A614/A6097 Corridor Improvements Environmental Statement

Volume 1A
Scheme Specific Assessment - Ollerton Roundabout

Via East Midlands Ltd

Project number: 60643622

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Quality information

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Environmental Statement Contents

Table of Contents

List of Tables

1. INTRODUCTION

1.1.1 Ollerton Roundabout 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 Ollerton Roundabout 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 Ollerton Roundabout 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 2A, and appendices are within Volumes 3 and 3A.

2. THE SCHEME

2.1 Existing Situation

2.1.1 Currently Ollerton Roundabout is a six-arm standard roundabout, with the Newark Road approach arm being bus-only. The junction conforms the meeting of the A614 Blyth Road, A614 Old Rufford Road, A616 Worksop Road, A616 Ollerton Road, A6075 Mansfield Road and Newark Road, facilitating local movements from Ollerton and local tourist attractions as well as strategic trips accessing the strategic road network (SRN) (A1(T) via the A614).

2.1.2 A McDonald's restaurant and a Costa Coffee shop (both with drive through access) have been built to the immediate south of the junction. A Public House is situated to the west of the junction (The Alders). Petrol filling stations are positioned on either side of Old Rufford Road leading into the junction from the south. Isolated housing is to the north-east of the junction (adjacent east of Blyth Road).

2.1.3 The roundabout is located on the outskirts of Ollerton village with the wider village located to the east. The area immediately to the east and south-east of the roundabout, bounded by the A616 Ollerton Road and the A614 Old Rufford Road is designated a conservation area (Ollerton Conservation Area) consisting predominantly of the village of Old Ollerton, within which are several historic and listed buildings.

2.1.4 There are footways along the roads leading into Ollerton Roundabout, with a bridleway 26 (Ollerton and Boughton Bridleway No. 26 (BW 26) changing name at the Parish boundary to Edwinstowe Bridleway No. 24 (BW 24) leading north-west through Sherwood Heath LNR. There are crossing points available around the junction, but no signalised non-motorised user crossing points are currently provided.

2.1.5 A campaign group called Ollerton Village Residents Association (OVRA) was formed over 30 years ago to help preserve and protect the historic core of the Ollerton village, as a result of ever-increasing levels of congestion at Ollerton Roundabout. The congestion regularly results in motorists using Station Road through Old Ollerton as an alternative route to the A616 and A614.

2.1.6 The junction currently experiences significant levels of congestion, particularly during the morning and evening peak time periods. Queue length surveys were recorded at the roundabout in June 2017 at the request of Nottinghamshire County Council (NCC). The A614 Old Rufford Road arm experienced the largest delays with a maximum queue length being observed measuring 550 m (approximately 100 cars) in the evening peak period. The biggest queue in the morning peak was recorded on the A616 Worksop Road arm with a maximum observed queue length of 275 m (approximately 50 cars).

2.1.7 Current speed limits approaching the roundabout are as follows:

- A616 Worksop Road – 60 mph;
- A614 Blythe Road – 60 mph
- A616 Ollerton Road – 60 mph;
- A614 Old Rufford Road – 50 mph;
- A6075 Mansfield Road – 50 mph.

2.1.8 Key environmental constraints within the area include, but are not limited to:

- residential properties in close proximity to the junction;
- several ecological designated sites within 200 m of the roundabout including Birklands West and Ollerton Corner Site of Special Scientific Interest (SSSI), Birklands and Bilhaugh Local Wildlife Site (LWS) and Sherwood Heath Local Nature Reserve (LNR) and LWS and habitats included within the Sherwood Forest Area possible potential Special Protection Area (ppSPA). Some of these habitats are adjacent to the existing junction.
- flood zone 2 and 3 areas associated with the nearby River Maun, including within the red line boundary for planning; and
- Ollerton Conservation Area to the south-east of the Scheme (including a small area within the assessment boundary for planning).

2.1.9 The landscape surrounding the immediate built environment situated near the roundabout is rural and includes both farmland (grazing and arable) and natural areas.

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

Future Situation

2.1.11 Without improvement, the current congestion and journey reliability problems experienced on the A614/A6097 are expected to persist and worsen over time as noted in the Transport Assessment (AECOM, 2021).

2.2 Scheme Description

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

2.2.2 The development of the Scheme design has been informed by knowledge of environmental constraints and engagement with stakeholders (including responses received during informal and statutory consultation).

2.2.3 It is proposed to enlarge the existing Ollerton Roundabout. The existing six approaches would be reduced to five by removing the bus-only arm Newark Road, which would be realigned to join the A616 Ollerton Road arm.

2.2.4 The Inscribed Circle Diameter (ICD) of the roundabout would be increased from 37.5 m to 60 m, with approaches from all directions widened to provide two entry lanes onto and around the circulatory of the roundabout. The roundabout exits would provide a short section of two lanes with a merge in turn arrangement to tie back into the single carriageway arms.

2.2.5 Changes to speed limits are proposed with the speed limit reduced from national speed limit to 40 mph at the roundabout and on all approaches.

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

2.2.7 All footways would be ‘shared use’, meaning this is a route which is available for use by both pedestrians and cyclists. New toucan crossing points (a crossing with signal controls) for both pedestrians and cyclists would be provided on the A6075 Mansfield Road and the A614 Old Rufford Road.

2.2.8 Accommodation works would be carried out by NCC as the acquiring authority, by agreement with landowners and affected parties. At the Ollerton Roundabout accommodation work would largely consist of boundary treatments at the residential

properties to the immediate north of the junction, the detail of which is still to be confirmed. The inclusion of anti-dazzle fencing would also be considered at locations where traffic flows are opposing, i.e. at drive through locations (Costa and McDonald's).

2.2.9 The total area needed for the Scheme construction and operation is approximately 5.1 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. Permanent and temporary land take is shown on the Land Affected plans within Appendix 2-3 of Volume 3A. Where permanent land take is required outside of the current highway boundary this would be acquired by negotiation or a Compulsory Purchase Order.

2.2.11 Temporary and permanent land take would include sections of agricultural land, as well as land within the property at Forest Corner, land within the designated Birklands West and Ollerton Corner SSSI, The Alders Public House, Costa Coffee and McDonald's, all of which is land outside the current highway boundary. Temporary land would be restored to current condition or better on return to the landowner.

2.2.12 A new highway boundary would be formed that would encapsulate the required permanent land take for the Scheme. Permanent land take would include sections of agricultural land and land from within the designated Birklands West and Ollerton Corner SSSI. The extent of vegetation clearance is shown in Appendix 2-1 in Volume 3A.

Earthworks and Landform

2.2.13 There is very little by way of earthworks proposed as part of this junction improvement. There are some proposed changes to the carriageway levels in the vicinity of the McDonald's restaurant to lower the carriageway (by approximately 400 mm) to tie in with existing levels to avoid the need for significant retaining structures. Instead, the proposals include provision of back-to-back kerbs to address the slight level difference between the McDonald's drive-through facility and the highway.

2.2.14 The proposals include a retaining feature (gabion baskets) to address a localised change in level of approximately 700 mm at the radius around The Alders Public House.

2.2.15 Additionally, the boundary feature around No.1 Forest Side is likely to consist of a small retaining wall which would accommodate a level difference of approximately 400 mm.

Drainage

2.2.16 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.

2.2.17 Where chambers outfall into underground storage (the size of which would be confirmed through the detailed design process), the surface water would be released by a flow control chamber at existing discharge rate by new carrier drain into the existing system which runs along Newark Road and outfalls into the River Maun.

2.2.18 At Ollerton Road, catchpits would flow east discharging into an existing ditch approximately 120 m east of the roundabout.

Lighting and Signage

2.2.19 Street lighting design for the Scheme has been designed in line with current design standards taking into account required Sight Stopping Distance and proposed speed limits. At the Ollerton Roundabout the street lighting has been designed to reduce the impact on the Birklands West and Ollerton Corner SSSI and the suspected bat roost at Forest Side.

2.2.20 LED lanterns would be installed and at relevant locations the lanterns would incorporate rear shielding to reduce light spill.

2.2.21 Lighting columns would be situated approximately 2 m to 3 m back from the 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 for road safety, as this is the focal area of any potential conflict zone[1].

2.2.22 The A614 north of the roundabout (near No.3 Forest Side) would be lit using 8.0 m lighting columns with a lower light output with Warm White LED lanterns with a rear shield.

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

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.

2.2.27 Some boundary treatments would be specific to the location and subject to further detailing of the design alongside discussions and agreement with landowners and affected parties.

Non-motorised User Provisions

2.2.28 Toucan crossing points (a crossing with signal controls) for both pedestrians and cyclists would be provided on the A6075 Mansfield Road and the A614 Old Rufford Road. This is an improvement to the existing situation where there are no dedicated non-motorised user crossings other than at Newark Road where an uncontrolled crossing is provided.

2.2.29 It is proposed to provide a 3 m wide shared use facility, with the exception of localised pinch points that have been agreed with NCC Countryside and Access Team and Rights of Way Manager. At the Ollerton Roundabout, the pinch points are anticipated to be in the vicinity of the toucan crossing on the west side of the junction (adjacent to Costa Coffee) where the width would be reduced to < 3 m (exact width to be confirmed during detailed design).

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

2.2.30 It is not proposed to provide specific facilities for equestrian users at this location. While it is acknowledged that Ollerton & Boughton Bridleway 26 (BW26) intersects the roundabout from the west at the A6075, NMU survey returns did not identify any equestrian usage at the junction. The constraints of the built environment around this junction mean that incorporation of Pegasus crossings into the proposed junction improvements could not be achieved.

2.2.31 Where the bus gate joins Ollerton Road from Newark Road, an uncontrolled crossing point would be provided to maintain pedestrian access to the facilities on the south-east side of the junction.

2.2.32 At the bus gate, a bus stop would be created marked with a bus stop pole and flag, complete with hardstanding and raised boarding kerb. Stops to the west of the roundabout (bus stops in both directions (NS0533 and NS0857) would also be marked with a bus stop pole and flag and installed with hardstanding and raised boarding kerbs.

2.3 Environmental Design and Enhancement

2.3.1 A landscape design has been prepared (see Appendix 2-2 of Volume 3A).

2.3.2 Where possible the design has maximised retention of any established hedgerows and the project team is collaborating with all affected landowners to agree appropriate boundary treatments that are in keeping with the junction and wider setting wherever possible.

2.3.3 Landscaping design at Ollerton Roundabout includes specific planting to support the local environment. The proposed planting at the SSSI includes an irregular 3-5 m wide band of mixed native shrub and hedgerow species to support request made by Natural England received during early engagement in 2019 (see Section 1.7 in Volume 1). This also aligns with a request from NCC's Senior Practitioner for Historic Buildings to introduce a small number of additional trees.

2.3.4 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 materials (including kerbs) removed during site clearance would be recycled and used as sub-base in new carriageway construction, subject to the appropriate consents.

2.3.5 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 A6075 Mansfield Road, to the south of Ollerton Roundabout. 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 is expected to commence in Autumn 2023 and take approximately 87 weeks to complete.

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 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;

- gabion wall;
- 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 (HMSO, 2002) and the Control of Pollution (Oil Storage) (England) Regulations 2001 (HMSO, 2001). Further details on the measures required for handling and storing fuels are provided in Chapter 11: 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;

[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.

- 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 Structures proposed at the Ollerton Roundabout include provision of gabion baskets, boundary/retaining wall and back to back kerbs to address level differences between the carriageway and adjacent land.

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 will 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 will 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) will inform the programme of construction activities to avoid closures of the A614 when the route will be needed to support the SRN. Similarly, when closures are required at the Ollerton Roundabout, the Contractor will 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 would be a 'live' document and would be continually reviewed and updated by the Principal Contractor.

2.4.24 The CEMP would 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 would be updated and developed throughout the construction phases in consultation with NCC where necessary. The CEMP would 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 would 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 would 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 would be cleared on a regular basis; and
- not burning waste or unwanted materials on-site.

2.4.30 The Principal Contractor and subcontractors would be required to carry out works in such a way that, as far as is reasonably practicable, the amount of spoil and waste to be disposed of by landfill is minimised. Any waste arisings from the site are to be transported and disposed of in accordance with relevant legislation including the following:

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

2.4.31 Whilst the Site Waste Management Plan (SWMP) Regulations (HMSO, 2008) were revoked as of the 1 December 2013, the Principal Contractor would 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 would 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 would 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.
- 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: Assessment of Alternatives.

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

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

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

4.1.6 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 2A and Appendix 5-1 of Volume 3.

5.2 Legislation and Policy

5.2.1 Full details 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, 2021). 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.	As noted in Section 5.8, the impacts of dust on the SSSIs and LWS in close proximity to the junction would be monitored during construction. The CEMP would include a plan to rectify any issues this highlights. As noted in Section 5.8, monitoring would be undertaken once the Scheme is open to traffic. If the additional monitoring indicates that the impacts are significant then a plan would be put in place to rectify this. 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);
- Ordnance Survey Mastermap (Ordnance Survey, 2021a), Ordnance Survey Addressbase Plus (Ordnance Survey, 2021b) and Google Earth (Google, 2020) mapping and imagery were used to identify receptor point locations;
- the Air Pollution Information Service (APIS) (UK Centre for Ecology and Hydrology, 2021) for habitat types, background nitrogen deposition rates for sites and site specific critical loads;
- the designated habitats within the study area were identified using the insight mapping website (Nottingham City Council, 2020); and
- consultation with the competent expert for biodiversity.

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 shown in Figure 5-2 of Volume 2A has been chosen as a proxy for the area within which dust-generating activities would occur. This is a cautious assumption as dust generating activities are unlikely to occur right to the edge of this assessment boundary.

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

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 2A.

General Assessment Methodology

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

- construction dust assessment to identify areas that could be affected by construction-phase activities;
- local air quality assessment for the construction of the Scheme for public exposure and designated habitats;
- local air quality assessment for the operation of the Scheme for public exposure and designated sites; 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 21 months for the Ollerton Roundabout 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	High	Low

Methodology for Determining Operational Effects

Scoping

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

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

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

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 roundabout 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 roundabout 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 roundabout 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 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

5.4.27 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).

5.4.28 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.

5.4.29 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.

5.4.30 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.

5.4.31 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).

5.4.32 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.

5.4.33 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.

5.4.34 Detailed information on the inputs used within the modelling for the local air quality assessment are provided in Appendix 5-1 of Volume 3.

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

Model performance

5.4.36 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.

5.4.37 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 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.

5.4.38 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.

5.4.39 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).

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

Public exposure receptors

5.4.41 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).

5.4.42 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.

5.4.43 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.

5.4.44 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.

5.4.45 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

5.4.46 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.

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

Table 5-3: Definitions of the magnitude of change criteria

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

5.4.48 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.

5.4.49 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

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

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

Designated Habitats

5.4.51 As well as impacts on human health, some air pollutants also have an effect on vegetation. Concentrations of pollutants in air and deposition of particles can damage vegetation directly or affect plant health and productivity. Deposition of pollutants to the ground and vegetation can alter the characteristics of the soil, affecting the pH and nitrogen availability that can then affect plant health, productivity and species composition. Increased greenhouse gas emissions on a global scale can affect the global climate, such that the ability of existing species to tolerate local conditions can change.

5.4.52 Internationally, nationally and locally designated sites of ecological conservation importance on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity (known as designated sites) are also considered in the operational phase assessment. Designated habitats include ‘Ramsar’ sites, Special Protection Areas (SPAs), Special Areas of Conservation (SACs), SSSI, LNR, LWS, Nature Improvement Areas (NIAs), Ancient Woodland (AW) and veteran trees. The following sites are within the air quality study area:

- Birklands West and Ollerton Corner SSSI;
- Birklands and Bilhaugh LWS; and
- Sherwood Heath LNR.

5.4.53 Birklands West and Ollerton Corner SSSI and Birklands and Bilhaugh LWS overlap as illustrated on Figure 5-1 of Volume 2A.

5.4.54 The competent expert for biodiversity confirmed that all these sites are sensitive to nitrogen deposition and therefore are considered in the assessment.

5.4.55 The pollutant of most concern for sensitive vegetation near roads is NO_X with a concentration of 30 µg/m^3 (annual mean) forming the critical load for designated habitats. Furthermore, critical loads for the deposition of nitrogen (N) representing the exposure below which there should be no significant harmful effects on sensitive elements of the ecosystem have been established for certain habitats and are expressed in deposition units of kg N/ha/year.

5.4.56 At each Designated Habitat, annual mean NO_X concentrations were predicted along a transect, at 10 m intervals up to 200 m from the ARN. For each point along the transect, the road NO_X concentrations have been predicted for the base year, Do Minimum and Do Something in the opening year. The road NO_X concentration is converted to road NO_2 concentrations and then converted to dry nutrient nitrogen (N) deposition rate (kg N/ha/yr) using conversion rates outlined in the DMRB LA 105. The road N deposition rate is added to background N deposition rates derived from the APIS (UK Centre for Ecology and Hydrology, 2020) to determine total N deposition rates. These rates have then been compared to the critical loads for each designated site.

5.4.57 The process for assessing the significance of air quality effects at designated habitats from DMRB LA 105 was followed. This states that if the total nitrogen deposition rate is under the critical load for the designated site in both Do Minimum and Do Something scenarios, or the change in total nitrogen deposition rate is less than 1% of the critical load, the effect is not significant. If these criteria are not met, further ecological assessment is required to determine whether the air quality effect is significant; these details are provided in Chapter 8: Biodiversity.

Overall significance determination

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

5.4.59 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

5.4.60 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.

5.4.61 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).

5.4.62 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.

5.4.63 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 (Defra, 2020c). Speed bands are assigned on a link-by-link basis as informed by the pivoted speeds provided by the appointed traffic consultant.

5.4.64 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.

5.4.65 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.

5.4.66 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 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 (µg/m^3)			
				2016	2017	2018	2019
18N	465090	367595	A614, North of Big Fish Roundabout, Ollerton (now a Costa Coffee shop)	36.0	34.6	33.9	32.1

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

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

5.5.7 The range of background concentrations for each 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 (µg/m^3)		Background Annual Mean PM_{10} (µg/m^3)	
	2018	2023	2018	2023
464500, 367500	8.3	7.0	13.3	12.5
465500, 367500	9.2	7.6	14.7	13.7

Designated Habitats

5.5.9 Details of the designated sites within the air quality study area are given in Table 5-7. Critical loads appropriate to use at detailed assessment stage as defined by APIS are provided. All sites are considered sensitive to nitrogen by the competent expert for biodiversity. Specifically for the Birklands West and Ollerton Corner SSSI/ Birklands and Bilhaugh LWS, the dwarf shrub heath is the site sensitive feature.

5.5.10 Details of the sites, designation, critical loads and deposition rates are provided in

Table 5-7. As described in DMRB LA 105, the deposition rate varies depending on the vegetation in each designated habitat. For grassland and similar habitats the rate is 0.14 kg N/ha/yr, while for forests and similar habitats a rate of 0.29 kg N/ha/yr is applied.

5.5.11 Note that part of the Sherwood Forest Area ppSPA is located within the Birklands West and Ollerton Corner SSSI.

Table 5-7: Designated habitats within the air quality study area.

Site Name	Habitat type (EUNIS code)	Critical load (kg N/ha/yr)	Background nitrogen deposition (kg N/ha/yr)	Deposition conversion rate (kg N/ha/yr)
Birklands West and Ollerton Corner SSSI (including part of the Sherwood Forest Area ppSPA)	Dry heaths	10 - 20	19.7	0.14
Birklands and Bilhaugh LWS	Dry heaths	10 - 20	19.7	0.14
Sherwood Heath LNR	Dry heaths	10 - 20	19.7	0.14

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 Changes to speed limits are proposed as part of the Scheme, with the speed limit reduced from the national speed limit to 40 mph at the roundabout and on all approaches. Lower speed limits can reduce noise caused by tyre/ road surface interaction which dominates at higher speeds.

5.6.5 The Scheme design aims to reduce congestion at the junction which will reduce the risk of air quality impacts at receptors where the road alignment remains unchanged.

5.7 Assessment of Likely Significant Effects

Construction

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

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

5.7.2 The main 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 2A. The construction dust risk potential is considered to be ‘small’ for the Scheme as it is a small junction improvement. Therefore, the sensitivity to potential dust effects is considered to be ‘High’ for receptors located within 50 m of the construction activity and ‘Low’ for receptors located between 50 and 200 m.

5.7.5 There are four residential receptors (properties along Blyth Road and Mansfield Road) and two food-based commercial receptors (McDonald’s restaurant and Costa Coffee café on Old Rufford Road) within 50 m of the assessment boundary for the construction dust assessment. There are approximately 10 receptors between 50 m and 200 m from the assessment boundary.

5.7.6 There are four designated habitats within 50 m of the assessment boundary: Birklands West and Ollerton Corner SSSI (including part of the Sherwood Forest Area ppSPA); Birklands and Bilhaugh LWS; and Sherwood Heath LNR.

5.7.7 As the potential dust effects is identified as ‘high’ for receptors located within 50 m of the assessment boundary, best practice mitigation measures suitable for this level of risk 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 5-8.

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 5-8: 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	4.5	15.7	17.4	15.6	15.6	<0.1
R2	1.5	18.2	33.6	30.1	32.5	+2.4
R3	1.5	16.0	18.9	17.1	16.6	-0.5
R4	1.5	16.0	20.0	17.9	16.7	-1.2

5.7.11 R1 is located between the A616 and Mansfield Road and although the queue length is reduced as a result of the Scheme, the road alignment moves closer to the receptor. Overall, the effect of the Scheme on R1 is predicted to be imperceptible.

5.7.12 Receptor R2, located on Blyth Road, is predicted to experience an increase in annual mean NO_2 concentration as a result of the Scheme. This is due to the roundabout moving closer to the property and therefore reducing the distance to the emission source (traffic).

5.7.13 Receptors R3 (located off Mansfield Road) and R4 (located along Old Rufford Road) are both predicted to experience a slight decrease in annual mean NO_2 concentrations. This is due to a reduction in vehicle queue length on the roads leading to the Ollerton Roundabout with the Scheme in place.

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

5.7.15 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.

Designated Habitats

5.7.16 Predicted annual mean NO_x concentrations and nitrogen deposition rates and changes in NO_x concentrations and nitrogen deposition rates attributable to the Scheme operation are presented in Table 5-9 for every ecological transect

modelled.

5.7.17 Within the Birklands West and Ollerton Corner SSSI/ Birklands and Bilhaugh LWS/ Sherwood Forest Area ppSPA, the sensitive site feature is the dwarf shrub heath habitat. As this feature is located over 100 m from the road, the air quality effects at the designated habitats considered to be not significant.

5.7.18 Similarly, the air quality effects at the Sherwood Heath LNR are considered to be not significant. Further details are provided in Chapter 8: Biodiversity.

5.7.19 Therefore, a conclusion of no likely significant air quality effect for designated habitats sites is recorded.

Table 5-9: Predicted NO_x concentrations and nitrogen deposition rates at designated habitat transects

Designated Habitat	Distance from road (m)	Grid Reference	Site Critical Load (kg N/ha/yr)	LTT DM Total NO_x concentration ($\mu g/m^3$)	LTT DS Total NO_x concentration ($\mu g/m^3$)	Change in LLT Total NO_x concentration ($\mu g/m^3$)	LTT DM Total Nitrogen Deposition (kg N/ha/yr)	LTT DS Total Nitrogen Deposition (kg N/ha/yr)
Birklands West and Ollerton Corner SSSI/Birklands and Bilhaugh LWS (including part of the Sherwood Forest Area ppSPA)	10.7	465070, 367571	10-20	55.9	75.3	+19.4	23.2	24.4
	20	465065, 367579	10-20	46.8	54.4	+7.6	22.5	23.1
	30	465060, 367587	10-20	40.4	43.8	+3.4	22.1	22.3
	40	465055, 367596	10-20	35.8	37.6	+1.7	21.8	21.9
	50	465050, 367605	10-20	32.4	33.3	+1.0	21.5	21.6
	60	465045, 367613	10-20	29.7	30.3	+0.6	21.3	21.4
	70	465040, 367622	10-20	27.5	27.9	+0.4	21.2	21.2
	80	465035, 367631	10-20	25.7	26.0	+0.3	21.0	21.0
	90	465030, 367639	10-20	24.2	24.4	+0.2	20.9	20.9
	100	465025, 367648	10-20	22.9	23.1	+0.2	20.8	20.8
	110	465020, 367657	10-20	21.7	21.9	+0.2	20.7	20.7

Designated Habitat	Distance from road (m)	Grid Reference	Site Critical Load (kg N/ha/yr)	LTT DM Total NO_x concentration ($\mu g/m^3$)	LTT DS Total NO_x concentration ($\mu g/m^3$)	Change in LLT Total NO_x concentration ($\mu g/m^3$)	LTT DM Total Nitrogen Deposition (kg N/ha/yr)	LTT DS Total Nitrogen Deposition (kg N/ha/yr)
	120	465015, 367665	10-20	20.8	20.9	+0.2	20.6	20.6
	130	465010, 367674	10-20	19.9	20.1	+0.2	20.6	20.6
	140	465005, 367683	10-20	19.2	19.3	+0.1	20.5	20.5
	150	465000, 367691	10-20	18.5	18.7	+0.1	20.5	20.5
	160	464995, 367700	10-20	17.0	17.1	+0.1	20.4	20.4
	170	464990, 367709	10-20	16.5	16.6	+0.1	20.4	20.4
	180	464985, 367717	10-20	16.0	16.1	+0.1	20.3	20.3
	190	464980, 367726	10-20	15.6	15.6	+0.1	20.3	20.3
	200	464975, 367735	10-20	15.2	15.3	+0.1	20.3	20.3
Sherwood Heath LNR	100	464975, 367536	10-20	18.1	18.1	-<0.1	20.5	20.5
	110	464964, 367536	10-20	17.3	17.3	-<0.1	20.4	20.4
	120	464954, 367536	10-20	16.7	16.7	-<0.1	20.4	20.4

Designated Habitat	Distance from road (m)	Grid Reference	Site Critical Load (kg N/ha/yr)	LTT DM Total NO_x concentration ($\mu g/m^3$)	LTT DS Total NO_x concentration ($\mu g/m^3$)	Change in LLT Total NO_x concentration ($\mu g/m^3$)	LTT DM Total Nitrogen Deposition (kg N/ha/yr)	LTT DS Total Nitrogen Deposition (kg N/ha/yr)
	130	464944, 367536	10-20	16.2	16.1	-<0.1	20.3	20.3
	140	464934, 367536	10-20	15.7	15.7	-<0.1	20.3	20.3
	150	464924, 367536	10-20	15.3	15.2	-<0.1	20.3	20.3
	160	464914, 367536	10-20	15.0	14.9	-<0.1	20.2	20.2
	170	464904, 367536	10-20	14.6	14.6	-<0.1	20.2	20.2
	180	464894, 367536	10-20	14.3	14.3	-<0.1	20.2	20.2
	190	464884, 367536	10-20	14.1	14.0	-<0.1	20.2	20.2
	200	464874, 367536	10-20	13.8	13.8	-<0.1	20.2	20.1

Note: Nitrogen deposition exceeded the critical load in the Do Minimum and Do Something Scenarios at all modelled receptors. Annual mean NO_x concentrations were below the objective at all modelled receptors.

Overall Significance of Effects

5.7.20 The conclusion of the construction dust assessment is that there would be not likely significant air quality effect for human health or designated habitats during the construction of the Scheme with appropriate best practice mitigation measures.

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

5.7.22 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, 2016) in the shortest timescale possible due to either the construction or the operation of the Scheme.

5.7.23 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 Nottinghamshire Wildlife Trust has requested that the impacts of dust Birklands West and Ollerton Corner SSSI in close proximity to the junctions be closely monitored during construction, with a plan in place to rectify a problem if shown to have arisen. This will be included in the CEMP.

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.

5.8.3 Nottinghamshire Wildlife Trust has requested that further monitoring is undertaken in key protected habitats site such as Birklands West and Ollerton Corner SSSI heathland, to ensure that the modelling reflects reality for the area of potential greatest irreversible habitat impact. If the additional monitoring indicates that the impacts are materially different to those predicted, then a plan will be put in place to rectify the situation. However, as noted within paragraph 5.4.38, the assessment is considered to be cautious.

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 Ollerton Roundabout.

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 (2021) (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 2A.

