to allow them to operate effectively, and temperature and extreme weather resilient surfaces.	Operation and Maintenance Manuals
	The detailed landscaping proposals are to include drought, and extreme weather -tolerant species where appropriate.	Landscape Proposals (Appendix 2-2 in Volume 3B)

12.8 Assessment of Likely Significant Effects

Construction

12.8.1 As described in Chapter 2: The Scheme, the construction stage is anticipated to take approximately 54 weeks at the proposed Junction at Mickledale Lane Junction.

12.8.2 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 12.4.

12.8.3 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 Scheme data and information, industry benchmarks and professional judgement. These are detailed in Section 12.5.

12.8.4 As detailed in Table 12-16, the total GHGs estimated to be emitted from the construction associated with the Scheme have been calculated to be 2,077 tCO_2e over the course of the 54-week construction period. The majority of emissions are associated with embodied carbon from the transport of materials raw materials accounting for approximately 61% of all construction emissions.

12.8.5 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 12-16 Estimated Construction GHG Emissions

Emission Source	Emissions (tCO_2e)	Percentage of Stage Emissions
Embodied carbon in raw materials	546	26%
Fuel usage onsite	22	1%
Transport of materials to site	1,258	61%
Disposal of construction waste	160	8%
Employee commuting	91	4%

Emission Source	Emissions (tCO_2e)	Percentage of Stage Emissions
Total emissions	2,077	

GHG Emissions Significance

12.8.6 As stated in Section 12.4, 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 12-17, detailing the construction emissions against that of the relevant UK Carbon Budgets, the Scheme contributes 0.0001% to the 4th Carbon Budget only.

12.8.7 The magnitude of impact during construction is therefore considered to be Low. As per Table 12-3 and Table 12-4 this is considered to be a minor adverse not significant effect.

Table 12-17 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	0.002077	0.0001%

12.9 CCV Assessment

Construction

12.9.1 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.

12.9.2 In consideration of the embedded and design mitigation and management measures described in Section 12.4, the resulting significance matrix for climate vulnerability has been undertaken in Table 12-18. No significant vulnerability impacts have been identified for the construction phase of work.

Table 12-18 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
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

12.9.3 During operations, 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.

12.9.4 In consideration of the embedded and design mitigation and management measures described in Section 7.6, the resulting significance matrix for climate vulnerability has been undertaken in Table 12-19. No significant vulnerability impacts have been identified for the operational phase of work.

Table 12-19: 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 and/or prolonged precipitation, storm events and heatwaves)	Flooding and storm damage to site and site assets, danger to maintenance workers and road users, inaccessible work site, possible power disruption, 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	Medium	Minor Adverse	Not Significant
Increased winter precipitation	Flooding of construction 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

12.10 Residual Effects

12.10.1 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.

12.10.2 The residual effects resulting from the Scheme are summarised in Table 12-20 and Table 12-21 below.

Table 12-20 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 12-21: 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

13. SUMMARY

13.1 Introduction

13.1.1 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.

13.2 Summary of Significant Effects

13.2.1 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;
- Road drainage and the water environment; and
- Climate.

13.2.2 The assessments reported in the following chapters identified likely significant environmental effects during the construction phases of the Scheme:

- Geology and soils; and
- Noise and vibration.

13.2.3 Table 13-1 summarises the likely significant effects associated with the construction and operation of the Scheme as detailed in Chapters 5 to 12 of this report.

Table 13-1 Summary of Likely Significant Residual Effects

Topic	Receptor	Phase	Proposed Mitigation and Monitoring	Residual effect
Geology and Soils	Agricultural soils (Grade 3a BMV)	Construction (permanent loss)	No additional mitigation proposed.	Moderate adverse
Construction Noise	7no. receptors	Construction	BPM and temporary screening where feasible	Significant adverse
Construction vibration	6no. receptors	Construction	BPM	Significant adverse

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15. ABBREVIATIONS

Abbreviation	Definition
AADT	Annual Average Daily Traffic
AAWT	Annual Average Daily Traffic
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
ASSI	Area of Special Scientific Interest
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
CAMS	Catchment Abstraction Management Strategy
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

Abbreviation	Definition
CWS	County Wildlife Site
dB	Decibel
Defra	Department for the Environment Food and Rural Affairs
DfT	Department for Transport
DCLG	Department for Communities and Local Government
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
ECoW	Ecological Clerk of Works
EFT	Emissions Factors 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
HER	Historical Environment Record
HSI	Habitat Suitability Index

Abbreviation	Definition
ICD	Inscribed Circle Diameter
ICE	Inventory of Carbon and Energy
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
LNR	Local Nature Reserve
LOAEL	Local Observed Adverse Effect Level
LPD	Local Planning Document
LRA	Land Research Associates
LTP	Local Transport Plan
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
MPA	Marine Protection Area
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
NCN	National Cycle Network
NERC	Natural Environment and Rural Communities
NEWP	National Environmental White Paper
NF_3	Nitrogen Trifluoride
NGR	National Grid Reference
NHLE	National Heritage List for England

Abbreviation	Definition
NIA	Nature Improvement Area
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
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
PCM	Pollution Climate Mapping
PDBE	Polybrominated diphenyl ethers
PFOS	Perfluorooctance sulfonate
PM	Afternoon peak
PM_{10}	Particulate Matter
PPG	Pollution Prevention Guidance
PPS	Planning Policy Statement
ppSPA	Possible Potential Special Protection Area
PRoW	Public Right of Way
pSAC	Possible Special Area of Conservation
pSPA	Potential Special Protection Area
PWS	Private Water Supply
PZ	Policy Zone
RBC	Rushcliffe Borough Council
RBMP	River Basin Management Plan
RCLA	Regional Landscape Character Area

Abbreviation	Definition
RCP	Representative Concentration Pathway
RIGS	Regionally Important Geological Sites
ROWIP	Right of Way Improvement Plan
SAC	Special Area of Conservation
SAM	Scheduled Ancient Monument
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
SOAEL	Significant Observed Adverse Effect Level
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
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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