6.2 Legislation and Policy

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

6.3 Consultation

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

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

Table 6-1 Scoping Response Summary

Stakeholder	Comment made	Response and where addressed in the ES
NCC (Scoping Opinion) and NCC Archaeological and Building Conservation Team	It is important to recognise that these designated heritage assets each have a 'setting' that contributes to their significance and that could be impacted upon and potentially harmed by the proposals. Ollerton Hall is a grade II* listed building within view of the roundabout and as such this designated heritage asset will require careful consideration and response within the scheme submission. Ollerton Hall and other heritage assets should be set as receptors in the Landscape and Visual Impact Assessment (LVIA) to ensure that suitable evidence is provided in the EIA. Noise receptors should be treated similarly.	The impact to the listed buildings and their setting, including Ollerton Hall, is considered in the assessment within Chapter 6: Cultural Heritage of Volume 1A. Ollerton Hall has been considered within this cultural heritage assessment and within the LVIA reported in Chapter 7: Landscape and Visual Effects.
	Harm to designated heritage assets (in this case the conservation area and individual listed buildings) is in some cases avoidable (or can be significantly reduced) 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. Detailed consultation prior to the submission of the planning application, to ensure collaborative input into the designs, is encouraged. Early consultation with NCC Historic Buildings and conservation officers at the Newark & Sherwood District Council should take place before designs are fully developed to ensure that there is opportunity to avoid adverse impacts and, where possible, introduce suitable enhancements to the scheme that can demonstrably mitigate these.	Likely significant effects have been considered to heritage assets within this chapter, including additional lighting and impacts relating to noise. Consultation was undertaken with the County Archaeologist during the preparation of the EIA, as minuted in Appendix 6-1 of Volume 3.
NCC Senior Practitioner for Historic Buildings	Would like to see new soft landscaping, green features - trees and hedges wherever possible. As the junction lies in close proximity to the Sherwood Forest area, a small increase in tree numbers in the area would be welcome.	Additional landscaping is included within the landscape design (Appendix 2-2 of Volume 3A) including to the east of the roundabout within the current conservation area boundary.
	Consideration should be made about the direct and indirect (i.e. setting) impacts and the proposed landscape mitigation in view of how it retains the existing character of the conservation area including: • Impact of new signage, especially on the west bound side of the Ollerton Road approach. Proposed signs on the verge at this location may fall inside the conservation area; minimising the number and size of signs would be of benefit here.	Where possible the design has maximised retention of any established hedgerows and is collaborating with all affected landowners to agree appropriate boundary treatments that are in keeping with the junction and wider setting wherever possible.

Stakeholder	Comment made	Response and where addressed in the ES
	• The proposed wall detail to the north east portion of the roundabout, to replace the hedge, will have a very distinct urbanising impact that is undesirable and will cause harm to the setting of the conservation area.	There is an amount of flexibility in the exact siting and sizes of signs which can be considered through the detailed design phase. At the north-east portion of the roundabout, a wall is proposed as a new boundary treatment around the residential property on Forest Side where a significant amount of land take is required to enable the construction of the works. The existing hedge removal is required to facilitate the overall improvement and the need for the wall is to address a level difference between the highway side and the land within the private land, and therefore, acts as a retaining feature with some structural properties which a hedgerow planting scheme would not be able to achieve. The detail of the wall is yet to be finalised; early design considers the provision of a low height wall with close boarded fence mounted atop. The detail however, will be considered through detailed design in parallel with the landowner and NCC's built heritage specialists.
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, 2021) 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) (Historic England, 2021) reference number. The non-designated heritage assets are identified with their HER reference number which uses the prefix 'MNT'.

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

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

Study Area

6.4.4 A study area of 500 m from the assessment boundary has been used in order to identify designated and non-designated heritage assets which may be affected by the Scheme (refer to Figure 6-1 of Volume 2A). 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, 2020d) and Environmental Assessment and Monitoring Revision 1 (LA 104) (Highways England, 2020c) 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 and 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 shall be 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 will not have been included.

6.5 Baseline Conditions

6.5.1 There are 42 assets recorded within the 500 m study area of this Junction. These comprise 11 listed and 31 non-designated assets. The designated assets are recorded with their NHLE number and non-designated assets are recorded with

their HER number. The heritage assets are recorded in Appendix 6-1 of Volume 3A and are shown on the known heritage assets figures (See Figure 6-1 of Volume 2A).

Designated Assets

6.5.2 The listed buildings include one Grade II* listed building and 10 Grade II listed buildings. The Grade II* listed building is Ollerton Hall (1045598), a c.1700 country house. The remaining Grade II listed buildings and structures consist of:

- Boundary wall at Ollerton Hall (1157063);
- Forest House Hotel (1045599);
- Ollerton War Memorial (1462834);
- Hop Pole Hotel and adjoining stable block and outbuilding (1157065);
- K6 Telephone Kiosk opposite Hop Pole Hotel (1241206);
- Ollerton Watermill and adjoining Mill House (1157098);
- Curiosity Cottage and adjoining shop (1370161);
- Old Post Office (1302573);
- Church of St Giles (1045600); and
- White Hart Inn (1370162).

6.5.3 Ollerton Conservation Area is also located directly to the east of the Scheme and within the assessment boundary. The conservation area boundary runs up to the Ollerton Roundabout alongside Ollerton Road (A616) and Old Rufford Road, with the part covering the Newark Road area being within the assessment boundary. The conservation area covers the area of western Ollerton, in which all of the listed buildings within the study area are contained.

6.5.4 It should be noted that a proposal has been made by NSDC to change the boundary of the Ollerton Conservation Area (NSDC, 2022). This may affect the impacts of the Scheme reported herein, although at the time of writing the conservation area boundary has not been changed. The change to conservation area boundary would remove McDonald's and the Esso petrol station on the south-eastern side of the roundabout from the conservation area.

Non-designated Assets

6.5.5 There are 31 non-designated assets recorded within the 500 m study area, ranging from medieval archaeological sites to modern buildings. None of these assets lie within the assessment boundary.

Archaeological and Historical Background

Prehistoric (Up to AD43)

6.5.6 There are no assets of prehistoric date recorded within the study area. 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).

6.5.7 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. One such example is a scheduled bowl barrow (1003476) located approximately 4 km north-west of the site, to the north of the River Meden, overlooking a dry valley. The barrow survives, comprising a 24 m diameter mound up to 1.7 m high. Although these features survive within the landscape, most of the remains of Neolithic and Bronze Age (2500-800BC) date within Nottinghamshire comprise cropmarks and find spots.

6.5.8 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). These features are often indistinguishable from Roman remains.

Roman (AD43-410)

6.5.9 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).

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

6.5.10 There are no assets of early medieval date recorded within the study area. Ollerton was recorded within the Domesday Book, 1086, indicating the presence of settlement during at least the latter part of the early medieval period (Open Domesday, 2011). The Domesday Book records the settlement as containing 15 households as well as two mills as well as ploughlands and woodland.

6.5.11 There are three assets of medieval date, consisting of the site of a medieval church in Ollerton (MNT14987) and associated inhumations (MNT12134) along with medieval finds from the church (MNT12132). The present church was constructed in the 18th century.

6.5.12 To the south of Ollerton is Rufford Abbey (1001085), situated approximately 4 km south of the 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)

6.5.13 There are 14 assets of post-medieval date recorded within the study area, comprising nine listed buildings and five non-designated assets. These comprise the 18th century structure of Church of St Giles (MNT4085) and post-medieval finds from the church (MNT12133).

6.5.14 A watermill (MNT4081) is located along the River Maun to the east of the site, which may be situated on a similar site to those recorded in the Domesday Book.

6.5.15 Within the study area is also a post-medieval house (MNT21793) and the site of an 18th century bridge over the River Maun, now replaced by a concrete bridge (MNT25606), both within Ollerton.

6.5.16 Numerous buildings within Ollerton are of post-medieval date, situated within Ollerton Conservation Area, which comprises the historic core of the town and includes Ollerton Hall (1045598), St Giles Church (1045600) and Main Street.

6.5.17 The site is shown on John Chapman's map of 1774 (see Appendix 6-2 of Volume 3 for historic maps), which records a toll booth on the north-east corner of the junction

which was located on the site of the current roundabout. This toll booth is no longer extant, although buried remains may survive within the site. The turnpike road, on which the toll booth was situated, ran from Ollerton towards Worksop to the north, which may have had medieval origins. The modern road from Ollerton follows a similar alignment, although the historic road would likely have been physically impacted by the subsequent road building and maintenance.

Modern (1900-present)

6.5.18 There are 25 assets of modern date within the study area, including two listed buildings and 23 non-designated assets of modern.

6.5.19 The majority of the assets are located within Ollerton to the east of the site and consist of extant buildings, including houses (MNT22163; MNT22158; MNT22157; MNT22153; MNT22155; MNT22150; MNT22117; MNT22115; MNT22112; MNT22113; MNT24821; MNT22162) cottages (MNT22159; MNT22156; MNT22151; MNT22122; MNT22116; MNT22114; MNT22088; MNT22111; MNT22149) and shops (MNT22119; MNT22121).

6.5.20 The site was developed in the 20th century to resemble the current road layout, with the addition of the Ollerton Roundabout on the 1945 Ordnance Survey map, as well as the addition of Ollerton Road to the north-east of the junction and Old Rufford Road to the south (see Appendix 6-2 of Volume 3).

Unknown

6.5.21 There is one asset of unknown date recorded within the study area. This is an undated rectilinear cropmark enclosure (MNT27452) that is recorded on satellite imagery, located on the southern side of Ollerton Road, to the north-east of the site.

Site Visit

6.5.22 The site is located to the north-west of Ollerton. A nature reserve is located to the west with modern buildings and service station to the south. Beyond these are several agricultural fields. The listed buildings in Ollerton are separated from the site by agricultural fields.

Plate 6-1 Agricultural field between Ollerton Road and Newark Road on the eastern side of Ollerton Roundabout. This is also the possible site of the former toll booth.

Plate 6-2 View to the west from the bridge over the River Maun (MNT25606) towards Ollerton Roundabout.

Plate 6-3 View of Ollerton War Memorial (1462834), looking north-east and its setting of the garden.

Plate 6-4 Ollerton Watermill and Mill House (1157098), north-east elevation

Plate 6-5 Ollerton water mill (1157098) south-west elevation, mill machinery details.

Plate 6-6 View to the east from the western edge of Ollerton, showing a street of buildings within the conservation area.

Future Baseline

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

6.6 Design, Mitigation and Enhancement Measures

6.6.1 As described in Chapter 2: The Scheme, the design has minimised the loss of hedgerows and incorporates a number of additional trees and soft landscaping within the western extent of the Ollerton Conservation Area to reflect the nearby Sherwood Forest area.

6.7 Assessment of Likely Significant Effects

Construction

6.7.1 A former toll booth is recorded on the historic mapping from the 18th century, located on the site of the north-eastern corner of the existing Ollerton Roundabout, along a turnpike road to Ollerton. While the building is no longer extant, it is possible that buried archaeological remains of the building survive around the existing junction. Remains of the building would possess archaeological and historical interest as the site of one of very few remaining toll booths in Nottinghamshire. The remains would be of low heritage value.

6.7.2 The assessment boundary for the Ollerton Roundabout extends beyond the existing road boundaries into the surrounding agricultural fields. Due to this, any surviving buried remains of the toll booth may be physically impacted during the construction of the Scheme. This would remove any buried building remains and would have a major magnitude of impact. This would result in a moderate adverse (significant) effect.

6.7.3 The line of a former turnpike road along the line of the A616 from Ollerton, which may have origins in the medieval period, although it has since been built over by modern roads. This road possesses archaeological and historical interest as the line of a historic road and may have had connections to the monastery at Rufford to the south. The road is of low heritage value.

6.7.4 There is potential for remains of this former road (medieval causeway) to be physically impacted during the construction of the Scheme, although the former road is likely to have been damaged during subsequent road constructions and maintenance. Due to this, there is thought to be limited physical impact to remains of the former turnpike road which would have a minor magnitude of impact. This would result in a slight adverse (not significant) effect.

6.7.5 There are no known archaeology assets recorded on the HER within the assessment boundary. There is however potential for previously unrecorded archaeological remains to survive within the assessment boundary, particularly in agricultural land at the south-east and north-east sides of the site, which may be physically impacted during the construction of the Scheme. 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.

6.7.6 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.

6.7.7 Ollerton Conservation Area lies partially within the assessment boundary along Newark Road, the south-east exit from the junction. The conservation area covers the historic core of the town including listed buildings such as Ollerton Hall (1045598) and the water mill (1157098). The conservation area possesses

architectural and historical interest as the area of the town retains its historic character. The conservation area is of medium heritage value.

6.7.8 The Ollerton Roundabout Scheme extends along Newark Road, into the western side of the conservation area. During construction, there would be an increase of noise and traffic associated with the Scheme and there may be some changes to road layout/ boundaries of Newark Road at the western edge of the conservation area. While this would alter a part of the conservation area, it is not thought to detract from the character or the value of the conservation area. The temporary increase of noise and traffic during construction would have a minor magnitude of impact, resulting in a slight adverse (not significant) effect.

6.7.9 Ollerton water mill and adjoining mill house (1157098) is a Grade II listed building located approximately 150 m south-east of the Ollerton Roundabout Scheme. The mill lies along the River Maun and comprises an 18th century, two storey brick building which retains a working mill wheel. The setting of the mill comprises its position on the River Maun, on the edge of Ollerton and the setting of the mill contributes to its value as the river is integral to its function. The building possesses architectural and historical interest as a surviving and working example of a post-medieval water mill. The building is of high heritage value.

6.7.10 The Scheme extends along Newark Road, approximately 150 m from the watermill. There would be no physical impacts to the mill and the building is partially screened from the Scheme by a building directly to the north-west, although there may be a temporary increase of noise and traffic associated with the construction of the Scheme. While there would be a change to the setting, this would not affect the value of the mill. This would have a negligible magnitude of impact, resulting in a slight adverse (not significant) effect.

6.7.11 Ollerton war memorial (1462834) is a Grade II listed building located approximately 140 m south-east of the Scheme in Ollerton. The war memorial was constructed in 1920 and consists of a limestone cross approximately 3.5 m high with a tapering rectangular shaft atop a trapezoidal plinth and a square three-step base. The monument is situated within a triangular garden to the north of Newark Road and surrounded by mature trees. The setting contributes to the value of the monument as part of the designed landscape. The war memorial possesses architectural and historical interest as a surviving 20th century First and Second World War memorial. The monument is of high heritage value.

6.7.12 The Scheme is located to the north-east of the war memorial and there would be no physical impacts to the monument. The memorial is screened from the Ollerton Roundabout by mature hedgerows and trees to the north-west along the river and partially screened to Newark Road to the south by mature trees. There may be an increase of noise and traffic along Newark Road during construction, although any changes to the setting of the monument would be temporary. There is considered to be a negligible magnitude of impact, resulting in a slight adverse (not significant) effect.

6.7.13 A 20th century concrete bridge over the River Maun (MNT25606) is located approximately 110 m south-east of the Ollerton Roundabout Scheme. The bridge is located on the site of a former 18th century bridge, shown on the Chapman, 1774 map of Nottinghamshire (See Appendix 6-2 of Volume 3). The extant bridge is a non-designated twin span modern concrete structure with stone parapets. The setting of the bridge comprises its position over the river and along Newark Road, an approach into Ollerton and the setting contributes to its value. The bridge possesses historical interest as the site of a historic river crossing. The bridge is of low heritage value.

6.7.14 The Scheme would not physically impact the bridge, although there would be an increase in noise and traffic during construction. This may result in some change to the setting of the bridge, although this would be a temporary change and would have a minor magnitude of impact. This would result in a slight adverse (not significant) effect.

Operation

6.7.15 Chapter 10: Noise and Vibration concludes that no receptors are expected to experience any adverse impact greater than a negligible adverse impact in both the short and long-term. The noise contour plans Figures 10-2 and 10-3 in Volume 2A show a negligible change within the Ollerton Conservation Area and at associated heritage assets. No significant adverse noise effects are predicted during the daytime or night-time due to operational noise as a result of the implementation of the Scheme.

6.7.16 Figure 8-2 within Volume 2A shows that the revised lighting design would reduce spill towards the Ollerton Conservation Area and associated heritage assets. This would also be the case with the proposed revised conservation area boundary noted in Section 6.5. However, in the context of the surrounding commercial development this would likely not be a discernible change.

6.7.17 Therefore, no change in operational impacts are predicted, resulting in a neutral effect on heritage assets.

6.8 Additional Mitigation

6.8.1 Following consultation with Nottinghamshire County Council's Archaeologist, a watching brief is required for the site in order to identify potential surviving archaeological remains, including possible remains of a medieval causeway which follows the line of A616 and a post-medieval toll booth within the assessment boundary.

6.8.2 The setting of the listed buildings should be taken into consideration during construction of the Scheme, to ensure that the Scheme does not adversely affect the value of the built heritage assets by altering the character and local distinctiveness of the area.

6.8.3 Preservation of the character of the Ollerton Conservation Area should be considered in the detailed design stage in order to reduce adverse impacts from urbanisation of the Ollerton Roundabout area. This may include reducing the presence of additional signage, subject to safety requirements. Signage should be minimised around the conservation, especially on the westbound side of the Ollerton Road approach where signs may be located within the conservation area.

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 buried remains of the former toll booth	Low	Local	Major	Moderate adverse	Watching brief to be undertaken to identify and record and surviving remains.	Slight adverse
Physical impacts to the former turnpike road (possible medieval road)	Low	Local	Minor	Slight adverse	Watching brief to be undertaken to identify and record and surviving remains of the former road.	Negligible
Physical impacts to unknown archaeology	Low	Local	Moderate	Slight adverse	Watching brief to identify any surviving archaeological remains.	Negligible
Temporary setting changes to Ollerton Conservation Area	Medium	Regional	Minor	Slight adverse	None proposed	Slight adverse
Temporary setting changes to Ollerton Water Mill and adjoining Mill House (1157098)	High	National	Negligible	Slight adverse	None proposed	Slight adverse
Temporary setting changes to Ollerton War Memorial (1462834)	High	National	Negligible	Slight adverse	None proposed	Slight adverse
Temporary setting changes to bridge carrying Newark Road over the River Maun (MNT25606)	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 Response Landscape or Visual Matters

Stakeholder	Stakeholder Comments	Scheme Response
Natural England	Landscape and visual impacts Natural England would wish to see details of local landscape character areas mapped at a scale appropriate to the development site as well as any relevant management plans or strategies pertaining to the area. The EIA should include assessments of visual effects on the surrounding area and landscape together with any physical effects of the development, such as changes in topography.	Local landscape character has been mapped to support the Landscape and Visual assessment within this chapter. The Landscape and Visual impact assessment has considered visual effects and changes as a result of the Scheme.
Natural England	The EIA should include a full assessment of the potential impacts of the development on local landscape character using landscape assessment methodologies. We encourage the use of Landscape Character Assessment (LCA), based on the good practice guidelines produced jointly by the Landscape Institute and Institute of Environmental Assessment in 2013. LCA provides a sound basis for guiding, informing and understanding the ability of any location to accommodate change and to make positive proposals for conserving, enhancing or regenerating character, as detailed proposals are developed.	
Natural England	Natural England supports the publication Guidelines for Landscape and Visual Impact Assessment, produced by the Landscape Institute and the Institute of Environmental Assessment and Management in 2013 (3rd edition). The methodology set out is almost universally used for landscape and visual impact assessment. In order to foster high quality development that respects, maintains, or enhances, local landscape character and distinctiveness, Natural England encourages all new development to consider the character and distinctiveness of the area, with the siting and design of the Scheme reflecting local design characteristics and, wherever possible, using local materials. The Environmental Impact Assessment process should detail the measures to be taken to ensure the building design will be of a high standard, as well as detail of layout alternatives together with justification of the selected option in terms of landscape impact and benefit.	The LVIA methodology within Section 7.4 uses the Guidelines for Landscape and Visual Impact Assessment 3rd Edition (Landscape Institute, 2013). The landscape design in Appendix 2-2 of Volume 3A is based on the local character of the Sherwood area.
Natural England	Rights of Way, Access land, Coastal access and National Trails The EIA should consider potential impacts on access land, public open land, rights of way and coastal access routes in the vicinity of the development. Consideration should also be given to the potential impacts on the adjacent/nearby National Trail. The National Trails website (National Trail, 2021) provides information including contact details for the National Trail Officer. Appropriate mitigation measures should be incorporated for any adverse impacts. We also recommend reference to the 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.	The assessment considers rights of way as identified in Section 7.5. There are no National Trails, areas of Access land or Coastal access within the study area.

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, 2020e) 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 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.

7.4.6 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.

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

Study Area

7.4.8 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.

7.4.9 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.

7.4.10 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.

7.4.11 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.

7.4.12 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.

7.4.13 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

7.4.14 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.

7.4.15 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.

7.4.16 The potential construction impacts in relation to the LVIA are:

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

Methodology for Determining Operational Effects

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

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

7.4.19 The year 1 assessment also assumes that new planting is immature and at the planted height specified in the landscape mitigation proposals, typically ranging between 0.5 m and 3 m in height.

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

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

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

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

Significance Criteria

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

Landscape Sensitivity

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

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

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

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

Source: DMRB LA 107 Table 3.22

Visual Sensitivity

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

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

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

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

DMRB LA 107 Table 3.41

Landscape Impacts

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

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

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

Magnitude of impact (change)		Typical descriptions
Major	Adverse	Total loss or large-scale damage to existing landscape character or distinctive features or elements; and/or addition of new uncharacteristic, conspicuous features or elements (i.e. road infrastructure).
	Beneficial	Large scale improvement of landscape character to features and elements; and/or addition of new 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

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

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

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

Magnitude of impact (Change)	Typical descriptions
Major	The Scheme, or a part of it, would become the dominant feature or focal point of the view.

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

Assumptions and Limitations

7.4.32 A site visit was undertaken by Landscape Architects from Via during February and June 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 2A).

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

7.5 Landscape Baseline Conditions

The Site

7.5.1 The site, including any areas required for temporary construction works, comprises a six-arm roundabout at the junction of the A614, A616, A6075 and the unclassified Newark Road. The junction is located around 300 m north-east of the village of Ollerton.

7.5.2 The roundabout island is circular, level, around 20 m in diameter, with grass that appears to be cut less frequently to encourage the growth of native wildflowers. Illuminated highway signage (arrows and chevrons), along with sponsorship signs, are located opposite each arm.

7.5.3 All routes leading to the roundabout are two lane single carriageways, with the exception of Newark Road, which is reduced to a single lane, bus-only entry. The A616 to the east has been widened to allow an additional filter lane.

7.5.4 Lighting columns are located around the outside of the roundabout, with traffic islands and associated signage on each arm.

7.5.5 The roundabout was constructed during the inter-war years, along with bypasses to Ollerton along what are now the A614 (south) and A616 (east). Prior to this time, the junction was a crossroads, with traffic travelling across a bridge and through the centre of Ollerton.

7.5.6 For clarity, each quadrant of the roundabout within the site and study area is

described in a clockwise manner, beginning with the north-east side of the A614.

7.5.7 To the north-east, between the A614 Blyth Road A616 Ollerton Road, is a footway, a narrow, mown verge then a low, managed hedge that forms the boundary to the garden of a residential property, No. 1 Forest Side. The garden is mainly laid to a mown lawn, with a vegetable garden close to the property and shrubs and trees to the eastern boundary, along which there is a grassed vehicle access from the A614.

7.5.8 Further east, the north side of the A614 is bounded by a footway and low hawthorn hedge, with a large arable field beyond.

7.5.9 The field, which includes a truncated hedge line, envelopes the properties No. 1 to No. 3 Forest Side. The three detached, single storey brick properties date from the 19th century and have a distinctive style, with tall chimney stacks, although exteriors have been much altered. The houses are unusual in that, as with the Mickledale Lane junction further south, they are of only a very small number that directly face onto the A614.

7.5.10 To the east, between the A616 and Newark Road, is a triangular field, laid to pasture, with a low hawthorn hedge around the majority of the boundary. A section along Newark Road is absent, meaning that the field is accessible from the adjacent footway, which also runs along the A616. A small wedge of mown amenity grass includes a bench that overlooks the roundabout.

7.5.11 Further to the east, a large pasture has been subdivided as paddock with equestrian facilities, with a taller and outgrown hedge along Newark Road. Mature trees border the eastern boundary of the field along the River Maun, which is crossed by the Maun bridge, characterised by stone abutments.

7.5.12 The pasture and Newark Road are within the Ollerton conservation area (see Figure 7-3 of Volume 2A).

7.5.13 To the south-east, between Newark Road and the A614 (south) (Old Rufford Road), is a single storey brick McDonald's drive-through and restaurant, with associated parking areas, constructed in the 1990s. Mown grass and ornamental planting to the curtilage and a clipped hedge boundary complements a small number of mature trees that pre-date the development.

7.5.14 Immediately to the south is an Esso petrol station, first constructed in the 1950s, with associated car wash and concessionary grocery store housed in a brick building.

7.5.15 To the south-east of both the McDonald's and the petrol station is an area of deciduous woodland, which screens a circular mown field beyond that borders the River Maun. An informal but visibly well-used footpath (not a Public Right of Way (PRoW)) runs across the field from Newark Road to the rear of the petrol station. Further south, the woodland extends a further approximately 140 m south as far as the A614 bridge over the River Maun.

7.5.16 This area, including the woodland, field, petrol station and McDonald's, are within the boundary of the Ollerton conservation area.

7.5.17 To the south-west, between the A614 (south) and A6075 Mansfield Road is a single storey brick and render building housing a Costa Coffee, fronting the roundabout with an area of unmown grass. The boundary hedge was recently removed to allow construction of the drive-through access, the building having previously housed a fish restaurant, Little Chef and a Happy Eater.

7.5.18 Immediately to the south and opposite the Esso garage, is a Shell petrol station,

also with a car wash. Soft landscape is limited to mown grass, with a generally open aspect to the flat agricultural field beyond.

7.5.19 To the west of the petrol station and facing onto the A6075 is a single detached property 'The Coombs', with a garden beyond and set within mature planting that provides a high degree of screening from the adjacent car parks. A dense hedge and trees represent the boundary to an agricultural field further to the south-west.

7.5.20 To the west, between the A6075 and the A616 Worksop Road, is a large, two-storey Public House 'The Alders', with car parking areas to two sides. The building was constructed around 2016 on the site of a much smaller Tourist Information Centre.

7.5.21 The boundary to the A6075 is dominated by a distinctive line of maturing trees, mainly oak, which provide screening to the pub from this direction. A footway with unmown grass verge and timber knee rail runs along the road. The areas next to the roundabout include mown grass ornamental shrub planting, a prominent ash tree, two silver birch and a Lombardy poplar. Along the A616 is a more open section, then a stand of dense oak and birch adjacent to the car park entrance.

7.5.22 Beyond the pub, further west, is Sherwood Heath: an area of unenclosed land crossed by footpaths that is a remnant of the wider heathland of Sherwood Forest. The land is part of the Birklands West and Ollerton Corner SSSI, the Sherwood Heath LWS and the Birklands and Bilhaugh LNR. It is owned by the Thoresby Estate, leased to NSDC and managed by the Sherwood Forest Trust. Management includes volunteer work by a Friends group. This area is subject to a local policy designation, 'Sherwood Forest Heritage Area' (NSDC Core Strategy, Core Policy 14, 2019).

7.5.23 The open, acid grassland and heath becomes more wooded further west, with deciduous woodland dominated by oak and birch. Around 800 m west of the site is the partly restored Thoresby Colliery spoil heap, which is visible in the wider area but has no influence on the site itself.

7.5.24 To the north-west, between the A616 and A614 (north) is another area of open, unenclosed woodland, but with a much more wooded character. This area is also part of the Birklands West and Ollerton SSSI. A small triangle of grass which appears to be managed for the benefit of native species is located close to the roundabout, albeit with a number of unofficial, detracting temporary signs.

7.5.25 This area and the mixed deciduous woodland beyond – which extends for some distance towards the centre of the Thoresby Hall estate - is also part of the adjacent SSSI across the A616 to the west and also part of the Sherwood Forest Heritage Area.

7.5.26 The lack of a footway, boundary treatments and built form within this area create a more 'natural' appearance, reflecting the adjacent forest. The nearest building is the Green Hut Café, a collection of small timber chalets, popular with bikers and located around 200 m along the north side of the A616.

7.5.27 Within the wider context, the junction is located at a transition point between the mixed woodlands and heathland of Sherwood Forest to the west and the more open, agricultural fields to the east.

7.5.28 Dominant to the east, but of limited influence on the junction due to screening, is the village of Ollerton. The historic centre of the village, centred on the Market Place and Grade II listed Church of St. Giles, is around 300 m south-east of the site. Also in the old centre is the Grade II listed War Memorial, set in a public open space between the River Maun and the adjacent mill race; and the Grade II listed 18th century watermill, which now houses a tearoom.

7.5.29 The opening of Ollerton colliery led to a large expansion of the village from the 1930s onwards, particularly to the north-east where it now extends for around 3 km as 'New Ollerton', merging with the hamlet of Boughton. The colliery closed in 1993, with the site and spoil heaps restored as woodland, a business park and housing.

7.5.30 Overall, the junction is a busy intersection of key routes, dominated by traffic and post-war, functional buildings that reflect the importance of passing trade. It represents a landmark for drivers, particularly on the A614 as a punctuation point between Nottingham and the A1(T). However, the wider context is largely rural and the presence of mature trees and the influence of adjacent heathland and woodland provide an impression of a 'gateway' to Sherwood Forest.

Landform and Hydrology

7.5.31 The site and study area lies on the gently eastwards dip slope of Triassic sandstones, with overlying drift deposits of clays and gravels along the River Maun.

7.5.32 The junction lies at 42 m above Ordnance Datum (aOD), with adjacent land to the east and south towards the River Maun at around the same level. The land rises gently towards the north-west, with a point beyond the Green Hut Café at around 51 m aOD.

7.5.33 The River Maun is the main hydrological feature, flowing from south to north and forming the western edge of the village of Ollerton. The watermill is located over a mill race that runs parallel to the main channel for around 250 m.

7.5.34 A drain, which is shown on 19th century OS mapping, runs to the west and south of the site, through adjacent fields and a culverted section under the two petrol stations. The feature appears to be only seasonally wet and, in some locations, appears as a shallow ditch.

Public Rights of Way

7.5.35 With reference to third-party online PRoW mapping (Rowmaps, 2021) there is a single PRoW within the immediate area:

- PRoW Ollerton and Boughton BW26 (bridleway), which runs from the Public House east of the roundabout across Sherwood Heath, then onwards to Edwinstowe.

7.5.36 An unofficial footpath runs across the field to the south-east of the site, between Newark Road and the A614.

Designations

International and National Designations

7.5.37 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

7.5.38 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.

7.5.39 The area to the west of the A614 and north of the A6075 is indicated on the NSDC Local Plan Policies Map (NSDC, 2019) as within the Sherwood Forest Heritage Area, subject to additional protection through Core Policy 14 'Historic Environment'.

Cultural Heritage Designations

7.5.40 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.

7.5.41 With reference to the Chapter 6: Cultural Heritage, there are a number of listed structures within the study area. All are Grade II listed and located within the old centre of Ollerton village, including the Church of St. Giles, Ollerton Water Mill and adjoining Mill House, Ollerton War Memorial, Forest House Hotel, Hop Pole Hotel and the White Hart Inn. The prevalence of hotels reflects the village's importance on historic transport routes.

7.5.42 Part of the site is within the Ollerton Conservation Area. The boundary includes the historic core of the village and extends north-west to include Newark Road, as well as the adjacent fields and woodland between the River Maun and the roundabout. Also within the Ollerton Conservation Area are the McDonald's restaurant and much of the Esso petrol station site.

Tranquillity

7.5.43 Tranquillity within the immediate vicinity of the site is low, being reduced by heavy traffic, both queuing and moving. Queuing traffic also extends along the approach roads, sometimes for significant distances, particularly the A614. The presence of activity associated with the petrol stations and restaurants/cafés add to movement and noise. Woodland screening serves to limit the influence of traffic towards Ollerton, whilst the presence of Sherwood Forest to the north-west offers an impression of a wilder, undeveloped periphery in this direction.

Future Baseline

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

Published Landscape Character Assessments

7.5.45 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.

7.5.46 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 2A, which illustrate the published landscape character assessment boundaries.

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

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

- "*A gently undulating and low-lying landform in the main, with low ridges dividing shallow, broad river valleys, vales and flood plains…*
- *The bedrock geology of Triassic and Jurassic mudstones has given rise to fertile clayey soils across much of the area…*

- *Agriculture is the dominant land use, with most farmland being used for growing cereals, oilseeds and other arable crops. While much pasture has been converted to arable use over the years, grazing is still significant in places, such as along the Trent and around settlements."*
- *A regular pattern of medium to large fields enclosed by hawthorn hedgerows, and ditches in low-lying areas, dominates the landscape*
- *Very little semi-natural habitat remains across the area...*
- *Extensive use of red bricks and pantiles in the 19th century has contributed to the consistent character of traditional architecture within villages and farmsteads across the area. Stone hewn from harder courses within the mudstones, along with stone from neighbouring areas, also feature as building materials, especially in the churches*
- *A predominantly rural and sparsely settled area with small villages and dispersed farms linked by quiet lanes, contrasting with the busy market towns of Newark and Grantham, the cities of Nottingham and Lincoln, the major roads connecting them and the cross-country dual carriageways of the A1 and A46*."

7.5.48 Relevant Statements of Environmental Opportunity (SEO) include:

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

7.5.49 Relevant stated landscape attributes are:

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

7.5.50 Landscape opportunities include:

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

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

7.5.51 With reference to Figure 7-2 of Volume 2A, the site is covered by a single LCA Regional Landscape Character Areas (RLCA) and two Policy Zones (PZ):

- Sherwood RLCA, which extend north from Nottingham as far as the River Idle near Retford.

7.5.52 Within the assessment boundary the Policy Zones directly affected is:

- S PZ 15 River Maun Meadowlands with Plantations, which covers a narrow corridor along the River Maun, from Mansfield Woodhouse to Whitewater Bridge, downstream from Ollerton.
- S PZ 26 Budby Estate Farmlands, which extends north-west as far as Budby and Thoresby Lake, including Budby South Forest.

7.5.53 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. The region runs northwards from Nottingham to the lowlands of the River Idle. 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.
S PZ 15 River Maun Meadowlands with Plantations	
Key Characteristics	
Narrow meandering river valley West of Edwinstowe-low lying fields to the north and steeper wooded valley side to the south Occasional sandstone outcrops to the southern bank Arable farming on flatter areas to the east Some willow, alder and riparian vegetation along the banks adjacent to the river Some views out to built edges, railway embankments and woodland edges	
Value	
The Policy Zone contains a coherent pattern of elements with a few detracting features, those present being urban fringe, sewage works, pylons and busy roads crossing the valley. The components of this landscape such as tree cover, patches of heathy vegetation and the generally undeveloped land within the river corridor are characteristic features. There are some small areas of flood meadow and historic field boundaries. Water meadows are still evident in the field pattern to the north of the river from Warren Farm to the east of Lamb Pens Farm. These meadows were created between 1816 and 1837. Most of the farmhouses in this Policy Zone date from this time.	

Overall: Taking the key characteristics and indicators of value into account S PZ 15 is assessed as medium landscape value.

S PZ 26 Budby Estate Farmlands

Key Characteristics

Large areas of commercial forestry/woodland blocks

Medium scale arable farmland.

Small scale pastoral landscapes.

Historic Thoresby Estate including red brick farm buildings and associated parkland

Human influence concentrated around the service hub at Ollerton and along transport routes such as the A614

Nucleated settlement at Budby/Perlethorpe.

Views limited by extensive woodland planting.

Value

The Policy Zone contains a coherent pattern of elements with a few detracting features, of which the most notable is the A614 and Ollerton Roundabout.

Extensive woodland means that the wider influence of perceptual change is limited, due to screening.

No landscape designations

Designated ecological interest of Sherwood Heath LNR and SSSI; and Birklands west and Ollerton Corner SSSI

Heritage features include the Thoresby Estate Parkland.

Recreational interest linked to the woodland areas.

The landscape is familiar to people from large centres of population passing through to adjacent areas and facilities such as Sherwood Forest Visitor Centre and Thoresby estate.

Overall: Taking the key characteristics and indicators of value into account S PZ 15 is assessed as medium landscape value.

7.6 Design, Mitigation and Enhancement Measures

7.6.1 The landscape design proposals are shown on Appendix 2-2 of Volume 3A. 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 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 Ollerton Roundabout include:

- use of species rich hedgerow of native trees and shrubs to establish new highway boundaries and integrate the junction into the landscape context;
- reinforcement of existing vegetation blocks by additional tree and shrub planting, to replace those lost to the Scheme;

- use of individual and hedgerow trees along the A616 and adjacent Newark Road to increase tree cover and act as a screen for the junction;
- tree planting on the roundabout for amenity value and to filter views; and
- heathland 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 dominated by commercial activity that they would effectively be of neutral significance at the scale of the regional landscape character area at all stages.

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

Table 7-7: Assessment of Landscape Effects in Construction

S PZ 15 River Maun Meadowlands with Plantations

Susceptibility

This PZ has a strong pattern of intact landscape elements within a rural context which is largely arable. Detracting elements are present and include transport routes, particularly the A614 in the vicinity of the Ollerton Roundabout, where commercial premises adjacent to the junction have an adverse influence on landscape character. Given the context, susceptibility to this particular scheme in construction is assessed as low.

Sensitivity

Taking medium value and low susceptibility into account S PZ 15 is assessed as medium sensitivity to the Scheme in construction.

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

Construction would involve removal of vegetation adjacent to the junction and there will be an increase in the amount of activity and human influence as a result of the presence of construction activity and vehicles, machinery, a temporary compound and traffic management. However, changes will be short-term and temporary and in most respects reversible on removal of the construction activity. Loss or damage to existing landscape elements will include removal of vegetation north of the A 6075 and elsewhere around the junction, including removal of a hedge adjacent to McDonald's. However, construction will be localised and of negligible scale such that the geographical extent of direct change in the PZ will be very localised and indirect effects on the PZ will be of very limited geographical extent. Overall, taking the context and short duration of construction into account there will be a negligible magnitude of effect on S PZ 15 during construction.

Significance of Effect

Overall, there will be a **slight adverse effect** on S PZ 15 during construction.

S PZ 26 Budby Estate Farmlands

Susceptibility

This PZ has a strong pattern of intact landscape elements within context that is dominated by woodland, including extensive plantations. Detracting elements are present and include transport routes, particularly the A614 in the vicinity of the Ollerton Roundabout, where commercial premises adjacent to the junction have an adverse influence on landscape character. Given the context, susceptibility to this particular scheme in construction is assessed as low.

Sensitivity

Taking medium value and low susceptibility into account S PZ 26 is assessed as medium sensitivity to the Scheme in construction.

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

Construction would involve removal of vegetation adjacent to the junction and there will be an increase in the amount of activity and human influence as a result of the presence of construction activity and vehicles,

machinery, a temporary compound and traffic management. However, changes will be short-term and temporary and in most respects reversible on removal of the construction activity. Loss or damage to existing landscape elements will include removal of mature trees along the north side of the A6075 and south side of the A616, both to the west of the roundabout; and removal of areas of acid grassland adjacent to the A614. However, construction will be localised and of negligible scale such that the geographical extent of direct change in the PZ will be very localised and indirect effects on the PZ will be of very limited geographical extent, the latter particularly due to screening by woodland. Overall, taking the context and short duration of construction into account there will be a negligible magnitude of effect on S PZ 26 during construction.

Significance of Effect

Overall, there will be a **slight adverse effect** on S PZ 26 during construction.

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

S PZ 15 River Maun Meadowlands with Plantations

Susceptibility

Influence of transport routes on landscape character occurs in the baseline from the A614 and existing busy junction and associated commercial premises. The Scheme will not increase traffic or introduce new uncharacteristic elements but there will be some intensification of highway elements such as signage and lighting and hence of greater influence on character than in the baseline. 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 S PZ 15 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 will include highway intensification derived from the larger footprint and presence of the modified roundabout, splitter islands, increased lighting and signage. Changes will be long-term and permanent. However, the addition of highway infrastructure would be of negligible scale and extent within the PZ. Indirect effects on the PZ will be of very limited geographical extent. The Scheme will include addition of vegetation to replace that lost in construction, including tree planting on the roundabout and locally on the roads surrounding it. In year 1 these will remain immature and contribute little to landscape character. Overall, there will be a negligible magnitude of effect on S PZ 15 during Year 1.

At Year 15, the landscape mitigation elements will have matured such that they contribute positively to the landscape context of the junction and particularly the roundabout within S PZ 15. However, the footprint of the junction and intensification of traffic (over increased lanes) and highway elements will remain as described for Year 1, albeit with some benefit derived from greater integration within the baseline as planting matures. Balancing these factors, there will be a negligible magnitude of effect on S PZ 15 at Year 15.

Significance of Effect

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

S PZ 26 Budby Estate Farmlands

Susceptibility

Influence of transport routes on landscape character occurs in the baseline from the A614 and existing busy junction and associated commercial premises. The Scheme will not increase traffic or introduce new uncharacteristic elements but there will be some intensification of highway elements such as signage and lighting and hence of greater influence on character than in the baseline. 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 S PZ 26 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 will include highway intensification derived from the larger footprint and presence of the modified roundabout, splitter islands, increased lighting and signage. Changes will be long-term and permanent. However, the addition of highway infrastructure would be of negligible scale and extent within the PZ. Indirect effects on the PZ will be of very limited geographical extent. The Scheme will include addition of vegetation to replace that lost in construction, including tree planting on the roundabout and locally on the roads surrounding it. Areas of acid grassland will replace those lost and managed with benefit to biodiversity. In year 1 these will remain immature and contribute little to landscape character. Overall, there will be a negligible magnitude of effect on S PZ 26 during Year 1.

At Year 15, the landscape mitigation elements will have matured such that they contribute positively to the landscape context of the junction and particularly the roundabout within S PZ 15. However, the footprint of the junction and intensification of traffic (over increased lanes) and highway elements will remain as described for Year 1, albeit with some benefit derived from greater integration within the baseline as planting matures and biodiversity benefits are realised through appropriate management. Balancing these factors, there will be a negligible magnitude of effect on S PZ 26 at Year 15.

Significance of Effect

Overall, taking the medium sensitivity and negligible magnitude of effect into account there will be a **slight adverse effect** on S PZ 26 in operation Year 1 and a **slight adverse effect** at Year 15.

7.8 Visual Baseline Conditions

7.8.1 Figure 7-1 of Volume 2A 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 within Ollerton Conservation Area;
- residents at properties in other locations in Ollerton (outside of the Ollerton Conservation Area);
- residents at other individual isolated properties;
- users of various local rights of way;
- viewers on minor roads; and
- users of recreational areas such as Sherwood Heath.

7.8.3 Following production of a ZTV of the Scheme, photoviewpoints were recorded from a total of eight locations within the study area (see Volume 2A Figures 7-1 for locations, Figures 7-4 for viewpoints and Figures 7-5 for photomontages), 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 images are Type 1 viewpoint photography and the photomontages are Type 4 visualisations.

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

Table 7-9: Representative Viewpoints Baseline Characteristics

Photoviewpoint 1: Sherwood Heath Local Nature Reserve

Grid reference	Elevation (m aOD)	Receptor type	Approx. distance	Photoplan	Date of Visit

464911, 367550	45.7	Recreational	70 m	Figure 7-5-1	July-Nov 2021

Description of the baseline view

View looking south-east across Sherwood Heath LNR from PRoW Ollerton and Boughton BW26, from a slightly elevated viewpoint.

Range of view – on the left-hand side of the view is the A616 northern approach to the Ollerton Roundabout, with mature vegetation on the edge of Birklands west and Ollerton Corner SSSI. The heathland of the Sherwood Heath LNR is in the foreground. There is car parking in the middle distance and houses on the built edge of the village of Ollerton in the far distance, these properties are in the Ollerton Conservation Area. The Alders Public House is visible on the right-hand side of view with car parking to its frontage and relatively new landscape treatment including tree and shrub planting between the visitor's car park and the roundabout.

The view of the existing roundabout is filtered by the vegetation on Sherwood Heath and the existing and more mature vegetation to the south-east of the car parking areas. There is a strong hedge line between the heathland area and the car parking area which also partially screens views of the roundabout. Detracting features in the view include lamp columns and road signage.

Value of the View	Value
This viewpoint reflects the views available to users of the PRoW and the associated car parking, and views from the carpark of The Alders PH. The viewpoint is not within an area subject to any landscape designations, but it does have an ecological designation. It is located on a well-used PRoW with adjacent car parking. The amenity value is high due to the open space, natural heathland surroundings including mature Oak and Birch trees. Although the view is ordinary, the content is largely rural and with some aesthetic quality which may be visited on that basis, leading to an overall medium value of the view.	**Medium**

Photoviewpoint 2: A614 travelling south, adjacent properties at Forest Side

Grid reference	Elevation (m aOD)	Receptor type	Approx. distance	Photoplan	Date of Visit
465081, 367637	43.6	Residents/Highway Users	0 m	Figure 7-5-2	July-Nov 2021

Description of the baseline view

View looking south towards the existing roundabout from the eastern side of the A614, from the gateway of the property – No.3 Forest Side, from a slightly elevated position.

Range of view – to the left-hand side of the view are the three Forest Side properties and their frontages. In the foreground is the approach to and the existing roundabout, in the distance the skyline is formed by vegetation between River Maun and the A614. The middle ground views are of a petrol station (Shell) and fast food services (Costa Coffee) and vegetation to the frontage of The Alders Public House including a mature Ash tree and a mature poplar. To the right-hand side of the view is the woodland at the southern end of the Birklands west and Ollerton Corner SSSI.

The view from this viewpoint is open with no screening or filtering features. Detractors in the view include pylons, business signage and highway signage, telegraph poles and lamp columns.

Value of the View	Value
This view represents the view available to vehicle drivers from the northern approach to the existing roundabout. There is limited pedestrian activity in the area because of the limited footpath width and there is no destination other than to the three properties themselves. Views from property No. 2 and No. 3 are screened by property No. 1, but views are available view from their frontages. Views from property No.1 are available from the frontage and the gable end which has direct views south towards the existing roundabout, these are partially screened by an existing garden hedgerow. There are no landscape designations and the amenity value of the area is reduced by proximity to the carriageway edge. The location is unlikely to be visited to experience the view and visual value is assessed as low.	**Low**

Photoviewpoint 3: A616 travelling west

Grid reference	Elevation (m aOD)	Receptor type	Approx. distance	Photoplan	Date of Visit
465221,367580	41.3	Highway	0 m	Figure 7-4-1	July-Nov 2021

Description of the baseline view

View looking south-west towards the existing roundabout from the footway on the south side of A616 Ollerton Road.

Range of view – To the left-hand side of the view is arable farmland with a roadside hedgerow and verge. In the foreground is the approach to the existing roundabout. In the middle distance is built development around the roundabout including a fast food outlet to the south and the Forest Corner properties to the north. The horizon is formed by mature woodland mainly at the edge of Sherwood Heath LNR and SSSI, and to the frontage of The Alders Public House which includes a mature Ash tree. To the ride-hand side of the view is a roadside hedgerow and verge.

There are open views of the existing roundabout and moving traffic on the east, south and north approaches to the roundabout. Detractors include highway signage, telegraph poles and lamp columns which combine to degrade the view.

The viewpoint is in an open break between Ollerton village and the service hub at Ollerton Roundabout. There are no residential properties in the vicinity of this viewpoint.

Value of the View	Value
This view reflects that available to vehicle users and cyclists on the eastern approach to the existing roundabout. There are no landscape designations, but this is an open area outside the built development of Ollerton, its value is reduced by its proximity to the carriageway and detracting elements such that the location is unlikely to be visited to experience the view. Value is assessed as low.	**Low**

Photoviewpoint 4: Entrance to Maida Lane, Ollerton

Grid reference	Elevation (m aOD)	Receptor type	Approx. distance	Photoplan	Date of Visit
465457, 367635	42.1	Highway	220 m	7-4-5	July-Nov 2021

Description of the baseline view

A distant view looking south-west towards the existing roundabout from the southern side of the A616. The viewpoint represents the western edge of the built area of Ollerton.

Range of View – To the left-hand side of the view is grazing land to the north-west of the River Maun valley which is used for horse grazing in paddocks divided by temporary fences. In the foreground of the view is the approach to the existing roundabout with roadside hedgerows, in the mid ground are fast food outlets near the existing roundabout (McDonald's, Costa Coffee) and the properties at Forest Corner. The horizon is formed by mature vegetation at to the edge of Alders Public House, the higher ground at Sherwood Heath and the well wooded edge of the SSSI. To the right-hand side of the view is arable agricultural land.

Behind the viewpoint is a Grade II listed building – Ollerton Hall (currently for sale) which is at the edge of the Ollerton Conservation Area which will have distant oblique views from its front elevation which has 3 storeys. The views from bungalows at the southern end of Maida Lane and on the south side of A616 are influenced and restricted by garden vegetation and riverine vegetation along the River Maun.

There are filtered views of the existing roundabout with moving traffic on the south, east and northern approaches, the views are filtered by hedge lines, the vegetation along the River Maun and isolated mature trees. Detractors in the view include lamp columns, telegraph poles and highway signage.

Value of the View	Value
This view reflects that available to vehicle drivers and other road users on the eastern approach to the existing roundabout. There is pedestrian activity between Ollerton village and the service hub at Ollerton Roundabout. The viewpoint also represents views from the Grade II listed	**Low**

property – Ollerton Hall on the edge of Ollerton which has distant but oblique views of the existing roundabout. However, it is currently unoccupied and therefore not a residential receptor for the purposes of this assessment.

There are no landscape designations, but this is an open area at the edge of the built development of Ollerton which is within a conservation area. The visual value is reduced by the proximity of the viewpoint to the carriageway, the influence of the buildings in the vicinity of the existing junction and urban fringe land use of horse grazing. The location is unlikely to be visited to experience the ordinary view and value is assessed as low.

Photoviewpoint 5: River Maun bridge, Ollerton

Grid reference	Elevation (m aOD)	Receptor type	Approx. distance	Photoplan	Date of Visit
465275, 367448	41.9	Residents/high way users.	120 m	Figure 7-4-2	July-Nov 2021

Description of the baseline view

View looking north-west towards the existing roundabout from the footway on the north-eastern side of Newark Road and within the Ollerton Conservation Area.

Range of view –To the left-hand side of the view is riverine vegetation along the River Maun and a strong mixed species hedgerow with mature trees to the southern edge of the road. In the foreground of the view is Newark Road and in the middle distance the existing roundabout with moving traffic, the horizon line is formed by mature vegetation to the north-west of the existing roundabout in the Birklands west and Ollerton Corner SSSI. To the right-hand side of the view is a strong mixed species hedgerow to the northern edge of the road and riverine vegetation along the River Maun.

Behind the viewpoint is the Ollerton Conservation Area which includes the Grade II listed Ollerton Watermill and the adjoining Mill House, from which there are likely to be distant gable end views only.

There are filtered views of the existing roundabout and moving traffic on the northern approaches. Views are filtered by distance, mature trees within the Ollerton Conservation Area, vegetation along the course of the River Maun and a mature hedgerow on both sides of Newark Road which constrains the view of the existing roundabout into a narrow field of view. Detractors in the view include lamp columns and road signs.

Value of the View	Value
This viewpoint reflects the views available to vehicle drivers and cyclists on the north-western approach to the existing roundabout. There is pedestrian activity between Ollerton village and the service hub at Ollerton Roundabout. There are views towards the existing roundabout from the rear of some residential properties on the edge of the Ollerton Conservation Area which are also of architectural and heritage interest such as Maun River Cottage, Little John Cottage and Sherwood House. There are no landscape designations. Although the amenity value is reduced by proximity to the carriageway edge, the viewpoint is within the Ollerton Conservation Area with adjacent listed buildings and features however as above there are only likely to be gable end views from Ollerton Watermill and the adjoining Mill House. Overall, this is an ordinary view with no elements of particular value and it is unlikely to be visited to experience the view.	**Low**

Photoviewpoint 6: A614 travelling north

Grid reference	Elevation (m aOD)	Receptor type	Approx. distance	Photoplan	Date of Visit
465102, 367431	42.1	Highway	0 m	Figure 7-4-3	July-Nov 2021

Description of the baseline view

View looking north towards the existing roundabout from the west side of the A614.

Range of view – To the left-hand side is a petrol station (Shell) with the Costa Coffee drive through restaurant to the north. In the fore ground of the view is A614 approach to the existing roundabout, In the middle ground is the existing roundabout and residential development at Forest Corner to the north, the horizon is formed by mature vegetation at

the edge of the Birklands west and Ollerton corner SSSI. To the right-hand side is another fast food outlet (McDonald's) with mature trees to its frontage and a petrol station (Esso).

There are open views of the roundabout with moving traffic on the north and south approaches. The field of view is constrained by development on either side of the carriageway including the petrol stations and café/restaurants facilities.

Value of the View	Value
This viewpoint reflects the views available to vehicle drivers and cyclists on the southern approach to the existing roundabout. There is pedestrian activity around the service facilities. There are no landscape designations. Amenity value is reduced by close proximity to the carriageway edge and surrounding service facilities. Value is assessed as very low as there are no elements of value and the functional and featureless elements of the commercial land use.	**Very Low**

Photoviewpoint 7: A6075 travelling east

Grid reference	Elevation (m aOD)	Receptor type	Approx. distance	Photoplan	Date of Visit
465015, 367475	43.4	Residents/highway	0 m	Figure 7-5-3	July-Nov 2021

Description of the baseline view

View looking north-eastwards towards the existing roundabout with moving traffic on the eastern and southern approaches, and from Newark Road, from a slightly elevated viewpoint.

Range of view - To the left-hand side of the view is a strongly vegetated boundary with mature trees to the north-west side of A6097. In the foreground is the approach to the existing roundabout, with the roundabout in the mid ground. The skyline is formed by mature vegetation around the residential properties at Forest Corner and the frontage of McDonald's. To the right-hand side of the view is a fast food outlet (Costa Coffee) and a petrol station with associated car parking with landscape treatment, and tree planting to the eastern boundary of a residential property – The Coombs.

Open views of the roundabout are constrained by the mature vegetation to the north and built development to the south. Detractors in the view include highway signage, lamp columns and telegraph poles, as well as moving traffic on the roundabout and on its approaches.

Value of the View	Value
This view represents the view available to vehicle drivers from the north-eastern approach to the existing roundabout. There is one residential property – The Coombs, which has a north-east aspect and no windows on the elevation that faces the existing roundabout. There are no landscape designations and amenity value is reduced by proximity to the carriageway edge and dominance of traffic and prominence of functional built form such that value is assessed as low.	**Low**

Photoviewpoint 8: PRoW Ollerton and Boughton Bridleway 8, at River Maun Bridge

Grid reference	Elevation (m aOD)	Receptor type	Approx. distance	Photoplan	Date of Visit
465693, 368266	38.8	Recreational	790 m	Figure 7-4-4	July-Nov 2021

Description of the baseline view

View looking south-east towards the existing roundabout along the valley of the River Maun, from the bridge over the River on PRoW Ollerton and Boughton Bridleway 8. Traffic on the northern approach to the roundabout and from Ollerton on the A616 is visible from this viewpoint.

Range of view from the PRoW– To the left-hand side of the view is riverine vegetation along the River Maun and a spur of the River Maun. In the foreground is an agricultural field crossed by power lines. There is a distant view of the site where only the petrol stations and the lamp columns can be picked out. The existing vegetation around the existing roundabout is visible including the Poplar in an area of mature vegetation to the south-east of The

Alders Public House. The skyline is formed by distant wooded ridgelines. To the right-hand side of the view is mature vegetation along the A614 at the edge of the Birklands west and Ollerton Corner SSSI.

Residential properties to the west side and southern end of Maida Lane are bungalows, and have no direct views of the Scheme, views from the rear are screened by mature vegetation along the Maun valley. There are two-storey houses to the northern end of Maida Lane, but these have no direct views towards the Scheme and are also screened by riverine vegetation around Little John Lakes.

The view of the site is filtered by distance and some intervening vegetation such as poor-quality hedgerows. Detractors in the view include electricity lines on wooden poles, telegraph poles, pylons and barbed wire fences.

Value of the View	Value
This viewpoint reflects the views available to users of the PRoW as well as residential receptors on the edge of Ollerton village. The viewpoint is not subject to any landscape designations but is located on a well-used PRoW The amenity value is high due to the open space, natural surroundings including mature trees and riverine vegetation. Value is assessed as medium due to the absence of detractors and pleasing composition of the landscape elements such that the location may be visited on account of the view.	**Medium**

7.9 Assessment of Visual Effects

Table 7-10 Assessment of Visual Effects at Representative Viewpoints

Photoviewpoint 1: Sherwood Heath Local Nature Reserve. Refer to Photomontage 7-5-1.

Susceptibility of Receptor to Specific Change	Susceptibility
All stages: Receptors at this location comprise users of the LNR and recreational users of the paths within it. Such users are higher range of susceptibility to visual intrusion from construction or highways as a result of an expectation of appreciation of views and being typically engaged in active enjoyment of the view. Viewers at this location are assessed as being of moderate susceptibility to change arising from construction activity/highway in a highway context, given an expectation of enjoyment of views and the absence of similar activity in the baseline. Views of the Scheme in year 1 of operation would potentially be incongruous in the context of this view in which the A616 highway forms only a minor part of the baseline. Viewers are therefore of medium susceptibility to the operational highway in year 1. Considering the medium value of the view against the medium susceptibility to views of the Scheme in year 1, viewers within the nature reserve are assessed as being of moderate susceptibility to the operational Scheme.	**Moderate**
Sensitivity	**Sensitivity**
All stages: Taking the medium value of the view with the moderate susceptibility to visual intrusion of construction/highways into account, users are assessed as being of moderate sensitivity.	**Moderate**
Nature of Effect: Size/Scale, Geographical Extent, Duration and Reversibility	
During construction: Construction activity to construct the revised junction would occupy a limited and localised central part of the view in the middle to background. Localised removal of vegetation (trees/shrubs along the A616) would include removal of a small number of trees within the view, the majority being retained and those removed being screened by the intervening vegetation (along the north section of the A616) or buildings to be retained, such as The Alders Public House. The introduction of traffic management/construction activity and machinery would temporarily add to adverse elements within the view. The construction activity would be viewed as a localised element, in the context of the existing highway and occur within a wide panorama which would be otherwise largely unchanged. The geographical extent of the view would also be localised and be experienced as a transient element from within the nature reserve. Given the relatively short duration, scale and extent and reversibility of construction activity and the nature of the view there would be minor adverse magnitude of change during construction of the Scheme.	**Minor**
Year 1 of operation: The Scheme would be partially visible within the same portion of the view as the baseline. Impacts would be derived from views of increased highway infrastructure and traffic in middle to background views as a result of the highway widening creating two lanes of traffic per carriageway and the size of the roundabout would increase and extend further into the view. The foreground and most of the middle ground would remain largely unchanged. In operation, lighting	**Minor**

Photoviewpoint 1: Sherwood Heath Local Nature Reserve. Refer to Photomontage 7-5-1.

columns would extend northwards and southwards along the A616 and A614, but these would be screened by intervening vegetation. At night there would a localised increase in visual intrusion from the additional lighting, albeit this would be seen within a baseline of lighting at the junction and numbers of viewers from this location are likely to be limited at night. This change in the view would be partially offset by the use of LED low light spill lighting for the replacement of existing columns. Overall, both in daytime and at night the geographical extent of the change in views from this location would be limited. The perceptible increase in the scale and extent of the highway would result in a minor adverse magnitude of change for both receptor groups at this location in Year 1. Refer to Photomontage 7-4-1.	**Negligible**
Year 15 of operation: Landscape mitigation planting within the footprint of the Scheme would be partially nature by year 15 and contribute to reduction in effects on visual amenity, compared to Year 1. In particular, the central planting within the relocated roundabout would act to screen views of housing in Ollerton present in the baseline such that there would be some reduction in built form within the view. Overall, there would be a negligible increase in highway visibility within a localised section of a wide panorama during the day by year 15. The overall magnitude of the impact would be negligible adverse.	

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

Photoviewpoint 2: A614 travelling south, adjacent property at Forest Side. Refer to Photomontage 7-5-2.

Susceptibility of Receptor to Specific Change	**Susceptibility**
All stages: This view represents the view available to vehicle drivers from the northern approach to the existing roundabout on the A614 and to a lesser extent the views external locations to the property and from a window in the gable end. The majority of users are at the lower range of susceptibility to visual intrusion from construction or highway infrastructure. 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: Taking the low value of the view with the moderate susceptibility to visual intrusion of construction into account, residents at this location are assessed as being of moderate sensitivity and vehicle users are assessed as being of low sensitivity.	**Moderate (Residents) Low (Vehicle Users)**
Nature of Effect: Size/Scale, Geographical Extent, Duration and Reversibility	**Magnitude**
During construction: Construction activity would be openly visible in the middle ground and extent into and beyond the viewpoint through white lining and installation of lighting columns beyond the current extent of the junction. The introduction of traffic management/construction activity and machinery would therefore be prominent and include some loss of vegetation in the adjacent to the existing roundabout, increasing visibility of commercial premises and activity. For residents adjacent to the viewpoint, views would be predominantly oblique to the view. Construction activity for road users would be widespread in the view but would be relatively short-term and reversible. Overall, taking the short-term nature of the construction into account there would be a moderate adverse magnitude of change in construction for residents and vehicle users.	**Moderate**
Year 1 of operation: In operation, lighting columns would extend northwards along the A614 and the new junction would be more prominent, slightly closer to the viewpoint and with intensification of highway elements including the width of the highway. At night there would a localised increase in visual intrusion from the additional lighting although this would largely be beyond the end of the residential properties. This change in the view would be partially offset by the use of LED low light spill lighting, including for the replacement of existing columns. The degree to which these elements would add to the view, given they are also in the baseline is limited but the localised increased	**Minor**

visibility of buildings and commercial activity would be coupled with intensification of highway elements. Effects at this stage would be permanent and adverse effects on viewers would be of minor magnitude, representing intensification of existing elements within a highway dominated panorama and hence adverse effects would be slight. Refer to Photomontage 7-4-2.

Year 15 of operation: By year 15 planting on the new roundabout would provide some beneficial screening of commercial premises beyond the junction and better integrate the highway such that adverse effects from the increased highway footprint and lighting columns would be of negligible magnitude. **Negligible**

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

Photoviewpoint 3: A616 travelling west

Susceptibility of Receptor to Specific Change	Susceptibility
All stages: This view represents the view available to vehicle drivers/other road users approaching the junction on the A616 travelling westwards. Users of main highways are at the lower range of susceptibility to visual intrusion from construction or highway infrastructure, as their primary focus is likely to be on travel/the highway rather than appreciation of views.	**Low**

Sensitivity	Sensitivity
All stages: Taking the low value of the view with the low susceptibility to visual intrusion of construction and highway infrastructure into account, viewers are assessed as being of low sensitivity.	**Low**

Nature of Effect: Size/Scale, Geographical Extent, Duration and Reversibility	Magnitude
During construction: Vegetation removal would occur either side of the approach to the junction and include hedgerow removal prominently within the view, predominantly on the right-hand side and some loss of individual trees. Construction activity to construct the revised junction would extend towards the viewpoint and comprise machinery such as hydraulic excavators, machines constructing the additional highway, laying surfacing and installing signage/lighting. The introduction of traffic management would add to the visual impact. Effects on visual amenity at this stage would be of relatively short duration and reversible but temporarily form a dominant element throughout the central part of the view. Overall, taking the duration and reversibility into account there would be a moderate adverse magnitude of change in visual amenity during construction of the Scheme.	**Moderate**
Year 1 of operation: The revised junction would be visible further to the right-hand side of the view. Vehicles using and approaching the junction both on the A616 and A614 would be more visible than in the baseline, in part as a result of the removal of intervening hedgerows which would increase visibility of the A614 to the north as a result. In operation, columns would extend eastwards along the A614 and A616 increasing the number of columns within this view. At night there would a localised decrease in light in the vicinity, with an increase in visual intrusion from the additional lighting. Overall, at night therefore lighting would extend wider within the view, but within areas already lit the intensity of lighting/extraneous light spill would be similar to or less than in the baseline. Mitigation planting and seeding would be immature and provide minimal landscape integration or screening of highway elements. The intensification of lanes at the junction and increased visibility of highway infrastructure, including lighting columns in the day and extent of lighting at night, taking into consideration increased openness as a result of vegetation loss would be of moderate magnitude, taking into consideration that highway is currently a significant part of the baseline view.	**Moderate**
Year 15 of operation: By Year 15 landscape mitigation would provide screening of traffic on other arms of the junction and a degree of screening within the roundabout itself. Planting of trees and shrubs in the wider context of the junction, for example in the highway land between the A614 Blyth Road and A616 Worksop Road would increase the extent of tree cover, off-setting the loss during construction but overall the junction would remain more prominent in the view than in the baseline as a result of the increased footprint/lanes and extent of highway infrastructure including lighting and	**Moderate**

Photoviewpoint 3: A616 travelling west

lighting columns and signage. Although partial mitigation would reduce the magnitude of effects on visual amenity at this stage, the prominence of the junction would remain of moderate magnitude.

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

Photoviewpoint 4: A616 entrance to Maida Lane, Ollerton

Susceptibility of Receptor to Specific Change	Susceptibility
All stages: Receptors at this location comprise users of the A616 Ollerton Road, including pedestrians. 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 low susceptibility to visual intrusion of construction and highway infrastructure into account, viewers at this location are assessed as being of low sensitivity.	**Low**

Sensitivity	Sensitivity
All stages:	**Low**

Nature of Effect: Size/Scale, Geographical Extent, Duration and Reversibility	Magnitude
During construction: Vegetation removal including a length to the south side of the A616 adjacent to the A614 junction would be visible. Traffic management and construction activity and machinery would form a relatively distant and small-scale element in the background. Given the relatively short duration and reversibility of construction activity combined with the limited scale and extent of construction within the view there would be negligible adverse magnitude of change during construction of the Scheme.	**Negligible**
Year 1 of operation: The view would largely resemble the baseline, although the short section of hedgerow to the south of the A616 and would be absent, increasing visibility of the modified junction in Year 1. The number of lighting columns would increase and at night the visible extent of light will be greater than in the baseline. This change in the view will be partially offset by the use of LED low light spill lighting, including for the replacement of existing columns. There will be intensification of traffic visibility and more open views of existing buildings in the vicinity of the roundabout, including The Alders Public House. The degree to which these elements will add to the view, given they are also in the baseline is limited but the localised increased visibility of buildings and commercial activity will be coupled with intensification of highway elements. Effects at this stage will be permanent and adverse but given the limited and localised extent of change as a result of distance, effects on viewers will be of negligible magnitude and hence adverse effects will be slight. The degree to which the highway elements will intensify in the view, given they are also in the baseline is very limited. Although effects at this stage will be considered permanent, adverse effects on the view and viewers be of negligible magnitude, being very localised within a largely unchanged panorama and hence significance would be neutral.	**Negligible**
Year 15 of operation: Mitigation will partially screen highway elements visible in year 1, through the reestablishment of the highway hedgerows for example. However, some elements such as lighting columns and lighting effects described in Year 1 will remain. Effects at this stage will remain of negligible magnitude, being very localised as a distant element within a largely unchanged panorama and hence significance would be slight.	**Negligible**

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

Photoviewpoint 5: River Maun bridge, Ollerton

Susceptibility of Receptor to Specific Change	Susceptibility
All stages: As described for Viewpoint 4 but also covering residential receptors on the edge of the Ollerton Conservation Area. The majority of users are at the lower range of susceptibility to visual intrusion from construction or highway infrastructure. However, residents in this location have an expectation of enjoyment of the view and while susceptibility for road users is low, for residents it is assessed as moderate.	**Moderate (residents) Low (vehicle/road users).**
Sensitivity	**Sensitivity**
All stages:	**Low**
Nature of Effect: Size/Scale, Geographical Extent, Duration and Reversibility	**Magnitude**
During construction: Vegetation removal would barely register within the view with the majority of the hedgerows either side of Newark Road being retained. Construction activity to construct the revised junction would form a distant element at the end of the funnelled vista. Machinery, traffic management and removal of existing lighting columns and installation of new signage/lighting would be visible but be very localised. The relocated roundabout construction would be largely screened by intervening vegetation and buildings to be retained. The effects described will be further reduced from properties on the residential edge of the village/conservation area due to vegetation along the River Maun. Given the relatively short duration and reversibility of construction activity combined with the limited scale and extent of construction within the view there will be negligible adverse magnitude of change during construction of the Scheme.	**Negligible**
Year 1 of operation: As for VP4, the view will largely resemble the baseline with effects from lighting columns and lighting at night also similar to VP4. However, the relocation of the roundabout further north and the effective stopping up of the direct access onto the junction will reduce the visibility of traffic and highway infrastructure such that the lighting columns will be the primary element visible and there will be intensification of their number and the extent of lighting. This change in the view will be partially offset by the use of LED low light spill lighting, including for the replacement of existing columns.	**Negligible**
Year 15 of operation: By Year 15**,** mitigation will beneficially reduce the prominence of most of the revised junction compared to the baseline, the exception being the additional lighting columns and lighting. However, the direct line of site to the highway will be obstructed by intervening planting and the lighting columns will be substantially screened such that there will be some beneficial reduction in views of moving traffic/highway elements by Year 15 and on balance, taking the increased effect of lighting into accounts effects will be neutral compared to the baseline.	**No change**

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:	**Neutral**	**Neutral**

Photoviewpoint 6: A614 travelling north

Susceptibility of Receptor to Specific Change	Susceptibility
All stages: Receptors at this location comprise users of the A614 approaching the existing junction. Use of roads is not primarily associated with appreciation of the view and hence the majority of users at this location is at the lower range of susceptibility to visual intrusion from construction or highway operation. Taking the very low value of the view with the low susceptibility to visual intrusion of construction/highway infrastructure into account, viewers at this location are assessed as being of negligible sensitivity.	**Negligible**
Sensitivity	**Sensitivity**
All stages:	**Negligible**
Nature of Effect: Size/Scale, Geographical Extent, Duration and Reversibility	**Magnitude**
During construction: The site compound to the south of the A6075 will be visible by road users approaching the viewpoint but largely screened from the viewpoint by intervening buildings and	**Minor**

Photoviewpoint 6: A614 travelling north

vegetation in the vicinity of the Shell garage. Vegetation removal, traffic management and construction activity and machinery would be visible in the vicinity of the existing junction in a narrow section of the view, predominantly in the middle ground but also extending towards the viewpoint. Removal of existing lighting columns and installation of new signage/lighting would be visible along with works to modify the roundabout and increase the highway footprint to accommodate dual lanes. Given the relatively short duration and reversibility of construction activity combined with a localised and geographically limited view there would be minor adverse magnitude of change during construction of the Scheme.	
Year 1 of operation: The view would contain less vegetation and more lighting columns as well as a perceptible intensification of highway infrastructure/highway. The hedge and trees adjacent to McDonald's would be absent within the view, intensifying the built form and the dominance of the highway corridor. The visibility of lighting columns would largely correspond to the number and locations in the baseline. At night, the lighting design and lux plans for the Scheme (Figure 8-2 in Volume 2A) indicate that the extent of illumination from highway sources will extend further to the viewer than in the existing situation, although the modelling excludes the lighting from the adjacent commercial premises which are well lit. The degree to which the highway elements would intensify in the view, given they are also, along with the commercial properties, the main element in the baseline, is limited. Mitigation planting would be visible, for example on the main roundabout but provide limited screening or integration in Year 1. Although effects at this stage would be considered permanent, adverse effects on the view and viewers would be of minor magnitude, being localised within a slightly modified panorama comprising similar elements to the baseline but with less vegetation.	**Minor**
Year 15 of operation: Mitigation would reinstate vegetation as a softening element within the view, including a section of hedge on the right-hand side which by Year 15 would reinstate a vegetated boundary to McDonald's. The perception of the wider highway on the approach to the junction would remain along with the increased presence of lighting columns. Tree planting on the modified roundabout would increase the vegetation cover within the view compared to the baseline and would provide screening of forward traffic to the north of the junction on the A614. Consequently, there would be some mitigation compared to the baseline roundabout, which is simply grassed. Effects on visual amenity would be of negligible magnitude at Year 15 and beyond.	**Negligible**

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

Photoviewpoint 7: A6075 travelling east. Refer to Photomontage 7-5-3.

Susceptibility of Receptor to Specific Change	**Susceptibility**
All stages: Receptors at this location comprise users of the A6075. The Coombs residential property is adjacent to the viewpoint. 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. However, it is acknowledged that residents in this location may be engaged in active enjoyment of the view, including within gardens and therefore susceptibility is assessed as moderate. Taking the low value of the view with the moderate susceptibility to visual intrusion of construction into account, highway viewers at this location are assessed as being of low sensitivity and residents are moderate sensitivity.	**Moderate (residents) Low (vehicle/road users).**

Sensitivity	**Sensitivity**
All stages:	**Moderate (residents) Low (vehicle/road users).**

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

Photoviewpoint 7: A6075 travelling east. Refer to Photomontage 7-5-3.

During construction: Vegetation removal would be prominent but short-term on the left-hand side of the view but include retention of existing trees and shrubs to the rear. Traffic management and construction activity and machinery would be visible in the vicinity of the existing junction in the fore to middle ground. Construction of the new access to the south of the A6075 would be visible in the right- hand side of the view. The site compound to the south of the A6075 will be visible by road users approaching the viewpoint but largely screened from the viewpoint by intervening buildings and vegetation in the vicinity of The Coombs. Construction activity to construct the revised junction would therefore be prominent within the central middle ground and extend to the viewpoint. Removal of existing lighting columns and installation of new signage/lighting would be visible. For residents adjacent to the viewpoint, views would be substantially screened by intervening vegetation within the garden and predominantly oblique to the view. Views of the site compound from The Coombs would equally be screened in summer and heavily filtered in winter but some upper floor views would potentially be obtained. Given the relatively short duration and reversibility of construction activity within a geographically limited extent but impacted much of the panorama view there would be moderate adverse magnitude of change during construction of the Scheme.	**Moderate**
Year 1 of operation: The view would contain less vegetation, more lighting columns as well as a noticeable intensification of highway infrastructure. 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 2A) indicate that the extent of illumination will extend further to the viewer than in the existing situation. This change in the view will be partially offset by the use of LED low light spill lighting, including for the replacement of existing columns. The highway footprint and traffic within it will be more extensive with fewer trees although the sense of enclosure and screening of The Alders Public House would be retained. Effects at this stage would be considered permanent and adverse effects on the view and viewers would be of moderate magnitude for highway users and minor magnitude for residents for whom screening is retained, comprising a modified panorama of a larger highway footprint and increased infrastructure with less vegetation. Refer to Photomontage 7-4-7.	**Minor**
Year 15 of operation: Mitigation would reinstate vegetation as a softening element within the view, adding trees to the roundabout which are absent in the baseline. Intensification and change in the scale of highway infrastructure in the view will remain Consequently, effects on visual amenity would be of negligible magnitude at Year 15 and beyond.	**Negligible**

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 8: PRoW Ollerton and Boughton Bridleway 8, at River Maun Bridge

Susceptibility of Receptor to Specific Change	**Susceptibility**
All stages: Receptors at this location comprise users of a PRoW. Such users are higher range of susceptibility to visual intrusion from construction or highways as a result of an expectation of appreciation of views and being typically engaged in active enjoyment of the view. Viewers at this location are assessed as being of moderate susceptibility to change arising from construction activity/highway in a highway context, given an expectation of enjoyment of views and the absence of similar activity in the baseline.	**Moderate**
Sensitivity	**Sensitivity**
All stages:	**Moderate**
Nature of Effect: Size/Scale, Geographical Extent, Duration and Reversibility	**Magnitude**
During construction: Vegetation removal, traffic management and construction activity and machinery would be largely indiscernible due to distance. Given the relatively short duration and reversibility of construction activity combined with a localised and geographically limited and distant	**Negligible**

view in which the scale and extent of change would be very limited, there would be negligible adverse magnitude of change during construction of the Scheme.

No change

Year 1 of operation: The view would contain less vegetation, but not in a discernible way, and more lighting columns but these do not register within the existing view and that would be the same during daytime for the modified junction due to distance. At night, the lighting design and lux plans for the Scheme (Figure 8-2 in Volume 2A) indicate that the extent of illumination will be more extensive than the existing situation, but with less light spill/glow into the sky. Although effects at this stage would be considered permanent, adverse effects on the view and viewers would only relate to increased lighting at a location at which numbers of night-time viewers are likely to be very small. Overall, therefore effects would be neutral.

No change

Year 15 of operation: As described for year 1.

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	No change	Neutral	Not required	**Neutral**
S PZ 15 River Maun Meadowlands with Plantations	Medium	Negligible	Slight	Not required	**Slight adverse**
S PZ 26 Budby Estate Farmland	Medium	Negligible	Slight	Not required	**Slight adverse**
Photoviewpoint 1: Sherwood Heath Local Nature Reserve	Moderate	Minor	Slight	Not required	**Slight adverse**
Photoviewpoint 2: A614 travelling south, adjacent 'No. 3 Forest Side'	Moderate (Residents) Low (Road users).	Moderate	Moderate (Residents) Slight (Road users).	Not required	**Moderate adverse (Residents) Slight adverse (Road users).**
Photoviewpoint 3: A616 travelling west	Low	Moderate	Slight	Not required	**Slight adverse**
Photoviewpoint 4: Entrance to Maida Lane, Ollerton	Low	Negligible	Slight	Not required	**Slight adverse**
Photoviewpoint 5: River Maun bridge, Ollerton	Moderate (Residents) Low (Road users).	Negligible	Slight	Not required	**Slight adverse**
Photoviewpoint 6: A614 travelling north	Negligible	Minor	Slight	Not required	**Slight adverse**
Photoviewpoint 7: A6075 travelling east	Moderate (Residents) Low (Road users).	Moderate (Road users) Minor (residents)	Slight	Not required	**Slight adverse**

Receptor	Sensitivity of Receptor	Magnitude of Impact	Initial Classification of Effect (with embedded mitigation)	Additional Mitigation	Residual Effect Significance
Photoviewpoint 8: PRoW Ollerton and Boughton Bridleway 8, at River Maun Bridge	Moderate	Negligible	Neutral	Not required	**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	No change	Neutral	Not required	**Neutral**
S PZ 15 River Maun Meadowlands with Plantations	Medium	Negligible	Slight	Not required	**Slight adverse**
S PZ 26 Budby Estate Farmland	Medium	Negligible	Slight	Not required	**Slight adverse**
Photoviewpoint 1: Sherwood Heath Local Nature Reserve	Moderate	Minor	Slight	Not required	**Slight adverse**
Photoviewpoint 2: A614 travelling south, adjacent 'No. 3 Forest Side'	Moderate (Residents) Low (Road users).	Minor	Slight	Not required	**Slight adverse**
Photoviewpoint 3: A616 travelling west	Low	Moderate	Slight	Not required	**Slight adverse**
Photoviewpoint 4: Entrance to Maida Lane, Ollerton	Low	Negligible	Slight	Not required	**Slight adverse**
Photoviewpoint 5: River Maun bridge, Ollerton	Moderate (Residents) Low (Road users).	Negligible	Slight	Not required	**Slight adverse**

Receptor	Sensitivity of Receptor	Magnitude of Impact	Initial Classification of Effect (with embedded mitigation)	Additional Mitigation	Residual Effect Significance
Photoviewpoint 6: A614 travelling north	Negligible	Minor	Slight	Not required	**Slight adverse**
Photoviewpoint 7: A614 travelling north	Moderate (Residents) Low (Road users).	Minor	Slight	Not required	**Slight adverse**
Photoviewpoint 8: PRoW Ollerton and Boughton Bridleway 8, at River Maun Bridge	Moderate	No change	Neutral	Not required	**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	No change	Neutral	Not required	**Neutral**
S PZ 15 River Maun Meadowlands with Plantations	Medium	Negligible	Slight	Not required	**Slight adverse**
S PZ 26 Budby Estate Farmland	Medium	Negligible	Slight	Not required	**Slight adverse**
Photoviewpoint 1: Sherwood Heath Local Nature Reserve	Moderate	Negligible	Slight	Not required	**Slight adverse**
Photoviewpoint 2: A614 travelling south, adjacent 'No. 3 Forest Side'	Moderate (Residents) Low (Road users).	Negligible	Slight	Not required	**Slight adverse**
Photoviewpoint 3: A616 travelling west	Low	Moderate	Slight	Not required	**Slight adverse**
Photoviewpoint 4: Entrance to Maida Lane, Ollerton	Low	Negligible	Slight	Not required	**Slight adverse**

Receptor	Sensitivity of Receptor	Magnitude of Impact	Initial Classification of Effect (with embedded mitigation)	Additional Mitigation	Residual Effect Significance
Photoviewpoint 5: River Maun bridge, Ollerton	Moderate (Residents) Low (Road users).	No change	Neutral	Not required	**Neutral**
Photoviewpoint 6: A614 travelling north	Negligible	Negligible	Neutral	Not required	**Neutral**
Photoviewpoint 7: A614 travelling north	Moderate (Residents) Low (Road users).	Negligible	Slight	Not required	**Slight adverse**
Photoviewpoint 8: PRoW Ollerton and Boughton Bridleway 8, at River Maun Bridge	Moderate	No change	Neutral	Not required	**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, 2020f).

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:

- Biodiversity Net Gain (BNG) Assessment (Baker Consultants Ltd., 2021a) – found in Appendix 4-2 of Volume 3;
- Shadow Habitats Regulations Assessment (sHRA) (Baker Consultant, 2021b) – found in Appendix 4-4 of Volume 3;
- Ecological Appraisal (Baker Consultants Ltd., 2020) – found in Appendix 4-5 Volume 3; and
- Preliminary Bat Roost Assessment (Baker Consultants, 2021) – Found in Appendix 8-2- of Volume 3A.

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 Ollerton Roundabout, 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)	Bat surveys need to be undertaken and that the impact of artificial lighting and noise should be considered with the use of lux diagrams and noise contour plans, unless it can be demonstrated that there will be no significant changes to the noise and lighting environment as a result of the Scheme.	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 2A). Embedded and additional mitigation, and the assessment are reported in Sections 8.6 and 8.7.
	Need for a methodology for how impacts of changes to noise, light and disturbance are to be assessed.	
	Targeted bird survey should be undertaken unless sufficient data is available for other sources and/or it can be demonstrated that there will be no significant changes to the noise and lighting environment as a result of the roundabout improvement.	
	In relation to bats and potential roost sites, it will need to be demonstrated that there will not be significant indirect impacts on potential roost locations as a result of noise, lighting or general disturbance.	An additional Preliminary Bat Roost Assessment (Baker Consultants Ltd, 2021) has been undertaken to determine whether suitable roosting features were present to support bats. (see Appendix 8-2 in Volume 3A). Further detail on the mitigation and the assessment is reported in Section 8.6 and 8.7.
	Potential impacts to the Sherwood ppSPA should be undertaken as part of the HRA assessment.	An sHRA (Baker Consultants Ltd, 2021b) has been undertaken (see Appendix 4-4 in Volume 3) which includes consideration for the Sherwood Area ppSPA.
	The creation of habitat should be delivered as far as possible at each individual junction comprising the overall combined Scheme.	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.
NCC Ecology Natural Environment Manager	Given the proximity of the Ollerton Roundabout to high-quality bat foraging habitat, I would suggest that bat activity surveys need to be undertaken at this location, and that the impact of artificial lighting and noise should be considered with the use of lux diagrams and noise contour plans, unless it can be demonstrated that there will be no significant changes to the noise and lighting environment as a result of the roundabout improvements.	The methodology for the assessment of the impact of artificial lighting and noise can be found in Section 8.4 of Volume 1A. Lux diagrams and noise contour plans are provided (see Figures 8-2, 8-3 and 8-4 in Volume 2A). Embedded and additional mitigation, and the assessment are reported in Sections 8.6 and 8.7 of Volumes 1A.

Stakeholder	Comment Made	How and where addressed in the ES
	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 as they lie outside the red line boundary– presumably because there will not be any direct impacts arising. 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.	Lux plans did indicate a potential adverse effect for bats for one property at Forest Side. An additional Preliminary Bat Roost Assessment (Baker Consultants Ltd, 2021) has been undertaken to determine whether suitable roosting features were present to support bats. (see Appendix 8-2 in Volume 3A). Further detail on the mitigation and the assessment is reported in Section 8.6 and 8.7 in Volume 1A.
	Similarly, given the diverse bird assemblage supported by the wider SSSI/SAC adjacent to the Ollerton Roundabout (including heathland/woodland and nocturnal species), as well as the comments in Table 9-3 that "Suitable nesting and foraging habitat is present for nightjar and woodlark within the Scheme boundary. Therefore, effects to both species due to the removal of suitable habitat as part of the works and therefore potential impacts to the ppSPA, cannot be discounted", it is recommended that targeted bird surveys are undertaken at this location, unless sufficient data is available from other sources, such as Birklands Ringing Group/ Nottinghamshire Biological and Geological Records Centre (NBGRC) and/or that it can again be demonstrated that there will be no significant changes to the noise and lighting environment as a result of the roundabout improvements.	Additional data has been obtained from the NBGRC. The impacts to nightjar and woodlark have been assessed within Volume 1A Chapter 8: Biodiversity and within the Shadow Habitats Regulations Report (Appendix 4-4 of Volume 3).
	The Sherwood ppSPA should be considered as part of the HRA assessment.	A Shadow Habitats Regulations Assessment has been undertaken, considering the Schemes at Ollerton Roundabout, Mickledale Lane Junction, Warren Hill Junction and White Post Roundabout. See Appendix 4-4 of Volume 3. This includes consideration for the ppSPA.
	Biodiversity Net Gain The creation of habitat should be delivered at each location, as far as possible, for example through the planting of native trees, shrubs and hedgerows and the seeding of native wildflower seed mixes. The Ollerton Roundabout in particular should be landscaped to reflect characteristic Sherwood habitats.	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, including for example, acid grassland and heathland creation are proposed, plus species including field maple, silver birch, downy birch, wild cherry, scots pine, sessile oak, English

Stakeholder	Comment Made	How and where addressed in the ES
		oak and rowan - all which are in keeping with the local character area.
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 of Volumes 1A Lux diagrams and noise contour plans are provided (see Figures 8-2, 8-3 and 8-4 in Volume 2A). Embedded and additional mitigation, and the assessment are reported in Sections 8.6 and 8.7 of Volume 1A.
	NWT would expect to see further monitoring undertaken in a key protected habitat 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.	Dust monitoring adjacent to the Birklands West and Ollerton Corner SSSI will be undertaken during construction, refer to Section 8.8 for further detail. A programme of monitoring is proposed adjacent to the roadside closest to the Birklands West and Ollerton Corner SSSI in the opening year to ensure emissions predictions are accurate, refer to Section 8.8 for further detail.
	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 daytime visual inspections and evening emergence surveys undertaken at the correct times of year by suitably licensed persons.	An additional Preliminary Bat Roost Assessment (Baker Consultants Ltd, 2021) has been undertaken to determine whether suitable roosting features were present to support bats. (see Appendix 8-2 in Volume 3A). Further detail on the mitigation and the assessment is reported in Section 8.6 and 8.7.

Stakeholder	Comment Made	How and where addressed in the ES
	Badgers - surveys of the whole site and adjacent land (up to 250 m) for field signs and setts.	An assessment for Badgers undertaken on 20th December 2019 as part of the extended Phase 1 habitat survey (Baker Consultants Ltd, 2020) – refer to appendix 4-5 of Volume 3. An additional badger survey undertaken in 2021 – refer to Section 8.5.
	Birds - breeding bird surveys to standard methodologies for at least 100m 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; ▪ Vibration; and ▪ Disturbance to sensitive species.	Noted, refer to Section 8.7 for the assessment considering these aspects where relevant.
	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 baseline 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.

8.4.3 Data searches relating to notable or protected species records up to 2 km from the junction were also requested from the Nottinghamshire Birdwatchers organisation, based on an early assumed extent of the works.

Field Surveys

8.4.4 The field surveys and associated reports, related to the Ollerton Roundabout Scheme, are outlined in Table 8-2.

8.4.5 Baker Consultants Ltd was commission 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.

8.4.6 Via undertook updated targeted surveys for badger and reptiles as detailed in Table 8-2.

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 50m from the Scheme 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	Joint Nature Conservation Committee (JNCC) (2010) Full details can be found in Ecological Appraisal (Baker Consultants Ltd ,

Survey Target	Survey Type and Survey Area	Date Undertaken and Consultancy	Description of Assessment Undertaken	Methodology
			support protected and notable species.	2020) – Appendix 4-5 of Volume 3
Badger	Badger Survey, within and up to 30m from the Scheme assessment boundary.	22nd March 2021, Via	Any signs of badger or badger setts present within, or up to 30 m from the assessment boundary were described and mapped to determine whether badgers were utilising the area.	The Mammal Society (1989) Refer to Section 8.5 for further detail
Reptiles	Presence absence of reptiles, within and up to 50 m from the Scheme assessment boundary.	15th April 2019 – 1st May 2019 (7 survey visits undertaken), Baker Consultants Ltd April 2021 – May 2021, Via	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.
Bats	Preliminary Bat Roost Assessment, structures subject to Scheme impacts.	3rd December 2021	Systematic inspection of suitable structures to assess its potential to support roosting bats.	Collins, J. (ed.) (2016) Details can be found in Preliminary Bat Roost Assessment (Baker Consultants, 2021) Appendix 8-2 in Volume 3A

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

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

Study Area

8.4.8 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.

8.4.9 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;
- protected and/or notable species recorded within 1km of each Scheme (unless stated otherwise); and
- internationally, nationally and locally designated sites of ecological conservation importance within 200 m of the affected road network (ARN) shall be included in the air quality assessment. Further details regarding air quality assessment methodology can be found in Chapter 5 Air Quality.

8.4.10 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, 2006).

8.4.11 In accordance with DMRB LA 115 Habitat Regulations Assessment (Highways England, 2020f), desk study information has been collated for sites designated at an International/European level, including SPAs, potential SPAs (pSPAs); SACs, candidate or possible (cSAC/pSAC) sites and Ramsar sites (wetlands of international importance) using the following criteria:

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

Methodology for Determining Construction and Operational Effects

8.4.12 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.

8.4.13 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

8.4.14 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, 2020b). 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

8.4.15 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, 2020h). 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.

8.4.16 Anthropogenic disturbance is known to alter animal behavioural patterns. Physiological responses to noise exposure in animals include hearing loss, elevated stress hormone levels and hypertension. These responses begin to appear at exposure levels of 55-60 dB (Barber, Crooks, Fristrup, 2009). The effects of noise on fitness levels (feather development and body size) are considered to have a positive impact to bird species with noise levels up to 70 dB (Kleist et al., 2017). Examples of perceived sound intensity determine that 20dB 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).

8.4.17 The changes in noise levels have been compared in relation to the studies undertaken above.

8.4.18 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.

8.4.19 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).

8.4.20 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.

8.4.21 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

8.4.22 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); • 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; and ▪ 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.

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

Table 8-4: Level of Impact and Typical Descriptions

Level of Impact (change)		Typical Description
Major	Adverse	Permanent/irreversible damage to a biodiversity resource; and the extent, magnitude, frequency, and/or timing of an impact negatively affects the integrity or key characteristics of the resource.
	Beneficial	Permanent addition of, improvement to, or restoration of a biodiversity resource; and 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.

Level of Impact (change)		Typical Description
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.

8.4.24 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

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

Assumptions and Limitations

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

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

8.4.28 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.

8.4.29 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.

8.4.30 The month of February 2019, when the extended Phase 1 habitat survey was undertaken, is not optimal to detect signs of some protected species and annual plants will not be present. However, it is considered that sufficient information was gathered during the Phase 1 habitat survey and further individual protected species survey to determine accurate baseline conditions.

8.4.31 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. Additional information is provided in the subsequent text. The location of designated sites can be viewed on Figure 8-1 in Volume 2A.

Table 8-6: Designated Statutory and Non-Statutory Sites located within the Ollerton Roundabout Study Area

Name	Status	Location/ distance from the Scheme assessment boundary	Interest
Sherwood Forest Area	Possible Potential Special Protected Area (ppSPA)[3]	Within Scheme assessment boundary	Nightjar and woodlark
Birklands West and Ollerton Corner	SSSI	Within Scheme assessment boundary	Botanical, invertebrate, herpetofauna
Birklands and Bilhaugh	SAC	1.1 km to the north-west (a second area of this site is located 2.2 km to the west)	Ancient oak woodland
	SSSI	500 m to the north-west	
	LWS	Within Scheme assessment boundary	
Ollerton Colliery	LWS	800 m to the south-east	Birds, botanical and invertebrate
Sherwood Heath	LNR	Within Scheme assessment boundary	Botanical (heathland), invertebrate, herpetofauna
	LWS	Within Scheme assessment boundary	
Cockglode and Rotary Wood	LNR	600 m to the west	Woodland, colliery spoil tip
Broughton Railway Banks	LWS	1.8 km to the east	Notable sections of habitat along railway embankments

[3] ppSPA - a site that may be added to the list of candidate sites, with regards to designation as an SPA.

Willow Dam and Grassland	LWS	1.9 km to the east	A mosaic of scrub and damp, species-rich grassland with notable species around a fishing pond

8.5.2 A number of the designated sites listed in Table 8-6 overlap in their extents.

8.5.3 Sherwood Forest Area ppSPA: a part of the ppSPA is located within the Birklands West and Ollerton Corner SSSI which is located within the Scheme assessment boundary. The ppSPA may be considered for designation due to populations of nightjar *Caprimulgus europaeus* and woodlark *Lullula arborea* presence.

8.5.4 Birklands West and Ollerton Corner SSSI: a part of the SSSI is located within the Scheme assessment boundary. The SSSI is described by Natural England (Natural England, n.d.) as ‘a remnant of the historic Sherwood Forest which supports an outstanding invertebrate fauna associated with old trees characteristic of open oak-birch woodland in Nottinghamshire together with notable tracts of lowland acid grassland and heath’. Between the A616 and A614 highways, the SSSI is characterised by oak-birch woodland that is in close proximity to the road, ‘scrubby’, relatively immature and open. Sherwood Heath is located between the A616 and A6075 highways. The heath is a typical example of a Sherwood Forest heathland with a mosaic of habitat types.

8.5.5 Birklands and Bilhaugh SAC: The SAC is part of the larger Birklands and Bilhaugh SSSI. Birklands and Bilhaugh SAC is the most northerly site selected for old acidophilous oak woods and is notable for its rich invertebrate fauna, particularly spiders, and for a diverse fungal assemblage, including *Grifoa suphurea* and *Fistulina hepatica* (JNCC, n.d.). Although there is continuous woodland habitat between the Scheme and the boundary of the SAC (at its nearest point), the woodland is not the characteristic old acidophilous oak wood (there are no veteran trees), for which the SAC is designated. Although there is oak-birch woodland in the vicinity of the roundabout, the woodland immediately adjacent is ‘scrubby’ and relatively immature, suggesting past disturbance. As such the characteristic invertebrate and fungal assemblages of the SAC are very likely to be geographically separated from the development site.

8.5.6 Sherwood Heath LWS and LNR: The boundaries of the LWS and LNR concur with the boundaries of the Ollerton Corner component of the Birklands West and Ollerton Corner SSSI which lies partially within the Scheme assessment boundary. The site is designated as an LWS because of its heathland and faunal interest. Its close proximity to Ollerton has contributed to its designation as an LNR.

8.5.7 Birklands & Bilhaugh LWS: the considerations regarding nightjar and woodlark habitat described for the Birkland West and Ollerton Corner SSSI also apply to the LWS.

8.5.8 Cockglode and Rotary Wood LNR, Ollerton Colliery LWS Broughton Railway Banks LWS and Willow Dam and Grassland LWS are geographically separated from the site and an adverse impact is not anticipated from the Scheme.

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

8.5.10 The MAGIC website identified the presence of Ancient Woodland within 1 km of the Scheme at the western end of Sherwood Heath. The woodland is part of the Birklands West and Ollerton Corner SSSI and is a type of oak-birch woodland that

is typical of the Sherwood Forest area.

8.5.11 No veteran or ancient trees/ woodland were noted within 60 m of the Scheme assessment boundary.

Habitats

8.5.12 The following habitats were recorded within and up to 50 m from the assessment boundary during the extended Phase 1 Habitat Survey undertaken on the 20th February 2019 by Baker Consultants Ltd and reported in the Ecological Appraisal (Baker Consultants Ltd, 2020a) found in Appendix 4-5 of Volume 3.

Amenity grassland

8.5.13 Short amenity-managed grassland, 'weedy' and heavily disturbed with significant bare patches. Perennial rye-grass, annual meadow-grass *Poa annua,* Yorkshire fog and daisy *Belis perennis.*

Poor semi-improved grassland

8.5.14 Horse-grazed, 'tussocky', species-poor sward with perennial rye-grass, cock's-foot, false-oat-grass, common ragwort, cow parsley *Anthriscus sylvestris,* germander speedwell *Veronica chamaedrys,* dove's-foot crane's-bill *Geranium mole* and common sorrel *Rumex acestosa.*

Unimproved neutral grassland

8.5.15 Species-poor, 'weedy', with a combination of coarse grasses such as cock's-foot and Yorkshire fog and more fine-leaved grasses such as red fescue.

Acid grassland

8.5.16 Extensive stretch of short acid grassland on the north side of Sherwood Heath SSSI.

Dry heath

8.5.17 Part of Sherwood Heath LNR.

Continuous bracken

8.5.18 Stands of bracken associated with Birklands West and Ollerton Corner SSSI.

Broadleaved woodland

8.5.19 Semi-natural oak-birch woodland with hawthorn and bramble shrub layer and bracken field layer. Young bluebell *Hyancinthoies non-scripta* and snowdrop present.

Plantation woodland

8.5.20 Stands of immature high forest of pedunculate oak, silver birch and rowan. Located in the grounds of the Public House.

Scattered broadleaved woodland

8.5.21 Scattered silver birch trees within the dry heath habitat.

Intact species-poor hedgerow

8.5.22 Five species-poor intact hedgerows were recorded during the Phase 1 habitat survey. All hedgerows are dominated with hawthorn and are heavily managed.

Species-poor hedgerow with trees

8.5.23 One species-poor hedgerow with trees is located along the roadside. It is 1.75 m high, trimmed; hawthorn, pedunculate oak, elder and dog rose are present.

Protected and Notable Species

8.5.24 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 Scheme 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 located within the Ollerton Roundabout Study Area

Species	Baseline Detail
Bats	Desk Study: The desk study returned 42 records of at least seven species of bats, including common and soprano pipistrelles *Pipistrellus sp.*, Leisler's bat *Nyctalus leisleri*, noctule *Nyctalus noctula*, brown long-eared *Plecotus auritus*, natterer's bat *Myotis nattereri* and Daubenton's bat *Myotis daubentonii*. One of the desk study records was a confirmed roost, located 0.85 km from the Scheme assessment boundary in Ollerton. Field Study: None of the trees within the site were of sufficient size/age to provide roosting opportunities. None of the buildings, including retail and food outlets and private dwellings, were checked for bats as they were outside of the Scheme red line boundary at the initial design stage. However, due to the development of the lighting Scheme, it is considered that the impact may extend beyond the assessment boundary. A further daytime Preliminary Roost Assessment was undertaken at 'Forest Side' as under initial lighting design proposals it was likely to be subject to an increase in lighting level above 1 lux. The survey assessed the building as having 'moderate' suitability for roosting bats, with a possible bat roost located within the roof space above the additional extension on the building. Droppings were found here and will be subject to DNA analysis to determine the species. No other buildings will be subject to an increase in lighting level and therefore have not been subject to further survey effort. The woodlands, hedgerows and heathland habitats provide potential dispersal and foraging habitat for bats, including the species returned by the desk study.
Badger	Desk Study: The desk study returned two records of badger *Meles meles* with the search area. A sett is present approximately 1km from the Scheme and a roadkill was observed on the A614. Field Study: No signs of badger were located during the Phase 1 Habitat Survey, but the woodlands, hedgerows, semi-improved grassland and heathland provide potential habitat for badger. No signs of badger were recorded during the additional field survey undertaken by Via in 2021.
Other Mammals	Desk Study: The desk study returned records of hedgehog *Erinaceus europaeus* within the study area, the nearest being 200 m from Ollerton Roundabout. Field Study: Habitats including hedgerows, heathland, woodland and gardens are all suitable for hedgehogs, although the mown roadside verges are less suitable, because of a lack of cover and foraging opportunities.
Amphibians	Desk Study: The desk study returned records for common toad *Bufo bufo* and a common frog *Rana temporaria*. All records were over 500 m from the Scheme. No records for GCN were returned within the desk study.

Species	Baseline Detail
	Field Study: The woodland, heathland, hedgerow and garden habitats provide suitable terrestrial habitat for amphibians. However, a lack of standing water within 500 m of the site is likely to significantly reduce the suitability of the habitat and protected amphibians at this site are not anticipated.
Reptiles	Desk Study: The desk study returned nine records of common lizard *Zootoca vivipara* associated with Sherwood Heath which is located partially within the Scheme assessment boundary. Field Study: The habitats on the heathland, open areas of woodland, unmown grass verges and section of unmanaged hedgerow provide suitable opportunities and refugia for common lizard. Targeted surveys within and up to 50 m from the Scheme assessment boundary were undertaken during April 2019 and April/May 2021 and have reported the presence of common lizard. The peak count for common lizard during the 2019 survey effort and 2021 survey effort was 1.
Birds	Desk Study: Records for birds were obtained from NBGRC in 2021. Multiple records for a range of bird species were returned. The data can be found in Appendix 8-1 in Volume 3A. One record for nightjar was returned within the desk study data, located 1.3 km away from the Scheme boundary. Four records for woodland were returned within the desk study data, the closest record being 600 m from the Scheme boundary. Field Study: During the Phase 1 Habitat Survey undertaken in 2019 and updated in 2020, incidental records of birds included a Blue tit *Cyanistes caeruleus*, great tit *Parus major*, goldfinch *Carduelis carduelis*, robin *Erithacus rubecula*, black bird *Turdus merula*, long-tailed tit *Aegithalos caudatus*, carrion crow *Corvus corone* and black-headed gull *Chroicocephalus ridibundus* were recorded. The dry heath within the Scheme assessment boundary provides suitable nesting habitat for nightjar. The habitats within the Scheme assessment boundary provide limited suitability for nesting skylark however, the scattered trees and woodland edges may provide suitable habitat for bird song and roosting for both species. Habitats within the Scheme assessment boundary provide potential nesting and/ or foraging habitat for a range of common bird species.
Invasive, non-native plant species	Desk Study: The desk study returned records of Himalayan Balsam *Impatiens glandulifera* in the vicinity of Ollerton, for the most part associated with watercourses. Field Study: No non-native invasive plant species were identified within the Scheme assessment boundary during the Phase 1 Habitat Survey.
Invertebrates	Desk Study: The desk study returned 22 butterfly records and 14 moth records. This included four butterfly species and 14 moth species, all recorded on Sherwood Heath. Small heath butterfly *Coenonympha pamphilus* is a Species of Principal Importance, but only for research and monitoring. Two of the moth species are Grade 2[4] species

[4] Grade 2: Includes all Nationally Notable Group B species recorded from more than five 10Km squares in Nottinghamshire since 1990, together with all Nationally Local species recorded from five or fewer 10km squares in Nottinghamshire since 1990.

Species	Baseline Detail
	in Nottinghamshire and the remaining 12 species are Grade 3[5] species in Nottinghamshire. Field Study: No records were observed during the field survey, but the timing was sub-optimal for this.

Importance of Ecological Features

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

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

[5] Grade 3: Includes all Nationally Local species recorded from more than five 10km squares in Nottinghamshire since 1990, together with all Nationally Common species recorded from five or fewer 10km squares in Nottinghamshire since 1990

Table 8-8: Importance of Ecological Features

Statutory designated site / non-statutory designated site/ habitat/ species	Ecological Feature	Rationale	Importance
Statutory and Non-Statutory Designated Sites			
Statutory designated site	Birklands and Bilhaugh SAC	SACs are protected areas internationally / in Europe which are legally protected	International or European
	Birklands West and Ollerton Corner SSSI	SSSI denoting a protected area in the UK which is legally protected	UK or National
	Sherwood Heath LNR	Nature reserve designated by Nottinghamshire and/ or the local authority	County
	Sherwood Forest Area ppSPA	ppSPA, if the area were to be formally proposed as a pSPA, plans and projects would have to be subject, by law, to the provisions under the Conservation of Habitats and Species Regulations 2017 (as amended) that apply to assessment of impacts on all European sites. A 'risk-based approach' has been undertaken, as advise by Natural England, in relation to the ppSPA.	Up to International or European if designated as a SPA.
Non-statutory designated site	Birklands and Bilhaugh LWS	LWS designated in Nottinghamshire	County
	Sherwood Heath LWS	LWS designated in Nottinghamshire	County
Habitats			
Grassland	Unimproved neutral grassland	Nottinghamshire Local Biodiversity Action Plan (LBAP) habitat	County
	Amenity grassland	No notable or protected habitat. Common habitats found within the local area, of limited ecological interest.	Local

Statutory designated site / non-statutory designated site/ habitat/ species	Ecological Feature	Rationale	Importance
Woodland and scrub	Plantation woodland (broadleaved)	This habitat may be of value to local wildlife including nesting birds and bats.	Local
	Broadleaved woodland	This habitat may be of value to local wildlife including nesting birds and bats.	Local
Tall herb and fern	Continuous bracken	No notable or protected habitat. Common habitats found within the local area, of limited ecological interest.	Local
Cultivated / disturbed land	Arable Land	Nottinghamshire LBAP habitat Common habitat found within the surrounding area, of limited / negligible ecological interest.	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
Legally Protect and Notable Species			
Bats	Roosting bats	Seven species of bat are Species of 'Principal Importance' in England. Five species of bat are included within the Nottinghamshire LBAP. Forest Side provides moderate suitability for roosting bats – species to be confirmed.	Up to Regional

Statutory designated site / non-statutory designated site/ habitat/ species	Ecological Feature	Rationale	Importance
	Foraging and commuting bats	Five species of bat including within Nottinghamshire LBAP Suitable foraging and commuting habitat noted within the Scheme assessment boundary	Up to County
Birds	Scheme within potential ppSPA boundary noted for Woodlark and Nightjar	Some suitable foraging habitat for both species within Scheme red line boundary Woodlark Schedule 1, and LBAP species. Woodlark are also a Species of 'Principal Importance' in England. Nightjar LBAP species	Woodlark – County Authority Nightjar – Local
	Suitable nesting habitat for a range of other bird species	49 species of bird are Species of 'Principal Importance' in England 88 species of birds included within Nottinghamshire LBAP Presence of suitable habitat within Scheme red line boundary	Up to County
Hedgehogs	Suitable habitat for hedgehog within the Scheme assessment boundary	Hedgehogs are a Species of 'Principal Importance' in England Hedgehog are a LBAP species within Nottinghamshire	County
Common Lizard	Common lizard population noted within Scheme assessment boundary	Protected by the Wildlife and Countryside Act 1981 (as amended) Common lizard is an LBAP species within Nottinghamshire Common lizard are a Species of 'Principal Importance' in England.	County

Future Baseline

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

8.6 Design, Mitigation and Enhancement Measures

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

Scheme Design

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

Designated Sites

8.6.3 The small area of temporary and permanent loss of Birklands West and Ollerton Corner SSSI habitat will be mitigated for by a mix of landscape design measures, including an informal hedgerow with trees and band of acid grass planting up to the highway boundary. These mitigation measures have been included within the BNG Assessment (see Appendix 4-2 of Volume 3) calculations to ensure these measures will be enough to mitigate the loss of SSSI.

8.6.4 The temporary areas of lost habitat within Birklands and Bilhaugh LWS will be reinstated, where possible, post-development which will include planting new trees and creating areas of species-rich grassland within the existing LWS boundary.

8.6.5 The Sherwood Heath LWS overlaps within the boundary of both the Birklands West and Ollerton Corner SSSI and Birklands and Bilhaugh LWS therefore mitigation measures associated with both these sites are also considered to provide mitigation for the LWS.

Habitats

8.6.6 The following mitigation measures would be put in place to reduce the effects of potential significance during the construction phase on ecological habitats:

- **Replacement of species-poor hedgerow/ species-poor hedgerow with trees**: the loss of hedgerow will be replaced, where possible and further enhanced with a species-rich hedgerow with trees, incorporating common hazel *Corylus avellana*, hawthorn *Crataegus monogyna*, dogwood *Corns sanguinea*, holly *Ilex aquifolium*, privet *Ligustrum vulgare*, blackthorn *Prunus spinosa* and dogrose *Rosa canina*. All species chosen are in keeping with the character assessment of the area.
- **Loss of grassland verges**: the loss of grassland verges will be reinstated, where possible and replaced with areas of species-rich grassland, acid grassland or amenity grassland where applicable. All types of grassland will be sensitively managed to allow for the grassland to be of at least moderate value, with only the visibility splays to be managed to a shortly mown sward.
- **Loss of scattered trees**: Replacement tree planting with associated native shrub understory will mitigate the loss of scattered trees during the construction phase of the Scheme. Proposed tree species include field maple *Acer*

campestre, silver birch *Betula pundula,* downy birch *Betula pubecens,* wild cherry *Prunus avium,* scots pine *Pinus sylvestris,* sessile oak *Quercus petraea,* English oak *Quercus robur* and rowan *Sorbus aucuparia.* All species chosen are in keeping with the local character assessment.

- **Loss of grassland within roundabout island**: the loss of grassland within the roundabout verge will be reinstated within the new roundabout and further enhanced with tree planting, species detailed above and within the landscape design. The proposed grassland is an acid mix to be managed to allow flowering, with only viability splays and path edges to be mown to a short sward.
- Further detail can be found within the landscape proposals on Appendix 2-2 of Volume 3A.

Species

- **Birds:** To mitigate the unavoidable loss of habitat value to foraging and nesting birds across the Scheme, trees, hedgerows and suitable heathland, in keeping with the character assessment of the area, will be planted as part of the landscape design.
- **Bats (roosting):** The Scheme lighting has been adapted throughout the design stage to ensure lighting impacts to roosting bats has been avoided. The proposed lighting scheme along the A614 north approach road has been modified to include 8.0 m lighting columns and warm white LED luminaires with rear shield to reduce the lighting spill at Forest Side and to use a more ‘bat friendly’ light spectrum. Additionally, the lighting scheme will be dimmed by 50% from 10:00pm to 7:00am.
- **Bats (foraging and commuting):** The Scheme lighting has been designed to minimise impacts to foraging and commuting bats. This includes the use of LEDs in ‘warm white’ to ensure more directional and controlled light source. In addition, the LED lanterns will have rear shielding, to reduce the amount of light spill into areas of suitable bat habitat. The lighting Scheme will also be dimmed by 50% from 10:00pm to 7:00am.
- **Common Lizard:** The provision of natural refugia / habitat piles within retained and newly created habitat area. The provision of refugia will 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

8.6.7 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.

Statutory Designated, Non-Statutory Designated Sites and Habitats

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

- **Pollution prevention control measures:** Water pollution prevention control measures and standard best practice measures to control construction dust, noise and lighting would be implemented during the construction phase via the

CEMP (refer to Chapter 5: Air Quality; Chapter 10: Noise and Vibration; Chapter 11: Road Drainage and the Water Environment).

Species

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

- **Bats (roosting, foraging and commuting):** Measures would be implemented during the construction phase to minimise impacts on foraging and commuting bats – this includes keeping lighting to a minimum by limited night-time working, where possible, and reducing lighting within habitat of value to bats. Any lighting used would be directional and positioned sympathetically to minimise light spill.
- **Badger:** Badgers are currently absent for the Scheme and immediate surrounding area. Dependant on the construction start date, pre-construction badger surveys may be required in order to determine whether baseline conditions remain as detailed in Section 8.5. If badger setts were found, then appropriate mitigation and a Natural England licence if required would be applied for accordingly.
- **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 Ecological Clerk of Works (ECoW) to determine whether there are any active nests.
- **Hedgehogs:** The removal of dense vegetation will be carried out under the supervision of the ECoW. Suitable habitat will be identified in advance of any clearance works in the local area to release any captured hedgehogs. If clearance work is carried out during winter months, provision will be made for captured hedgehogs to be overwintered in captivity.
- **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 passive displacement methodology, where suitable lizard habitat adjacent to the Scheme will be further enhanced by the creation of hibernacula, the Scheme working area will then be cleared in the reptile active season, under the supervision of ECoW to displace the lizards from this area. The area will then be maintained as sub-optimal reptile habitat until works are completed.
- **ECoW:** ECoW will be required for nesting birds (if clearance works are undertaken during the breeding bird season), clearance of suitable common lizard habitat and clearance of suitable hedgehog habitat.

Essential Mitigation - Operation

Statutory Designated, Non-Statutory Designated Sites and Habitats

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

8.6.11 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.

8.6.12 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.

8.6.13 Both the habitat creation/ enhancement within the highway boundary, and as part of the scheme design and BNG requirements will be funded by NCC.

Enhancements

8.6.14 As detailed within the Scheme design, the landscape design has incorporated enhancements to ensure net gain is achieved, where possible, within the Scheme 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; and
- additional scattered trees with species in line with the character assessment of the area.

8.6.15 Further detail can be found within the landscape proposals – see Appendix 2-2 of Volume 3A.

8.6.16 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

8.6.17 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 Construction of the Ollerton Roundabout Scheme would have a direct impact, through habitat loss from the following designated sites:

- Birklands West and Ollerton Corner SSSI;
- Sherwood Forest Area ppSPA;
- Birklands and Bilhaugh LWS; and

- Sherwood Heath LWS/LNR.

8.7.4 Construction of the Scheme will result in the direct loss of 0.058 ha of the Birklands West and Ollerton Corner SSSI. Embedded mitigation measures have been incorporated into the landscape design as detailed within Section 8.6 above. BNG calculations have been undertaken to ensure the mitigation measures detailed offset the habitat loss within the SSSI. The calculations determine that the embedded mitigation measures incorporated into the landscape design for Ollerton as a stand-alone Scheme results in the following net gains:

- 10.89% habitat units; and
- 120.10% hedgerow units.

8.7.5 Therefore, in the long-term it is considered that once the proposed habitats have established, the Scheme would result in a minor beneficial impact on a receptor of UK or national value, resulting in a slight beneficial (not significant) effect.

8.7.6 As it will take up to 20 years for the habitats to reach their desired condition, it is considered that in the short-term there will be a minor adverse impact on a receptor of UK or national value, resulting in a slight adverse (not significant) effect.

8.7.7 Construction of the Scheme will result in the direct loss of 0.158 ha of Sherwood Heath LWS/LNR. Embedded mitigation, as detailed in Section 8.6 has been proposed as part of the landscape design. This includes the reinstatement of trees and species rich grassland post-development. There will be permanent loss of this habitat due to the realignment of the highway boundary. However, it is considered that the proposed mitigation within the LWS/LNR boundary, the enhancement of the habitats currently present, and the small area of permanent loss, that in the long-term, the Scheme would have a minor beneficial impact on a receptor of County value resulting in a slight beneficial (not significant) effect. However, as it will take time for the proposed habitat to mature and reach their condition, it is considered that in the short-term there will be a moderate adverse impact on a receptor of County value, resulting in a slight adverse (not significant) effect.

8.7.8 The boundary of both the SSSI and the LNR overlap completely with the LWS boundary thus, the mitigation measures detailed in Section 8.6 are appropriate for the LWS. It is therefore considered that with the relevant mitigation measures / enhancements and the small area of permanent loss, that in the long-term the Scheme would have a minor beneficial impact on a receptor of local value, resulting in a slight beneficial (not significant) effect. As it will take time for the proposed mitigation habitat to mature and reach their desired condition, 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.

8.7.9 The Scheme will result in the loss of approximately 0.1 ha of the ppSPA. The ppSPA is noted for its breeding bird (nightjar and woodlark) interest. The habitats within and immediately beyond the ppSPA boundary are considered to be sub-optimal due to the levels of disturbance. Whilst the mosaic of habitats could provide foraging opportunities, it is considered that there are better quality habitats such as acid grassland, open woodland, dry heath and bare ground located away from the roundabout where current disturbance levels are much lower. Therefore, it is considered that due to the small fraction of ppSPA to be lost, and the sub-optimal habitats lost suitable for the target species, it is anticipated that the Scheme would result in a negligible impact on a receptor of international or European value, resulting in a slight adverse (not significant) effect.

8.7.10 All other statutory and non-statutory designated sites noted within the baseline conditions, refer to Section 8.5, are considered to be separated from the Scheme by

roads, arable fields and urban development, therefore a significant impact is not anticipated.

Indirect effects – dust and air emissions

8.7.11 The potential dust effects have been identified as 'high' for receptors within 50 m of the Scheme, according to the air quality assessment. As Sherwood Forest Area (ppSPA) Birklands West and Ollerton Corner (SSSI), Birklands and Bilhaugh (LWS) and Sherwood Heath (LNR, LWS) are all within the assessment boundary and fall within this 'high' category. Therefore, 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.

Habitats

Direct effects – habitat loss from vegetation clearance

8.7.12 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 Scheme 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)	Importance	New habitat	Habitat gains (ha)	Net permanent gains
Amenity grassland	0.26 ha	Local	Amenity grassland	0.058 ha	-0.202 ha
Broadleaved woodland	0.07 ha	Local	Broadleaved woodland	0.07 ha	+0.012 ha
			Mixed scrub	0.012 ha	
Unimproved / semi-improved neutral grassland	0.20 ha	Up to County	Acid grassland	0.132 ha	-0.027 ha
			Mixed scrub	0.041 ha	
Continuous bracken	0.07 ha	Local	Not replaced	0.0 ha	-0.07 ha
Arable land	0.02 ha	County	Not replaced	0.0 ha	-0.02 ha
Species-poor hedgerow	190 m	Local	Native species-rich hedgerow	76 m	-114 m
Species-poor hedgerow with trees	100 m	Local	Native species-rich hedgerow with trees	135 m	+35 m

Amenity grassland

8.7.13 A total of 0.26 ha of amenity grassland will be lost as part of the construction of the Scheme. 0.058 ha of the amenity grassland will be reinstated post construction, resulting in a permanent loss of 0.202 ha. The amenity grassland within the Scheme boundary is considered to lack ecological value due to the small areas to be lost and lack of species diversity present within the habitat. Therefore, the loss of this habitat will result in a negligible impact on a receptor of local value, resulting in a neutral effect (not significant).

Broadleaved woodland

8.7.14 The construction of the Scheme will result in the loss of 0.07 ha of broadleaved woodland. The landscape proposals include replacing 0.07 ha of woodland and additional 0.12 ha of mixed scrub to mitigate the loss of woodland. The proposed species include oak *Wuercue robur*, silver birch *Betula pendula*, goat willow *Salic caprea* and alder *alnus sp.* All species are suitable and in keeping with the local character assessment. It is considered that in the long-term, the construction of the Scheme will result in a minor beneficial impact on a receptor of local value, resulting in a neutral effect (not significant).

8.7.15 It will take up to approximately 15 years for the proposed habitats to mature and reach their desired condition, 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).

Unimproved / semi-improved neutral grassland

8.7.16 Approximately 0.2 ha of neutral grassland will be lost as part of construction of the Scheme. However, most of the grassland is 'weedy' with common species indicative of disturbance rather than sustained grassland management. Following completion of the construction works, the site would be subject to the creation of 0.132 ha of acid grassland and 0.041 ha of mixed scrub to mitigation the loss of habitat, resulting in a permanent loss of 0.025 ha of neutral grassland. However, an additional 0.078 ha of retained grassland on site will be enhanced from neutral grassland to acid grassland. It is considered, that in the long-term, the Scheme will result in a minor beneficial impact on a receptor of up to County value, resulting in slight beneficial effect (not significant).

8.7.17 It will take approx. 15 years for the habitat to establish to the desired maturity and condition. Therefore, it is considered that in the short-term, the loss of this vegetation during construction will result in a minor adverse impact on a receptor of up to County value, resulting in a slight adverse (not significant) effect.

Continuous bracken

8.7.18 Approximately 0.07 ha of continuous bracken will be lost as part of the proposed works. Due to the small section of habitat to be removed, it is considered that this will cause a negligible impact on a receptor of local value, resulting in a neutral effect (not significant).

Arable land

8.7.19 An area of approximately 0.02 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 their low ecological interest and lack of notable species in associated with this habitat. Therefore, it is considered that the loss of this habitat type would constitute a minor adverse impact on a receptor of County value, resulting in a slight adverse effect (not significant).

Species-poor hedgerow

8.7.20 Approximately 190 m of species-poor hedgerow will be lost as part of the Scheme. The landscape design includes approximately 76 m of species-rich hedgerow to be planted to compensate for the loss of this habitat, resulting in a permanent loss of 114 m of species poor hedgerow. Additionally, 274 m of retained species-poor hedgerow will be enhanced incorporating at least 5 woody species per 30 m. Proposed species include common hazel *Corylus avellana*, hawthorn *Crataegus*

monogyna, dogwood *Corns sanguinea*, holly *Ilex aquifolium*, privet *Ligustrum vulgare*, blackthorn *Prunus spinosa* and dogrose *Rosa canina*. It is considered that, once established, this would constitute a minor beneficial impact on a receptor of local value, resulting in a neutral effect (not significant).

8.7.21 It will take approximately 12 years for the habitat to establish to the desired maturity and condition. Therefore, due to the habitat loss during the construction of the Scheme, it is considered that in the short-term this will result in a moderate adverse impact on a receptor of local value, resulting in a slight adverse effect (not significant).

Species-poor hedgerow with trees

8.7.22 Approximately 100 m of species-poor hedgerow with trees will be lost as part of the Scheme. The landscape design includes approximately 135 m of species-rich hedgerow with trees to be planted to compensate for the loss of this habitat. Each new hedgerow planted will be species rich comprising of common hazel *Corylus* avellana, hawthorn Crataegus monogyna, dogwood Corns sanguinea, holly Ilex aquifolium, privet Ligustrum vulgare, blackthorn Prunus spinosa and dogrose Rosa canina. It is considered that, once established, this would constitute a minor beneficial impact on a receptor of local value, resulting in a neutral effect (not significant).

8.7.23 It will take approximately 20 years for the habitat to establish to the desired maturity and condition. Therefore, due to the habitat loss during the construction of the Scheme, it is considered that in the short-term this will result in a moderate adverse impact on a receptor of local value, resulting in a slight adverse effect (not significant).

Species

Bats

8.7.24 The potential impacts of construction upon bats relate to habitat loss for foraging and commuting and disturbance (from noise and artificial light). No roosts will be removed.

Direct effect – habitat loss

8.7.25 Construction of the Scheme will not result in the direct loss of any known bat roosts. The trees subject to removal within the assessment boundary were surveyed for bat roost suitability during the initial Phase 1 habitat survey and it was considered that none of the trees within the assessment boundary were of sufficient size to provide roosting opportunities. Therefore, it is considered that the loss of habitat for roosting bats would have a negligible impact on a receptor of up to County value, resulting in a neutral effect (not significant).

8.7.26 Construction of the Scheme will result in the loss of habitat that may be utilised by foraging and / or commuting bats, including scattered trees and hedgerows. Upon completion of the works, new hedgerows will be created and re-aligned with the existing hedgerows and additional trees will be planted. As such, the loss of suitable habitat will be temporary and largely replaced and further enhanced post construction. Additionally, all suitable habitats lost are subject to artificial lighting during the night and therefore is considered to be of low quality for some species of bat. Therefore, it is considered that the direct loss of suitable foraging and commuting habitat as part of the construction of the Scheme would have a negligible impact on a receptor of up to County value, resulting in a neutral effect (not significant).

Indirect effects – lighting and noise impacts

8.7.27 As detailed in Section 8.6, best practice construction measures would be implemented during the construction phase to minimise disturbance to bats through minimising night-time working and avoiding any direct illumination of habitats of value to bats. The construction of the Scheme is limited to the extent of the roundabout, therefore it is considered highly unlikely that the construction of the Scheme will result in any suitable roosting structures being lit beyond their current levels. With the implementation of such measures, it is considered that there would be a negligible impact on a receptor of up to Regional value, resulting in a neutral effect (not significant).

8.7.28 In terms of roosting, there is no direct evidence that noise can affect a bats ability to roost and indeed roosts have been recorded in road bridges and industrial buildings subject to high noise levels. In the case of the Scheme, Forest Side has been assessed as having 'moderate' potential for roosting bats, with unconfirmed dropping being noted within part of the building. 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 levels during the construction phase and such measures would be detailed within the CEMP. It is considered that as the construction of the Scheme would result in temporary fluctuation in noise, which will be managed via the CEMP such that the impacts would be negligible impact on a receptor of up to regional value, resulting in a neutral effect (not significant).

Birds

Direct effects – loss of habitat for woodlark and nightjar

8.7.29 The habitats lost as part of the construction of the Scheme are considered to be sub-optimal for woodlark and nightjar due to the high levels of disturbance. Whilst the mosaic of habitats could provide foraging opportunities, it is considered that there are better quality habitats such as acid grassland, open woodland, dry heath and bare ground located away from the roundabout where current disturbance levels are much lower. Therefore, it is anticipated that the Scheme would result in a negligible impact on a receptor of up to County value, resulting in a neutral effect (not significant).

Direct effects – loss of habitat for other common bird species

8.7.30 Suitable nesting habitat is available for common bird species across the Scheme boundary. Without mitigation, there is the potential for direct mortality of nesting/ breeding birds through clearance of suitable vegetation. 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 local value, resulting in a neutral effect (not significant).

Indirect effect –noise impacts (applicable to all species)

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

Hedgehogs

Direct effect – habitat loss

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

Indirect effect – construction activities

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

Common Lizard

Direct effects – habitat loss

8.7.34 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. Additionally, high value habitat is available adjacent to the Scheme, which will sustain the 'low' population within and around the Scheme boundary. Therefore, it is considered that the construction works would have a negligible impact on a receptor of County value, resulting in a neutral effect (not significant).

Indirect effects – noise impacts

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

Operation

Statutory Designated and Non-Statutory Designated Sites

8.7.36 Birklands West and Ollerton Corner SSSI, Sherwood Heath LNR and Birklands and Bilhaugh LWS are known for their invertebrates, open-birch woodland and lowland acid grassland and heath. The operational lighting Scheme has been designed to reduce light spill, where possible, to incorporate aspects of road safety but also minimise ecological impacts. The proposed lighting Scheme will increase levels of illumination beyond what is already present to a maximum width of 20 m from the road. It is considered that this small increase in lighting levels will not affect the features that the designated sites are known for, therefore it is considered that the operational lighting Scheme impact would have a negligible impact on a receptor of up to UK or national value, resulting in a neutral effect (not significant).

8.7.37 The ppSPA is noted for its breeding bird (nightjar and woodlark) interest. An increase in illumination has the potential to cause disruption to these species. The habitats suitable for both these species which will become illuminated under the proposed lighting Scheme include:

- a strip of gorse scrub flanked by amenity-managed grassland on the south side of the A616; and
- dense bracken on the north side of the A6075.

8.7.38 It is considered that as these habitats are located within 20 m of the road and are already sub-optimal for both species due to car headlights, vehicle noise, and disturbance from people. The additional illumination will not change the existing impacts discussed, because the presence of nightjar / woodlark in close proximity to the road is not anticipated. Therefore, the operational lighting of the Scheme would result in a negligible impact on a receptor of up to International or European value, resulting in a slight adverse effect (not significant).

8.7.39 The noted features of the SSSI, LNR and LWS are not sensitive to the impacts of noise, therefore the operational noise as a result of the Scheme would result in no change on a receptor of up to UK or national importance, resulting in a neutral effect (not significant)

8.7.40 As discussed, the ppSPA is noted for its breeding bird (nightjar and woodlark) interest. Noise can have an adverse impact on avian behaviour and physiology, (Marler et al. (1973), Zollinger et al. (2019)). Ortega (2012) reviewed research away from laboratory conditions and suggested that physical damage to the ears, stress responses, flight or flushing responses occur in wild populations along with avoidance of noisy areas, changes in reproductive success and changes in vocal communication. Noise modelling data, and the contour plans, detailed in Figure 8-3 and 8-4 in Volume 2A, determine that there is an 0.6 dB increase in noise during the daytime, up to 25 m from the assessment boundary in comparison to the baseline, with either no change, or a 0.1 dB decrease in noise between 25 m - 600 m from the Scheme boundary. It is considered that habitats within 20 m of the site are sub-optimal for woodlark / nightjar due to the high level of disturbance from car headlights, vehicle noise and disturbance from people. Therefore, the presence of nightjar / woodlark within this area is not anticipated. Therefore, the operational noise levels will result in a negligible impact on a receptor of up to International or European value, resulting in a slight adverse effect (not significant).

8.7.41 The methodology for determining the appropriate level of air quality assessment has been carried out following DMRB LA 105 and further supplementary information provided within Natural England (2016); refer to Chapter 5: Air Quality for further details regarding methodology.

8.7.42 In assessing the sensitivity of the affected SSSI, it is appropriate to refer to APIS guidance for sensitive supporting habitat and features of interest for the Birklands West and Ollerton Corner SSSI. The site feature of interest is Dwarf Shrub Heath. Table 8-10 presents the APIS critical load data for nitrogen deposition.

Table 8-10: APIS Data for Nitrogen Deposition

Site Name & Designation	Site Interest Feature Sensitivities	Nitrogen Deposition (kg N/ha/yr)
Birklands West and Ollerton Corner SSSI	Dwarf shrub heath (*Calluna vulgaris – Deschampsia flexuosa* heath – sensitive	Max: 25.5 Min: 19.2 Average: 19.7

Source: (UK Centre for Ecology and Hydrology, 2021).

8.7.43 As per DMRB LA 105 guidelines, it is appropriate to refer to Natural England (2016) to determine the increase in nitrogen deposition required to reduce measured species richness by 1 at different background nitrogen deposition levels. It is assumed that the air quality attribute for the Birklands West and Ollerton Corner

SSSI has been set to restore, therefore the background nitrogen deposition has not been considered for this assessment. Table 8-11 presents the Natural England (2016) data required to reduce measured species richness by one.

Table 8-11: Natural England data for Required Increase in Nitrogen Deposition to Reduce Species Richness by 1

Site Name & Designation	Survey / Habitat	Habitat / species critical load kg N ha-1 yr-1	Increase in N deposition (in kg N ha-1 yr-1) required to reduce measured species richness by 1 at different background long-term N deposition levels					
			5 kg N	10 kg N	15 kg N	20 kg N	25 kg N	30 kg N
Birklands West and Ollerton Corner SSSI	Upland Heath	10-20	0.4 kg	0.8 kg	1.3kg	1.7kg	2.0 kg	2.4 kg

8.7.44 Air quality modelling (refer to Air Quality, Chapter 5, Table 5-8 for data) identified that land up to 60 m from the Ollerton Roundabout will be affected by changes in air quality due to the proposed re-location of the roundabout closer to the SSSI. The modelling has identified an anticipated change in nitrogen deposition between the Do Minimum(DM) and the Do Something (DS) of up to 1.3 kg N/ha/yr up to 60 m from the road.

8.7.45 It is recognised that small increases in nitrogen deposition can have an adverse impact on dwarf shrub heath habitat. However, the impact is limited to a distance of 60 m from the nearest road, beyond which the change in nitrogen deposition is 0.0 kg N/ha/yr. The habitat within 60 m of the road within the SSSI comprises a mix of unmanaged neutral grassland, amenity-managed grassland, plantation broadleaved woodland, continuous bracken, tall ruderal, bramble and gorse scrub. The nearest dwarf shrub heath habitat is at least 100 m from the road. The modelling suggests that nitrogen deposition rates for the SSSI will be 0.0 kg N/ha/yr at that distance from the road, therefore not exceeding the increase in nitrogen deposition required to result in a loss of 1 species. Therefore, it is considered that the operational nitrogen deposition will result in no change to a receptor of UK or national importance, resulting in a neutral effect (not significant).

8.7.46 The air quality data for the Sherwood Heath LNR was also obtained during the air quality modelling. The boundary of the Sherwood Heath LNR extends up to the current highway boundary. However, there is a Public House and associated car park abutting the highway boundary, therefore it is considered that potentially sensitive habitats are present 100 m from the roundabout, which is where the first receptor point for the Sherwood Heath LNR was located. At this distance from the Scheme, there is no change in nitrogen deposition from the Do Minimum and the DS. Therefore, it is considered that the operational nitrogen deposition will result in no change to a receptor of County value, resulting in a neutral effect (not significant).

8.7.47 The Birkland and Bilhaugh LWS boundary overlaps both the Birklands West and Ollerton Corner SSSI and Sherwood Heath LNR, therefore the effects concluded for both these sites are also applicable for the Birkland and Bilhaugh LWS.

8.7.48 All other statutory designated and non-statutory designated sites are outside the

ZoI for air quality and have therefore not been considered as part of this assessment.

Species

Bats

8.7.49 The potential operational impacts upon bats relate to direct mortality and increases in artificial light and noise levels.

Roosting

8.7.50 Forest Side was assessed as having 'moderate' potential for roosting bats, with unconfirmed droppings being present in one section of the building, indicating the presence of a possible roost. All other suitable roosting structures have been discounted due to negligible suitability to support the species, or they are not subject to an increase in lighting levels in comparison to the baseline, so therefore have been scoped out of the assessment. The lighting design has been adapted throughout the design stage to avoid impacts to roosting bats. The measures detail the embedded mitigation (see Section 8.6) are required to reduce the light spill to Forest Side. The incorporation of this mitigation ensures that the lighting does not excess 1 lux for both horizontal and vertical light spill. Therefore, the Scheme would result in the building being subject to an increase in lighting levels of up to 0.8 lux, with the lighting levels of the roof and soffit boxes being subject to a maximum increase of 0.6 lux. A clear full moon has a lux level of between 0.25 - <1 (ILP, BCT, 2018) As this lighting increase is less than 1 lux, which is similar to that of natural light sources, it is considered that the operational lighting scheme will have a slight adverse impact to a receptor of up to Regional value, resulting in a slight adverse effect (not significant).

8.7.51 Noise modelling data was obtained for both the daytime and night-time as detailed in Figures 8-3 and 8-4 in Volume 2, to determine the changes in noise levels during the operational phase. The receptor points were located every 25-100 m to the north and north-west of the assessment boundary as these habitats are considered high value habitats for noise-sensitive species, including roosting bats. The overall change in noise for any structures that may be utilised for roosting bats is expected to be limited to a 1dB increase. With the increase being less than 3 dB (which is perceived to have negligible effects on bats (Barber, Crooks, Fristrup, 2009)) it is considered the operational noise levels will constitute a negligible impact on a receptor of up to regional value, resulting in a neutral effect (not significant).

Commuting and foraging

8.7.52 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 (Highway England, 2020). Therefore, due to the approaches of the roundabout having a speed limited of 40 mph there is a requirement to light the road 89 m from the roundabout junction. This lighting extent is greater than the current lighting Scheme in place for Ollerton Roundabout, therefore the light levels extend further along the A614 – Blyth Road, A614 – Old Rufford Road, A6075 – Mansfield Road, and A616 – Worksop Road. The increase in lighting levels causes woodland, continuous bracken, grassland, scattered trees, dry heath and species poor hedgerow to be lit <1 lux as part of the Scheme. Refer to Figure 8-2 in Volume 2A for light contour plans. Although these habitats provide suitable foraging and / or commuting habitat for bats, it is considered that the areas of grassland, hedgerows and scattered trees are isolated stands, separated and surrounded by the existing road network which may act as a barrier for foraging bats, decreasing the accessible area and quality of these habitats (Altringham and Berthinussen, n.d.). Approximately 0.193 ha of woodland will be subject to an

increase in light level in comparison to the current baseline. It is considered that due to the small amount of area impacted by the lighting Scheme, and the surrounding extensive high value habitat to the north and north-west of the red line boundary that the increase in lighting levels will constitute a minor adverse impact on a receptor of up to County value, resulting in a slight adverse effect (not significant).

8.7.53 Noise modelling data was obtained for the Scheme both during the daytime and during the night-time to determine the changes in noise levels during the operational phase as shown in Figures 8-3 and 8-4 in Volume 2A. The receptor points were located every 25-100 m to the north and north-west of the Scheme boundaries as these habitats were considered high value for foraging and commuting bats. The noise data modelling determined for the night-time that up to 25 m from the red line boundary there would be an overall increase in 0.5 dB compared to the baseline conditions, all other receptor points had a slight decrease in noise levels by 0.1 dB. Studies have been undertaken regarding traffic noise and how it effects bats in the surrounding habitat. Finch, Schofield and Mathews (2020) conducted the first controlled field experiment to test the impacts of traffic noise of free-living bat assemblages. The results of the experiment concluded that the playback of traffic noise decreased overall bat activity. Therefore, it is considered that due to the presence of the road already in place, the surrounding habitat, at least 20 m from the highway boundary is determined as sub-optimal due to the current baseline traffic noise. Combined with the increase being less than 3 dB, which is perceived to have negligible effects (Barber, Crooks, Fristrup, 2009), it is considered the operational noise levels will constitute a negligible impact on a receptor of up to County value, resulting in a neutral effect (not significant).

Birds

8.7.54 The impact of operational noise and lighting regarding both nightjar and skylark are discussed above in relation to the Sherwood Forest Area ppSPA.

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

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

8.7.57 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.

8.7.58 As discussed above, the noise modelling determined that the majority of receptors have an overall negligible beneficial impact with the introduction of the Scheme, and a 0.5 dB increase is restricted to 25 m from the Scheme boundary. As the increase in overall noise levels does not exceed 3 dB, it is considered that the increase in noise level is negligible.

8.7.59 Therefore, it is considered that the Scheme operation would have a negligible impact on a receptor of up to County value, resulting in a neutral effect (not significant).

Hedgehogs

8.7.60 Britain’s hedgehog numbers are in severe decline, with a possible reason for this

being increased deaths caused by road collisions (Mammal Society, 2020). The speed at which a vehicle is travelling has the potential to impact the number of road traffic accidents. According to the road traffic data obtained for the Scheme, for the opening year (2023) and for 2037 there are limited changes in speed bands between the Do Minimum and the Do Something. Additionally, there is a decrease in the current speed limit on the approach to the roundabout from national speed limited to 40 mph. Therefore, it is considered that the introduction of the Scheme will constitute a minor beneficial impact on a receptor of County value, resulting in a slight beneficial (not significant) effect.

Common Lizard

8.7.1 Mitigation measures detailed in Section 8.6 include the creation of refugia / habitat piles within areas of retained common lizard habitats. This will be made up of rubble, logs and bricks to create suitable new habitat. The overall noise levels within suitable common lizard habitat areas during operation of the Scheme vary between 62.7 dB to 65.7 dB during the day. The existing habitat, where common lizard was noted to be present during the targeted species surveys, have a current overall baseline noise level of approximately 70 dB. Therefore, the noise levels during the operational phase are not considered to have an adverse impact as they will not exceed the current baseline levels where common lizard are present. 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 Dust monitoring adjacent to the Birklands West and Ollerton Corner SSSI will be undertaken during construction to ensure that management measures implemented through the CEMP are successful in reducing dust impacts on this receptor.

8.8.2 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, and in the long-term (once habitats have established) from neutral to slight. Therefore, no further additional mitigation measures have been identified.

Operation Phase

8.8.3 Natural England have raised concerns regarding forecasted trends in emission reduction being inaccurate and have requested a programme of monitoring to compare to the predictions made in the assessment for effects on Birklands West and Ollerton Corner SSSI. A programme of air quality monitoring (nitrogen dioxide) is therefore proposed adjacent to the roadside closest to the Birklands West and Ollerton Corner SSSI in the opening year.

8.8.4 No other 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 8-12.

Table 8-12: Residual Effects

Description of Effect	Sensitivity of Receptor	Nature of Effect/ Geographic Scale	Magnitude of Impact	Initial Classification of Effect (with embedded mitigation)	Additional Mitigation	Residual Effect Significance
Construction						
Loss of Birklands West and Ollerton Corner SSSI	UK or National	Loss of 0.058 ha of SSSI	Minor adverse	Slight adverse (not significant)	No additional mitigation required	Slight adverse (not significant)
Loss of Sherwood Forest Area ppSPA	Up to International or European if designated as a SPA	Loss of 0.1 ha of ppSPA	Negligible adverse	Slight adverse (not significant)	No additional mitigation required	Slight adverse (not significant)
Loss of Sherwood Heath LNR	County	Loss of 0.158 ha of LNR	Moderate adverse	Slight adverse (not significant)	No additional mitigation required	Slight adverse (not significant)
Loss of Birklands and Bilhaugh LWS	Local	Loss of 0.058 ha of LWS	Moderate adverse	Slight adverse (not significant)	No additional mitigation required	Slight adverse (not significant)
Loss of amenity grassland	Local	Permanent loss of 0.202 ha of grassland	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
Loss of broadleaved woodland	Local	Loss 0.07 ha of woodland, to be reinstated on a like-for-like basis and additional mixed scrub areas created	Moderate adverse	Slight adverse (not significant)	No additional mitigation required	Slight adverse (not significant)
Loss of neutral grassland	Up to County	Permanent loss of 0.025 ha of grassland	Minor adverse	Slight adverse (not significant)	No additional mitigation required	Slight adverse (not significant)
Loss of continuous bracken	Local	Loss of 0.07 ha of continuous bracken	Negligible adverse	Neutral effect (not significant)	No additional mitigation required	Neutral effect (not significant)
Loss of arable land	County	Permanent loss of 0.02 ha of arable land	Minor adverse	Slight adverse (not significant)	No additional mitigation required	Slight adverse (not significant)
Loss of species-poor hedgerow	Local	Permanent loss of 114 m of hedgerow	Moderate adverse	Slight adverse (not significant)	No additional mitigation required	Slight adverse (not significant)
Loss of species-poor hedgerow with trees	Local	Loss of 100 m of species-poor hedgerow with trees to be lost, reinstated post construction with an additional 135 m of species-rich hedgerow with trees				
Loss of suitable bat roosts	Up to County value	Loss of suitable roosting habitat	Negligible adverse	Neutral effect (not significant)	No additional	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
					mitigation required	
Loss of suitable bat habitat	Up to County value	Loss of suitable foraging or commuting habitat	Negligible adverse	Neutral effect	No additional mitigation required	Neutral effect (not significant)
Lighting impact on roosting, foraging and commuting bats	Up to regional value	Destruction / disturbance to dispersal corridors and potential roosting structures	Negligible adverse	Neutral effect (not significant)	No additional mitigation required	Neutral effect (not significant)
Noise impacts to roosting bats	Up to regional value	Disturbance to potential roosting structures	Negligible adverse	Neutral effect (not significant)	No additional mitigation required	Neutral effect (not significant)
Noise impacts to commuting / foraging habitats	Up to County value	Disturbance to potential commuting corridors / foraging habitat.	Negligible adverse	Neutral effect (not significant)	No additional mitigation required	Neutral effect (not significant)
Noise impacts on birds	Up to County value	Destruction / disturbance to nesting birds	Negligible adverse	Neutral effect (not significant)	No additional mitigation required	Neutral effect (not significant)
Loss of suitable hedgehog habitat	County	Injury / mortality during habitat clearance	Negligible adverse	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
Effect of construction activities on hedgehog	County	Injury / mortality during construction activities	Negligible adverse	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 adverse	Neutral effect (not significant)	No additional mitigation required	Neutral effect (not significant)
Effect of noise on common lizard	County	Disturbance / habitat degradation	Negligible adverse	Neutral effect (not significant)	No additional mitigation required	Neutral effect (not significant)
Operation						
Increase lighting to Birklands West and Ollerton Corner SSSI / Sherwood Heath LNR/ Birklands and Bilhaugh LWS	Up to UK or national importance	Habitat degradation due to lighting increase	Negligible adverse	Neutral effect (not significant)	No additional mitigation required	Neutral effect (not significant)
Increase lighting to Sherwood Forest Area ppSPA	International or European importance	Habitat degradation due to increase in lighting	Negligible adverse	Slight adverse effect (not significant)	No additional mitigation required	Slight adverse effect (not significant)
Increase noise level to Birklands West and Ollerton Corner SSSI /	Up to UK or National importance	Habitat degradation due to noise increase	Negligible adverse	Neutral effect (not significant)	No additional	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
Sherwood Heath LNR/ Birklands and Bilhaugh LWS					mitigation required	
Increase noise to Sherwood Forest Area ppSPA	International or European importance	Habitat degradation due to increase in noise levels	Negligible adverse	Slight adverse effect (not significant)	No additional mitigation required	Slight adverse effect (not significant)
Increase in nitrogen deposition to Birklands West and Ollerton Corner SSSI	UK or National	Reduction in species richness within SSSI	No change	Neutral effect (not significant)	No additional mitigation required	Neutral effect (not significant)
Increase in nitrogen deposition to Sherwood Heath LNR/ Birklands and Bilhaugh LWS	County	Reduction is species richness within LNR / LWS	No change	Neutral effect (not significant)	No additional mitigation required	Neutral effect (not significant)
Lighting impacts to roosting bats	Up to Regional	Disturbance to a potential bat roost	Minor adverse	Slight adverse (not significant)	No additional mitigation required	Slight adverse (not significant)
Noise impacts to roosting bats	Up to Regional	Disturbance to potential bat roost	Negligible adverse	Neutral effect (not significant)	No additional mitigation required	Neutral effect (not significant)
Lighting impacts to foraging / commuting bats	Up to County	Habitat degradation / behavioural patterns	Minor adverse	Slight adverse (not significant)	No additional	Slight adverse (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
					mitigation required	
Noise impacts to foraging / commuting bats	Up to County	Habitat degradation / behavioural patterns	Negligible 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 adverse	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 adverse	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	Negligible adverse	Neutral effect (not significant)	No additional mitigation required	Neutral effect (not significant)
Hedgehog	Up to County	Mortality / injury due to road collisions	Minor beneficial	Slight beneficial (not significant)	No additional mitigation required	Slight beneficial (not significant)
Common Lizard	Up to County	Changes in operational noise levels effecting common lizard behaviour / habitat degradation	Negligible adverse	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 2A, and Appendices 9-1 and 9-2 of Volume 3A. This assessment has followed the methodology within DMRB LA 109 Geology and Soils Revision 0 (Highways England, 2019).

9.2 Legislation and Policy

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

9.3 Consultation

9.3.1 The following responses from the Scoping Opinion are relevant to the geology and soils assessment:

Table 9-1 Summary of Relevant Consultation Responses

Consultee	Comments	Where Addressed in the ES
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	Chapter 10 indicates that areas of infilled land may exist at the site, together with potential coal mining waste. Furthermore, the proposed scheme encroaches onto the fuel station 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 groundwater beneath the site from the drainage 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	2.3 Regionally and Locally Important Sites The EIA will need to consider any impacts upon local wildlife and geological sites. Local Sites are identified by the local wildlife trust, geoconservation group or a local forum established for the purposes of identifying and selecting local sites. They are of County importance for wildlife or geodiversity. The Environmental Statement should therefore include an assessment of the likely impacts on the wildlife and geodiversity interests of such sites. The assessment should include proposals for mitigation of any impacts and if appropriate, compensation measures. Contact the local wildlife trust, geoconservation group or local sites body in this area for further information.	Consultation with Nottinghamshire Biological and Geological Records Centre (Table 9-2). Section 6.5 – Baseline Conditions.

Consultee	Comments	Where Addressed in the ES
	5. Soil and Agricultural Land Quality Soil is a finite resource that fulfils many important functions and services (ecosystem services) for society, for example 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 applicant should consider the following issues as part of the Environmental Statement: 1. The degree to which soils are going to be disturbed/harmed as part of this development and whether 'best and most versatile' (BMV) agricultural land is involved. This may require a detailed survey if one is not already available. For further information on the availability of existing agricultural land classification (ALC) information see www.magic.gov.uk. Natural England Technical Information Note 049 - Agricultural Land Classification: protecting the BMV agricultural land also contains useful background information. 2. If required, an agricultural land classification and soil survey of the land should be undertaken. This should normally be at a detailed level, e.g. one auger boring per hectare, (or more detailed for a small site) supported by pits dug in each main soil type to confirm the physical characteristics of the full depth of the soil resource, i.e. 1.2 metres. 3. The Environmental Statement should provide details of how any adverse impacts on soils can be minimised. Further guidance is contained in the Defra Construction Code of Practice for the Sustainable Use of Soil on Development Sites.	Soil and agricultural land classification 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 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 Appendix 9-1 of Volume 3A.

9.4.2 In addition, a Phase 2 geo-environmental ground investigation was carried out in February 2021, to establish the ground conditions at the site. The ground investigation comprised excavation of four window sampler boreholes, one rotary borehole, eight in-situ Dynamic Cone Penetration (DCP) tests, two trial pits and one infiltration test pit. Three soil samples were tested for potential contaminants of concern. The ground investigation results are presented in the factual ground investigation report, which is included in Appendix 9-2 of Volume 3A.

9.4.3 The reports are referenced as follows:

- Via East Midlands Ltd (2021). Ollerton Roundabout, Ollerton, Nottinghamshire. Phase 1 – Geo-Environmental Desk Study; and
- Nicholls Colton Group (2021). Factual Report on a Ground Investigation for Proposed Layout Improvements at Ollerton Roundabout, Nottinghamshire. Ref. G21007-FR.

9.4.4 Supplementary ground investigation works are planned for the site, including areas not previously investigated. As part of the ground investigation, additional samples will be collected for contamination testing, including leachability. Groundwater testing will also be carried out if groundwater is encountered during future monitoring visits. The results of the existing and additional testing will be used to carry out quantitative environmental risk assessments and update the conceptual site model.

9.4.5 A soil resources and agricultural land quality survey has been carried out by Land Research Associates for the site (30th September 2021). The results of the survey have been used to determine the agricultural land classification (ALC) for the agricultural land and the resource value of the SSSI soils. 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.

9.4.6 To inform the baseline conditions, additional consultation has been carried out with stakeholders, agencies and on-line resources as per Table 9-2.

Table 9-2: External Sources of Information

Stakeholder / Agency	Details
British Geological Survey (BGS)	GeoIndex Onshore (BGS, 2021) – information on 1:50,000 geology, faults and artificial ground. 1:50,000 geological map series (BGS, 1996). 113 Ollerton. Solid and Drift (British Geological Survey, 1996).
Cranfield Soil and Agrifood Institute (Cranfield University, 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, 2021b).
Natural England (NE)	Information requested on sensitive geological sites within the study area. Response received: 2nd February 2021.
NSDC	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 (Nottingham City Council, 2021a).

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 area is shown in Figure 9-1 of Volume 2A.

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) has been determined using the significance matrix taken from DMRB LA 104, which has been reproduced in Chapter 4: Environmental Assessment Methodology in Volume 1. This is based on the environmental value (sensitivity) versus the magnitude of

impact (degree of change).

9.4.20 The criteria used to determine the receptor sensitivity and magnitude of impact for geology and soils are presented in Table 9-3 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 Global Conservation Review 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). Agricultural land classification (ALC) grade 1 & 2 or Land Capability for Agricultural Classification (LCAc) grade 1 & 2.
	Contamination – human health	Very high sensitivity land use such as residential or allotments.
	Contamination – surface water	Watercourse having a Water Framework Directive (WFD) classification shown in a River Basin Management Plan (RBMP) and Q95[6] ≥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 Groundwater dependent terrestrial ecosystems (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.

[6] 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
	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.
	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 ≤0.001 m^3/s.
	Contamination – groundwater	Unproductive strata.
Negligible	Geology	No geological exposures, little / no local interest.
	Soils	Previously developed land formerly in ‘hard uses’ with little potential to return to agriculture.
	Contamination – human health	Undeveloped surplus land / no sensitive land use proposed.
	Contamination – surface water	N/A

Receptor value (sensitivity)	Description	Typical examples
	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 Impact

9.4.25 The magnitude of change, i.e. the magnitude of the impact, 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 Highways England Water Risk Assessment Tool (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).

Magnitude of impact (change)	Description	Typical examples
		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.
	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.

Magnitude of impact (change)	Description	Typical examples
		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.
	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 and intrusive site investigation works using the sources described in Section 9.4. The assessment is based on the information available at the time of reporting and is based on the Scheme design as described in Chapter 2: The Scheme, including the likely extents of land take required for its construction and operation.

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

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

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 3A) identified a moderate risk of natural ground stability hazards from compressible deposits (alluvium) underlying the site and there may be 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 Potential effects related to impacts on future mineral resources do not form part of the geology and soils assessment, in accordance with DMRB LA 109. However, as the Scheme will be located in the area of the existing road junction, it is not expected to have any significant impacts on mineral resources.

9.5 Baseline Conditions

9.5.1 Baseline conditions have been identified for the study area to assess the potential geology and soils effects of the Scheme on the receptors identified in Table 9-3.

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 3A).

9.5.3 The existing roundabout is located at an elevation of 42 m above Ordnance Datum (aOD). The following changes in elevation were recorded within the assessment boundary, moving away from the roundabout:

- to the south-west, the A6075 / Ollerton Road rises to approximately 45 m aOD;
- to the north-west, the A616 / Worksop Road rises to approximately 46 m aOD;
- to the north, the A614 / Blyth Road rises to approximately 45 m aOD;
- to the north-east, the A616 / Ollerton Road falls very gradually to approximately 40.5 m aOD;

- to the south-east, Newark Road lies relatively flat and level with the roundabout; and
- to the south, the A614 / Old Rufford Road lies relatively flat and level with the roundabout.

9.5.4 Within the wider surrounding area (approximately 1 km from the assessment boundary), there are areas of higher ground to the west (97.4 m aOD) and south-east (73.6 m aOD) of the site. The land to the south also gradually rises in elevation. To the north-east, the topography follows the River Maun, which flows to the north-east at an elevation of approximately 35 m aOD.

9.5.5 The topographic data indicates a general fall in elevation towards the existing roundabout from most of the surrounding areas, with the elevation continuing to fall very gradually to the north-east of the roundabout, following the River Maun.

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.

Table 9-5 Summary of Published Geology

Geological Feature	Description
Artificial Deposits	No deposits of artificial ground are shown on the geological mapping sources.
Superficial deposits	Alluvium underlies the existing roundabout and surrounding area to the north-east, east and south-west. This is described as clay, silt, sand and gravel. Glaciofluvial deposits are locally mapped in the north-western part of the study area. These deposits are described as sand and gravel. Superficial deposits are largely absent in the western part of the study area.
Bedrock Geology	Sherwood Sandstone Group, Chester Formation directly underlies the western part of the study area and sub-crops the superficial deposits in the central and eastern parts of the study area. 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.

Encountered Ground Conditions

9.5.7 The ground conditions identified at the site during the Phase 2 ground investigation are summarised in Table 9-6.

Table 9-6 Summary of Encountered Ground Conditions

Material Name	Depth Range to Base (m bgl)	Description
Topsoil (made ground)	0.2 – 0.5	Dark brown sandy silt with frequent rootlets.
Made ground	0.5	Dark brown clayey gravelly sand with fragments of glass and asphalt, between 0.2 m and 0.5 m bgl. This material was only

Material Name	Depth Range to Base (m bgl)	Description
		encountered in one location, in an agricultural field to the east of the existing roundabout.
Possible alluvium	1.9 – 3.0	Medium dense to dense brown gravelly sands and sandy gravels to depths of between 1.9 m and 3.0 m bgl. Particle size distribution (PSD) testing on two samples confirmed <5 % fines (clay / silt) content. In one location, the possible alluvium was slightly clayey between 0.3 m and 0.8 m bgl. PSD testing confirmed 28 % fines content.
Chester Formation (Sherwood Sandstone Group)	>10.0	Dense reddish-brown sand and gravelly sand, to a maximum proven depth of 10.0 m bgl (base not encountered).

9.5.8 Made ground deposits were found to be very limited in thickness at the site, generally comprising topsoil only. Slightly deeper made ground deposits (0.5 m bgl) were encountered in one location within the field to the east of the existing roundabout. This location will be included within the permanent works for the Scheme.

9.5.9 It was noted during the ground investigation that the superficial deposits (alluvium) and bedrock geology (Chester Formation) recorded on the BGS mapping were not clearly defined, due to the similarity of the geological materials.

9.5.10 Alluvium would typically be expected to include cohesive materials, such as soft clays as well as sand and gravel. Organic matter can also be present. This is inconsistent with the deposits identified at shallow depth across the site, which were consistently gravelly sands and sandy gravels.

9.5.11 It is considered possible that the alluvium, if present, could have been removed during the original construction of the road and development of the surrounding land uses. Therefore, the sands and sandy gravels described as possible alluvium in Table 9-6 could alternatively represent a highly weathered profile at the top of the Chester Formation.

Geological Features

9.5.12 No designated local geology sites (LGS) or other important geological features have been identified within the study area. Therefore, the environmental sensitivity of sensitive geological receptors is considered to be negligible.

Hydrogeology

9.5.13 The key hydrogeological 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 Hydrogeological Baseline

Hydrogeological Feature	Description
Aquifers	The superficial deposits (alluvium and glacio-fluvial deposits) are classified as Secondary A Aquifers.

Hydrogeological Feature	Description
	The bedrock geology (Chester Formation) is classified as a Principal Aquifer. Based on the topography and local surface watercourses (Table 9-8), the main direction of groundwater flow within the aquifers is likely to be to the north-east.
Groundwater vulnerability	Groundwater vulnerability is classed as high in relation to the superficial and 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)	Source protection zones are defined around large and public potable groundwater abstraction sites. The study area is located within Zone 3 (total catchment area) of a groundwater SPZ. This relates to the Sherwood Sandstone Principal Aquifer. A number of SPZ 1 (Inner Protection) areas around public water supply sources are located on the Sherwood Sandstone Group; however, none are located within 1 km of the assessment boundary. No Drinking Water SgZ for groundwater are located within 1 km of the site. The closest is approximately 1.2 km from the assessment boundary, to the north-east. Drinking Water SgZ are established around public water supplies where additional pollution control measures are needed.
Groundwater abstractions	Information provided by the Environment Agency indicates that there are no Environment Agency licenced groundwater abstractions within 1 km of the site. No private groundwater abstractions have been identified by NSDC within 1 km of the site.
Discharge consents to groundwater	Information on discharge consents is based on the Envirocheck report only. The Envirocheck report includes records for 11 discharge consents to groundwater within 1 km of the site. The closest records relate to a former tourist information centre and a private property located immediately west of the assessment boundary, at Ollerton Roundabout. The discharge consents relate to sewage discharges – final treated effluent. The remaining discharge consents relate to sewage and trade discharges to land / soakaways.
Groundwater levels	During the Phase 2 ground investigation, groundwater was only encountered in one location, at a depth of 6.00 m bgl. It was noted that use of water to assist drilling could have masked other groundwater strikes. A monitoring well was installed and has been monitored for groundwater levels on 13 occasions to date. Standing water depths of between 4.98 m bgl and 5.22 m bgl were initially recorded in March and April 2021. Between June and September 2021, the groundwater level has varied between 5.29 m bgl (10th September) and 5.40 m bgl (16th July-Nov 2021), with a median depth of 5.30 m bgl across the monitoring period. All other exploratory hole locations were terminated at shallow depths (maximum of 4.00 m bgl) and remained dry.
Permeability	Infiltration testing in one location indicated that suitable infiltration is likely to be achieved in the near surface sand and gravel deposits at the site. The deposits generally displayed good drainage

Hydrogeological Feature	Description
	characteristics of moderate permeability, typical of clean sands and gravels. This indicates that a plausible pathway exists for any surface or ground contamination, if present, to migrate into the underlying Principal Aquifer.

9.5.14 The baseline information indicates that the groundwater receptors within the study area have a high environmental sensitivity. However, groundwater is expected to be deeper than 4 m bgl. This reduces the likelihood of near surface contaminants reaching the underlying groundwater body within the Principal Aquifer / SPZ 3.

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

Hydrology

9.5.16 The key hydrological features of the study area, which are considered relevant to the geology and soils assessment, are summarised in Table 9-8.

Table 9-8 Summary of Hydrological Baseline

Hydrological Feature	Description
Surface water features – linear	The River Maun and tributaries are located to the south and east of the site, flowing to the east and north-east. The closest tributary (Ollerton Brook) flows along the south-eastern boundary of a field located in the south-western area of the site. Ollerton Brook is culverted underneath two petrol filling stations and the A614 / Old Rufford Road, in the southern area of the site. The watercourse is in open channel to the east of the petrol filling stations. A bridge crosses the stream on Newark Road, to the south-east of the site. Surface water runoff from the site is likely to flow into Ollerton Brook. The River Maun is approximately 100 m from the assessment boundary at its closest point. The river has a Q95 of <1 m^3 / s. A HEWRAT assessment has been carried out for the River Maun, which indicates that surface water runoff from the site is currently unlikely to have a significant impact on the River Maun (see Chapter 11: Road Drainage and the Water Environment). Highway surface water drainage from within the site area and from surrounding roads sloping towards Ollerton Roundabout is expected to runoff into ditches at the side of the roads and into Ollerton Brook at the southern margins of the site.
Surface water features – non-linear	Fishing lakes are located downstream of the site, approximately 375 m to the north-east of the assessment boundary. The ponds are adjacent to the River Maun and appear to be artificially constructed (possibly former gravel pits). Small pond features are indicated on current mapping within Sherwood Heath LNR, to the west of the existing roundabout and within a public open space at Fairfield Park to the south-east. Based on their distance from the site, it is considered unlikely that these features are significant receptors for contamination from within the assessment boundary.
Surface water quality	The River Maun recorded a GQA Grade C for river quality in 2000 at a monitoring point to the east of the site. The overall classification for the River Maun, Rainworth Water to Poulter catchment was Moderate in 2019, which meets the 2015 objective (Moderate).

Hydrological Feature	Description
Drinking Water Surface Water Safeguard Zones (SgZ)	No Drinking Water SgZ for surface water are located within 2 km of the site.
Surface water abstractions	Information provided by the Environment Agency indicates that there are seven current surface water abstractions within 1 km of the assessment boundary. The closest abstraction is located approximately 150 m south-east of the site and is related to production of energy (milling and water power). The remaining abstractions are related to general agricultural use and private non-industrial amenity use. One additional abstraction for general agriculture is included within the Envirocheck report, approximately 300 m north-east of the site. It is possible that this abstraction is no longer active, although no end date has been supplied.
Discharge consents to surface water	Information on discharge consents is based on the Envirocheck report only. The Envirocheck report includes records for five surface water discharge consents within 1 km of the assessment boundary. The closest was located approximately 30 m south of the site and relates to sewage discharge of final treated effluent to Ollerton Brook. The discharge consent was revoked in 1991. The remaining discharge consents relate to sewage discharge of final treated effluent and discharge of other matter.
Pollution incidents to controlled waters (up to 1999)	The Envirocheck report includes nine incidents within 1 km of the assessment boundary, between 1996 and 1999. All were Category 3 (minor) incidents.
Substantiated pollution incidents register (from 1999)	The Environment Agency has provided information on substantiated pollution incidents in the last five years. Three incidents were located within 1 km of the assessment boundary. The closest incident was approximately 150 m south-east of the assessment boundary, in February 2020. The incident was a Category 3 (minor) incident to land and water, caused by a combined sewage overflow. The Envirocheck report includes two incidents prior to 2015 within 1 km of the site. The closest was 150 m south-east of the site in 2012 and was a Category 2 (significant) incident, impacting water. The pollutants were described as inert mineral materials and ammonia solutions.
Surface water flooding	The indicative floodplain map for the area, presented in the Envirocheck report, shows that the central, eastern and southern portions of the site lie within flood zone 2 and flood zone 3 areas. This indicates that the site is at risk of flooding from the River Maun. The site is generally at negligible risk of surface water flooding with localised low risk (1000-year return) of surface water flooding indicated across the site. The agricultural field in the south-western area of the site also has a localised low risk (1000-year return) of surface water flooding.

9.5.17 The baseline information indicates that Ollerton Brook is likely to have a low to medium environmental sensitivity. For the purposes of the geology and soils assessment, the environmental sensitivity is assumed to be medium.

9.5.18 As the River Maun has a WFD status and a Q95 of <1 m^3/s, the environmental sensitivity of this watercourse is high.

9.5.19 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

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

Table 9-9 Historical and Current Land Uses

Identified Land Use	Description
Highways	The existing Ollerton Roundabout is located in the centre of the study area. The roundabout was constructed in the late-1930s. The centre of the roundabout is grass-covered, with curb stone edging. Grass verges are located around the outer perimeter of the roundabout. During a site walkover carried out by Via in December 2020, various service manhole covers were observed within the verges. Six roads branch out from the roundabout, comprising the A614 / Blyth Road to the north, the A614 / Old Rufford Road to the south, the A616 / Worksop Road to the north-west, Newark Road to the south-east, the A6075 / Mansfield Road to the west and the A6075 / Ollerton Road to the east. No evidence of contamination was encountered during the Phase 2 ground investigation. Limited testing on three samples in proximity to the highway (two from roadside verges to the north and south-west of the roundabout and one from a field to the east) did not identify any significantly elevated concentrations of potential contaminants, such as lead or total petroleum hydrocarbons (TPH). The samples were collected at depths of between 0.2 m and 1.0 m bgl.
Petrol stations	Two petrol filling stations are located on either side of the A614, approximately 50 m south of the existing roundabout. The petrol filling stations, currently operated by Esso and Shell, have been present since at least the early 1970s. The Scheme will slightly encroach across the boundaries of the petrol filling stations. However, this area is outside the main construction area and was not included within the Phase 2 ground investigation. Contamination from the petrol stations could impact groundwater underlying the site as groundwater flow is expected to be to the north-east. No evidence that contamination from the petrol stations has migrated northward underlying the site was observed during the ground investigation. However, it should be noted that as groundwater was not encountered in most locations, there is potential for unidentified fuel contamination to be present in groundwater underlying the site.
Coal mining	The site is located in an area historically used for deep coal mining, with the former Thoresby Colliery to the west and the former Ollerton Colliery to the east. However, the Phase 2 ground investigation did not identify any evidence of mine waste deposits at the site. The potential risks from mine gas within the study area are likely to be low due to the depth of the coal seams (approximately 450 m and 670 m below ground level).
Sand and gravel mining	Old gravel pits are shown on historical maps in the north-west and west of the study area. A sand pit is also shown in the south-west of the study area. These pits appear to have been infilled by 1960. The former gravel pit in the north-west of the study area underlies the site in the forested area immediately west of the A614 Blyth Road and could potentially underlie the existing road at the northern extent of the site. However, this area is outside the main construction area and was not included within the Phase 2 ground investigation.
Waste sites and infilled land	No registered or historical landfill or waste transfer sites have been identified within the study area. However, as noted above, there is evidence of possible gravel pits in the area, including one located within the north-western area of the site. The pits appear to have been infilled with unknown materials.

Identified Land Use	Description
	The Envirocheck report includes one record of potentially infilled land (water) within the site area. This is approximately in the location of a culverted watercourse under Newark Road.
Residential	A residential property is located immediately to the north-east of the roundabout. The Scheme (permanent works) will encroach into the southern part of the garden attached to this property. At the time of writing, it has not been possible to carry out any sampling in the garden. However, based on the current residential use, no contamination impacts are expected.
Restaurants	A McDonald's restaurant and Costa Coffee are located immediately to the south of the roundabout. The Big Fish restaurant and car park are included within the assessment boundary. A small takeaway café is also located to the north-west of the roundabout. A recently constructed Public House, 'The Alders', is located immediately to the west of the roundabout. The Scheme will slightly encroach into the land associated with the Public House, including landscaping areas and a car park. Chemical testing carried out on one soil sample collected at the south-western boundary of the Public House did not identify any significant evidence of contamination.
Agriculture	Agricultural fields are located immediately to the east of the roundabout, beyond which is the village of Ollerton. The Scheme will include the corner of a field in this area. Chemical testing carried out on a soil sample collected within the field did not identify any significant evidence of contamination. Agricultural land is also located to the south of the petrol filling stations and to the north and east of the residential property. This land is partially included within the assessment boundary, to the north-east and south-west of the existing roundabout.
Designated Sites	Birklands West and Ollerton Corner SSSI lies immediately to the north and west of the site. The designation was awarded in 2001. The SSSI condition is classed as unfavourable (no change). The assessment boundary encroaches the SSSI land to the north-west of the existing roundabout, between the A616 / Worksop Road and the A614 / Blyth Road. The assessment boundary also encroaches into the SSSI land at the north-western extent, along the roadside verges of Worksop Road. Chemical testing carried out on one soil sample collected from a roadside verge area within the extents of the designated SSSI did not identify any significant evidence of contamination. The Scheme will include land that is indicated to be part of Sherwood Heath LNR, immediately to the west of the existing roundabout. Most of the LNR is also part of the designated SSSI. However, the Scheme will include an area, immediately west of the existing roundabout, that is part of the designated LNR, but not part of the SSSI. This area has recently been developed with a Public House and car park. A public information centre building was previously located in this part of the study area, along with a paved area, trees and vegetated areas. A possible potential Special Protection Area (ppSPA) is located adjacent to the site (Sherwood Area). This is a site that may be added to the list of candidate sites, with regards to designation as a SPA. The site is located within a nitrate vulnerable zone (NVZ) for surface water and groundwater.

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

- made ground and infilled ground (former gravel pit) on site;
- hardstanding materials containing coal tar and other potential contaminants;

- spills and leaks of fuels / oils from vehicles utilising the roads on-site;
- spills and leaks of fuels / oils from the petrol filling stations to the south of the Scheme;
- industrial spills and pollution incidents within the study area; and
- agricultural land uses (e.g. fertilisers, pesticides, herbicides, leaks and spills).

9.5.22 Based on the Scheme design (see Chapter 2: The Scheme) and baseline information in Table 9-9, the following potential human health receptors have been identified at the site:

- current and future users of the site, surrounding roads and businesses;
- current and future residents in the surrounding area;
- current and future consumers of agricultural products (e.g., crops, meat products); and
- current and future visitors to the nearby SSSI / LNR.

Soil Resources and Agricultural Land Classification

9.5.23 The baseline conditions related to agricultural land classification (ALC) and soil resources are summarised in Table 9-10.

Table 9-10 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 the River Maun, to the east of the existing roundabout, 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.
SSSI / LNR soils	The site boundary encroaches a SSSI to the north and north-west of the existing roundabout, along narrow strips on the western side of Blyth Road and on both sides of Worksop Road (approximately 0.29 ha in total). This will include approximately 0.14 ha in total for the temporary works. Approximately 0.14 ha will be included within the permanent works between Blyth Road and Worksop Road. This will include proposed areas of woodland replacing existing grassland (0.017 ha). Approximately 0.01 ha will be included within the permanent works along Worksop Road. Approximately 0.30 ha of the site are located within the LNR, immediately west of Ollerton Roundabout on Worksop Road and Mansfield Road. Approximately 0.23 ha will be included within the Scheme permanent works. However, most of this area of the LNR comprises roadside verges around the recently developed Public House and car park. There is very little overlap of the SSSI and LNR within the site area (0.01 ha, within an area of permanent works on Worksop Road).
Agricultural soils	The site boundary includes small areas of agricultural land (approximately 0.30 ha in total) on the eastern side of the study area, including 0.21 ha between the Ollerton Road and Newark Road arms of the existing roundabout and 0.09 ha to the north of Ollerton Road. The site boundary also includes an area of agricultural land (0.59 ha) to the south-west of the existing roundabout, between Mansfield Road and Ollerton Brook. Most of the agricultural land required will be used for the temporary works and will be returned to agricultural use following completion of the construction works. However, a

Resource	Description
	total area of approximately 0.15 ha will be included in the permanent works, in the eastern area of the site. This will largely to be used in landscaping, which is expected to include areas of acid grass heathland, woodland and species rich hedges. The initial findings of the ALC survey carried out at the site indicate that the areas of agricultural land on-site are Grade 2, which is considered to be BMV land.

9.5.24 Based on the desk study information and initial survey findings, the environmental sensitivity of the soil resources is assessed to be very high.

Future Baseline

9.5.25 The future baseline is expected to be very similar to the existing conditions as there will be limited changes in land use.

9.6 Design, Mitigation and Enhancement Measures

9.6.1 The geology and soils assessment is based on the absence of any specific / additional mitigation measures for geology and soils effects. However, general design, mitigation and enhancement measures, outlined in Chapter 2 – The Scheme, are included within the assessment.

9.6.2 The relevant mitigation measures for geology and soils are summarised in Table 9-11.

Table 9-11 Mitigation Measures

Receptor	Mitigation	Design / Implementation
Geology	None required.	N/A
Soil resources	Mitigation measures will include the following: ▪ Prior to commencing construction works, agricultural topsoil from areas of permanent loss will be stripped and stockpiled. 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. 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” (2009) (Defra, 2009), BS 3882:2015 (BSI, 2015) “Specification for Topsoil and Requirements for Use”, BS 8601:2013 “Specification for Subsoil and Requirements for Use” (BSI, 2013a) and the CL:AIRE guidance “The Definition of Waste: Development Industry Code of Practice” (CL:AIRE, 2011).
Human health	Mitigation measures will include the following:	Prior to commencing construction works on site, a CEMP and SWMP / MMP will be prepared by the appointed contractor.

Receptor	Mitigation	Design / Implementation
	▪ 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). ▪ 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.	This will be implemented by the contractor on site. A contamination watching brief will be prepared and implemented by the contractor. This will identify the procedures required to ensure that any potential contamination encountered is identified, assessed and, if necessary, remediated.
Controlled waters	Mitigation measures will include the following: ▪ 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 on-site / adjacent watercourse (Ollerton Brook) will be protected from surface water runoff related to the construction works and temporary compound. This could require, for example, an exclusion zone between the compound and the watercourse, dedicated areas to store hazardous materials further away from the watercourse 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 9-12.

Table 9-12 Geology and Soils Effects – Construction

Receptor Type	Type of Effect	Description
Soils	Adverse	Permanent loss of approximately 0.15 ha of agricultural land.
		Permanent loss of approximately 0.37 ha of SSSI / LNR land. However, the areas of permanent loss are generally verge areas / non-sensitive parts of the designated sites.

Receptor Type	Type of Effect	Description
		Temporary loss of approximately 0.74 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 and infilled ground (former gravel pit) on-site. ▪ Hardstanding materials containing coal tar and other potential contaminants. ▪ Spills and leaks of fuels / oils from vehicles utilising the roads on-site. ▪ Agricultural runoff (e.g., nitrate). ▪ Spills and leaks of fuels / oils from the petrol filling stations to the south of the site. ▪ 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 and SSSI / LNR.
		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 9-13. 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 9-13 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 soil resources during construction works.	Very High	Minor (adverse)	Moderate adverse (due to potential localised impacts around road boundaries)	Yes
		Temporary loss of agricultural land, compared with the existing baseline: 0.15 ha in the eastern area; and 0.59 ha in the south-western area.	Very High	Negligible (adverse)	Slight adverse	No
	Use of agricultural land within the permanent works for the Scheme.	Permanent loss of approximately 0.15 ha of agricultural land, compared with the existing baseline.	Very High	Negligible (adverse)	Slight adverse	No
	Use of SSSI / LNR land during construction of the Scheme.	Permanent damage to soil resources within the SSSI / LNR during construction works.	High	Minor (adverse)	Moderate adverse (due to potential unnecessary loss of soil resources)	Yes
		Temporary loss of approximately 0.21 ha of SSSI / LNR land, compared with the existing baseline.	High	Negligible (adverse)	Slight adverse	No
	Use of SSSI / LNR land within the	Permanent loss of approximately 0.35 ha of SSSI / LNR land,	High	Negligible (adverse)	Slight adverse	No

Geology and Soils Receptor	Description of Sources / Cause of Impact	Description of Impacts	Receptor Value (Sensitivity)	Magnitude of Impact	Significance of Effects	Significant Effect? (Yes / No)
	permanent works for the Scheme.	compared with the existing baseline.				
Contamination – human health	Soil and groundwater contamination related to historical sources and construction works (see Table 9-12).	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
		Impacts on visitors to the nearby LNR / SSSI from ingestion of contaminated particulates, dermal contact with soils and / or inhalation of contaminated dust / particles during construction.	High	Negligible (adverse)	Slight adverse (due to short duration and low potential for contamination).	No

Geology and Soils Receptor	Description of Sources / Cause of Impact	Description of Impacts	Receptor Value (Sensitivity)	Magnitude of Impact	Significance of Effects	Significant Effect? (Yes / No)
		Impacts on users of surrounding businesses from ingestion of contaminated particulates, dermal contact with soils and / or inhalation of contaminated dust / particles during construction.	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.	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 have migrated from the site.	Medium	Negligible (adverse)	Slight adverse	No
Contamination – surface water	Soil and groundwater contamination	Impacts on Ollerton Brook from surface water run-off	Medium	Minor (adverse)	Slight adverse	No

Geology and Soils Receptor	Description of Sources / Cause of Impact	Description of Impacts	Receptor Value (Sensitivity)	Magnitude of Impact	Significance of Effects	Significant Effect? (Yes / No)
	related to historical sources and construction works (see Table 9-12).	and / or migration of contaminated groundwater.				
		Impacts on River Maun from surface water run-off and / or migration of contaminated groundwater.	High	Negligible (adverse)	Slight adverse	No
Contamination – groundwater	Soil and groundwater contamination related to historical sources and construction works (see Table 9-12).	Impacts on Principal Aquifer from leaching of contaminated soils, surface water run-off and / or migration of contaminated groundwater.	High	Minor (adverse)	Moderate adverse (due to the identified adverse effects and pathways)	Yes
		Impacts on Secondary A Aquifers from leaching of contaminated soils, surface water run-off and / or migration of contaminated groundwater.	High	Minor (adverse)	Moderate adverse (due to the identified adverse effects and pathways)	Yes

Operation

9.7.3 The possible geology and soils effects identified for the Scheme are described in Table 9-14.

Table 9-14 Geology and Soils Effects – Operation

Receptor Type	Type of Effect	Description
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 9-12) 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 road junction could be slightly higher than the current conditions (e.g., spills and leaks from vehicles on the road). This is due to the predicted increase in traffic and the increased risk of traffic collisions associated with the Scheme.
	Beneficial	Improvements in road surfacing, drainage and buried services could reduce the potential for contaminated surface water runoff to migrate to the receptors during operation.
		Improvements in road surfacing, drainage and buried services could also reduce the potential infiltration of groundwater through areas of contaminated ground during operation.

9.7.4 An assessment of the likely significance of the above effects during the operation of the Scheme is presented in Table 9-15. 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 9-15 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	None identified.	None identified.	Very high	No change	Neutral	No
Contamination – human health	Soil and groundwater contamination related to historical sources, construction works, and future uses of the site (see Table 9-14).	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 visitors to nearby LNR / SSSI from ingestion of contaminated particulates, dermal contact with soils and / or inhalation of contaminated dust / particles.	High	No change	Neutral	No
		Impacts on future consumers of agricultural produce (e.g. crops or meat products) due to contamination of agricultural land.	Very high	Negligible (adverse)	Slight adverse	No
		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 related to historical sources, construction works, and future uses of the site (see Table 9-14).	Impacts on Ollerton Brook from surface water run-off and / or migration of contaminated groundwater.	Medium	Negligible (adverse)	Slight adverse (due to potential increase in surface water runoff)	No
		Impacts on River Maun from surface water run-off and / or migration of contaminated groundwater.	High	Negligible (adverse)	Slight adverse	No
Contamination – groundwater	Soil and groundwater contamination related to historical sources, construction works, and future uses of the site (see Table 9-14).	Impacts on Principal Aquifer from leaching of contaminated soils, surface water run-off and / or migration of contaminated groundwater.	High	Negligible (adverse)	Slight adverse	No
		Impacts on Secondary A Aquifers from leaching of contaminated soils, surface water run-off and / or migration of contaminated groundwater.	High	Negligible (adverse)	Slight adverse	No

9.8 Additional Mitigation

9.8.1 Additional mitigation measures to address the likely significant geology and soils effects are presented in Table 9-16.

Table 9-16 Additional Mitigation Measures

Receptor	Additional Mitigation	Design / Implementation
Geology	None required.	N/A
Soil resources	Prior to commencing construction works, agricultural topsoil and valuable SSSI / LNR soils 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. Prior to commencing construction works, valuable SSSI / LNR soil resources from areas of permanent loss will be stripped and stockpiled for use in ecological / landscaping areas.	The mitigation measures will be determined within the soil resources plan (see Table 9-15).
Human health	Additional mitigation may be required if significant contamination is identified that presents a risk to one or more receptors.	A supplementary 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 confirm any additional mitigation measures required prior to construction. In the event that any unexpected contamination is identified during construction, 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	Mitigation measures will include the following: 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 supplementary 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 confirm any additional mitigation measures required prior to construction.

9.9 Residual Effects

9.9.1 An assessment of the geology and soils effects following implementation of additional mitigation measures is presented in Table 9-17.

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. The cumulative effects associated with the permanent loss of agricultural land across the whole Project are discussed in Volume 1, Chapter 9.

Table 9-17: 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 soil resources during construction works.	Very High	Loss or damage to soil resources within the assessment boundary.	Minor (adverse)	Moderate adverse	See Table 9-16 for additional mitigation.	Slight adverse
Temporary loss of 0.74 ha agricultural land, compared with the existing baseline.	Very High	Loss of agricultural land within the assessment boundary.	Negligible (adverse)	Slight adverse	No additional mitigation proposed.	Slight adverse
Permanent loss of approximately 0.15 ha of agricultural land, compared with the existing baseline.	Very High	Loss or damage to soil resources within the assessment boundary.	Negligible (adverse)	Slight adverse	No additional mitigation proposed.	Slight adverse
Permanent damage to soil resources within the SSSI / LNR during construction works.	High	Loss or damage to soil resources within the assessment boundary.	Minor (adverse)	Moderate adverse	See Table 9-16 for additional mitigation.	Slight adverse
Temporary loss of approximately of 0.21 ha SSSI / LNR land, compared with the existing baseline.	High	Damage to soil resources within the assessment boundary.	Negligible (adverse)	Slight adverse	No additional mitigation proposed.	Slight adverse
Permanent loss of approximately 0.35 ha of SSSI / LNR land, compared with the existing baseline.	High	Loss or damage to soil resources within the assessment boundary.	Negligible (adverse)	Slight adverse	No additional mitigation proposed.	Slight adverse
Construction impacts on nearby 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

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 future consumers of agricultural produce (e.g. crops or meat products) due to contamination of agricultural land (e.g. areas used for storage and compounds).	Very high	Human health impacts from consumption of contaminated crops / meat.	Negligible (adverse)	Slight adverse	No additional mitigation proposed.	Neutral
Construction impacts on visitors to the nearby LNR / SSSI from ingestion of contaminated particulates, dermal contact with soils and / or inhalation of contaminated dust / particles.	High	Contamination impacts on human health receptors within the study area.	Negligible (adverse)	Slight adverse	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 study 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 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 Ollerton Brook from surface water run-off and / or migration of contaminated groundwater.	Medium	Contamination impacts on surface water receptor within the study area.	Minor (adverse)	Slight adverse	No additional mitigation proposed.	Slight adverse
Construction impacts on River Maun from surface water run-off and / or migration of contaminated groundwater.	High	Contamination impacts on surface water receptor within the study area.	Negligible (adverse)	Slight adverse	No additional mitigation proposed.	Neutral
Construction impacts on Principal Aquifer from leaching of contaminated soils, surface water run-off and / or migration of contaminated groundwater.	High	Contamination impacts on groundwater receptor within the study area.	Minor (adverse)	Moderate adverse	See Table 9-16 for additional mitigation.	Slight adverse
Construction impacts on Secondary A Aquifers from leaching of contaminated soils, surface water run-off and / or migration of contaminated groundwater.	High	Contamination impacts on groundwater receptor within the study area.	Minor (adverse)	Moderate adverse	See Table 9-16 for additional mitigation.	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
Impacts on future consumers of agricultural produce (e.g. crops or meat products) due to contamination of agricultural land during operation.	Very high	Contamination impacts on human health receptors outside of study area.	Negligible (adverse)	Slight adverse	See Table 9-16 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 within study area.	Negligible (adverse)	Slight adverse	See Table 9-16 for additional mitigation.	Neutral
Impacts on Ollerton Brook from surface water run-off and / or migration of contaminated groundwater during operation.	Medium	Contamination impacts on surface water receptor within the study area.	Negligible (adverse)	Slight adverse	See Table 9-16 for additional mitigation	Neutral
Impacts on River Maun from surface water run-off and / or migration of contaminated groundwater.	High	Contamination impacts on surface water receptor within the study area.	Negligible (adverse)	Slight adverse	See Table 9-16 for additional mitigation	Neutral
Impacts on Principal Aquifer from leaching of contaminated soils, surface water run-off and / or migration of contaminated groundwater during operation.	High	Contamination impacts on groundwater receptor within the study area.	Negligible (adverse)	Slight adverse	See Table 9-16 for additional mitigation	Neutral
Impacts on Secondary A Aquifers from leaching of contaminated soils, surface water run-off and / or	High	Contamination impacts on groundwater receptor within the study area.	Negligible (adverse)	Slight adverse	See Table 9-16 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
migration of contaminated groundwater during operation.						

10. NOISE AND VIBRATION

10.1 Introduction

10.1.1 This chapter considers the noise and vibration impacts of the construction and operation of the proposed Scheme by using the assessment methodology described in the DMRB LA 111 Noise and Vibration Version 2 (Highways England, 2020h).

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

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 2A shows the noise contour changes across the study area and any impacts on ecological receptors is assessed in Chapter 8: Biodiversity, of this Environmental Statement.

10.4 Assessment Methodology

General Approach

10.4.1 The noise and vibration assessment includes the following elements:

- quantitative/qualitative assessment of construction noise and vibration impacts; and
- quantitative assessment of operational traffic noise impacts.

10.4.2 Construction traffic noise was scoped out as traffic changes during construction are expected to be minimal, and use the Major Road Network, resulting in minimal increases in the proportion of Heavy Goods Vehicles (HGV) within the traffic flows. Where short-term diversions are required, these are expected to be diverted to the Strategic Road Network (SRN), which would be likely to result in minor changes to traffic flows on these roads during construction.

10.4.3 Operational impacts resulting from vibration are scoped out of further assessment in accordance with DMRB.

10.4.4 Key methodology documents of relevance to the noise and vibration assessment are as follows:

- DMRB LA 111 Noise and Vibration;
- Calculation of Road Traffic Noise (CRTN) (Department for Transport, 1988);

- BS 5228-1&2:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites (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 Institute, 1993).

10.4.5 DMRB LA 111 describes a standard methodology for the assessment of noise and vibration impacts during the construction and operational phases of road projects.

10.4.6 The CRTN is the standard method applied in the UK to assess noise from road traffic. The document defines calculation methods for assessing road traffic noise based on the following five parameters: traffic flows, percentage of heavy vehicles, the traffic speed, the gradient of the road, and the road surfaces.

10.4.7 BS 5228-1&2 gives recommendations for basic methods of noise and vibration control relating to construction and open sites where work activities/operations generate significant noise and vibration levels. These are the standards more typically used to assess noise and vibration arising from construction activities.

Baseline Conditions

10.4.8 Baseline conditions in the vicinity of the Scheme are detailed in Section 10.5, which provides details of potentially sensitive receptors within the study area which have been determined from the OS address base dataset and OS mapping.

10.4.9 Sensitive receptors are illustrated on Figure 10-1 in Volume 2A. The vast majority of potentially sensitive receptors in the vicinity of the Scheme are residential properties. Non-residential potentially sensitive receptors can include educational buildings, medical buildings and facilities (such as places of worship).

10.4.10 The Institute of Acoustics (IOA) and the Association of Noise Consultants (ANC) published a document called “Joint Guidance on the Impact of COVID-19 on the Practicality and Reliability of Baseline Sound Level Surveying and the Provision of Sound & Noise Impact Assessments – Version 6” (Institute of Acoustics, 2021) to help their members to adjust their baseline assessments in light of the COVID pandemic.

10.4.11 The COVID pandemic has resulted in variation in journey patterns compared to pre-COVID travel patterns. Therefore, traditional baseline noise measurements have not been used to validate the noise model due to potential unreliability and inaccuracy of the data.

10.4.12 Current guidance states that for transport schemes, there may still need to be some reliance on predicted sound levels to describe the baseline conditions, with a corresponding need to obtain flow/ activity data. There are now many sources of noise transport data available, and these should be used, along with (where possible) previously made direct site measurements to describe baseline conditions. A link is provided to the most recent noise mapping carried out in England which includes the roads around Ollerton Roundabout. The noise modelling undertaken for this Scheme was compared and validated against the noise levels in the Defra strategic noise maps (Extrium, 2018), produced in accordance with the requirements of the Environmental Noise (England) Regulations 2006 (as amended) for the baseline year traffic data of 2018.

10.4.13 The 18-hour Average Annual Weekday Traffic ($AAWT_{18hr}$) flows for the baseline year of 2018 were used to create the baseline noise scenario (data provided from the traffic modelling as described in Chapter 4: Environmental Assessment Methodology) by using the CRTN method which was then compared with Defra’s

strategic noise maps at three different validation locations for the following road traffic noise indicators: L_{den}, L_{night}, and $LA_{eq,16hr}$. The results of the validation exercise are presented in Section 10.5.

10.4.14 The 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 119 NSRs were identified within the 300 m study area and four 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 662 NSRs were identified with the 600 m study area.

10.4.19 The baseline assessment will identify any Noise Important Areas (NIA) located within the study as shown in the Defra Strategic Noise maps.

10.4.20 The construction and operational study areas and location of the NSRs are illustrated in Figure 10-1 within Volume 2A.

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 assessment boundary.

10.4.24 Annex C presented in BS 5228-1 provides the sound level data from a range of site equipment and activities. Values of the sound power levels for a particular type and size of machine and the equivalent continuous sound pressure levels for the site activities given in Tables C.1 to C.12 of BS 5228-1 has been used in the prediction of the activity noise levels.

10.4.25 Noise levels generated by construction activities are deemed to be significant if the total noise (pre-construction ambient plus construction noise) exceeds the pre-construction ambient noise by 5 dB or more, subject to lower cut-off values of 65 dB, 55 dB and 45 dB LA_{eq}, from construction noise alone, for the daytime, evening and night-time periods, respectively.

10.4.26 DMRB adopts the ABC method in BS 5228-1 for identifying the threshold of potentially significant construction noise effects. This approach is based on setting the threshold for the onset of potentially significant adverse effects (i.e. the significant observation adverse effect level (SOAEL)) depending on the existing ambient noise level. The lowest observed adverse effect level (LOAEL) is the existing ambient noise level. Table 10-1 below is adopted from Table E.1 in BS5228-1, which sets out the construction noise SOAEL and LOAEL proposed for this assessment.

Table 10-1 Example threshold of SOAEL and LOAEL at dwellings

Time of Day	SOAEL LAeq,T (dB) Façade			LOAEL LAeq,T (dB) Façade
	Category A1	Category B2	Category C3	
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 (DTM) of the different scenarios for the study area.

10.4.36 The following traffic scenarios have been modelled and assessed:

- Do Minimum (without the Scheme) in the opening year (DMOY);
- Do Something (with the Scheme) in the opening year (DSOY);
- Do Minimum in the future assessment year (DMFY); and
- Do Something in the future assessment year (DSFY).

10.4.37 The SOAEL and the LOAEL for road traffic noise used in this assessment are detailed in Table 10-4, as defined in DMRB LA 111.

Table 10-4 Noise SOAEL and LOAEL for all receptors

Time of Day	SOAEL	LOAEL
06:00 – 00:00	68 dB LA10,18h (façade)	55 dB LA10,18h (façade)
23:00 – 07:00	55 dB Lnight,outside (free-field)	40 dB Lnight,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.

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) LA10,18h dB	Magnitude of the Impact	Noise level change (rounded to 0.1 dB) LA10,18h 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 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

Likely 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 effect.

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 with the Joint Guidance on the Impact of COVID-19 on the Practicality and Reliability of Baseline Sound Level Surveying and the Provision of Sound & Noise Impact Assessments provided by the IOA and ANC as described earlier in this section.

- Ordnance Survey (OS) Address Base Plus data detailing building usage and OS Building Height Attribute data have been used as provided in 2020. However, the heights of residential buildings have been standardised as a 6 m height. All the noise models developed were created by assuming a calculation height of 4 m.
- The construction assessment is based on the construction information that is currently available as described in Chapter 2: The Scheme and noted herein. As with all construction assessments, the exact details of the construction activities would not be fully understood before the detailed design stage of a scheme when the exact construction methods and programme will be determined. Whilst the precise details may be subject to change, the overall assessment of significant construction effects is unlikely to be materially worse than reported herein, 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 and several commercial developments, all in very close proximity to the existing roundabout where the noise environment is dominated by road traffic noise, both free-flowing and stationary during periods of congestion.

10.5.2 Further to the east and south-east is the urban edge of the town of Ollerton which lies within the 600 m study area of the Scheme. In total 662 NSRs have been identified within the study area including two other NSRs – Creative Care East Midlands (Care Home) and St Gilles Church.

10.5.3 Within the study area, and immediately adjacent to the assessment boundary to the west and north-west lies the Birkland West & Ollerton Corner SSSI which is also, partially designated as a LWS (Birklands & Bilhaugh).

10.5.4 To the east and south-east lies Ollerton Conservation Area which is also immediately adjacent to the assessment boundary. The nearest listed building approximately 200 m south-east of the assessment boundary. Heritage assets within the study area are considered in Chapter 6: Cultural Heritage.

10.5.5 Three NIAs were identified through the Extrium, England Noise and Air Quality Viewer (Extrium, 2018) within 600 m of the Ollerton Roundabout Scheme. One, (ID 7781) is located on the A614, starting approximately 600 m south of the roundabout for a distance of around 50 m. A further NIA (ID 7780) is located on the A6075 starting approximately 350 m east of the roundabout for a distance of around 250 m and a third (ID 14530) is located on the A6075 starting approximately 700 m east of the roundabout for a distance of around 100 m. All three NIAs are the responsibility of NCC.

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 Forest Side, NG22 9DY	65 - 69.9	65.0	65 - 69.9	68.9	55 - 59.9	56.8
The Green Hut Café, NG22 9DR	60 - 64.9	60.0	60 - 64.9	61.5	50 - 54.9	52.2
The Alders Public House, NG22 9DR	55 - 59.9	55.7	55 - 59.9	57.4	45 - 49.9	48.2

10.5.7 The results obtained from the Scheme-specific noise model for Ollerton show noise levels at all the validation points are inside the same range as the Defra noise maps, and so the use of the Scheme noise model to represent the baseline conditions is considered valid.

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	660	2	660	2
	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 Changes to speed limits are proposed as part of the Scheme, with the speed limit reduced from the national speed limit to 40 mph at the roundabout and on all approaches. Lower speed limits can reduce noise caused by tyre/ road surface interaction which dominates at higher speeds.

10.6.2 The design of the new roundabout involves enlarging the circulatory diameter to the north and west with alterations to the approach arms. The effect of this is to move some of the gyratory flow and the northbound A614 exit from the roundabout slightly further away from the nearest NSRs on Blyth Road. Increased distance of traffic flows from receptors will lead to a corresponding decrease in noise levels, even for relatively small changes for those NSRs located closest to the existing road.

10.6.3 No other embedded mitigation or enhancement measures have been identified.

10.7 Assessment of Likely Significant Effects

Construction

Construction Noise

10.7.1 At this stage, precise information on the construction works is not available. To provide an indication of the likely construction noise levels for various road construction activities, noise predictions were made at various distances from these activities based on a representative distance between construction activities and NSRs. Table 10-9 provides a summary of the predicted $LA_{eq,1hr}$ at various distances from the different typical road construction activities at all dwellings with a direct line of sight to the construction activities. Each activity consists of a range of typical construction plant associated with that particular activity and is assumed to be operating at the nearest part of the assessment 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 part of the assessment boundary)	3	0	0	0	0	0	13	33	69

10.7.2 The predicted construction noise levels described above represent the likely worst-case scenario, based on noise levels at representative distances across the study

area. There are four NSRs within 10 m of the assessment boundary with the remaining NSRs (115 in total) all located in excess of 200 m from the assessment boundary.

Table 10-10 Magnitude of Noise Impact at the NSRs due to construction activities

Noise Sensitive Receptor Address	Ambient noise levels (LOAEL) ($LA_{eq,16hr}$)	Ambient noise levels (rounded to nearest 5 dB)	BS 5228 threshold value (SOAEL)	Distance from assessment boundary	Predicted Max noise levels ranges ($LA_{eq,1hr}$)	Exceedance of BS 5228 threshold	Magnitude of the Impact
R1: 1 Forest Side, NG22 9DY, Ollerton	64.9	65	70	Less than 10 m	81.4 - 83.5 dB(A)	11.4 - 13.5 dB(A)	Major
R2: 2 Forest Side, NG22 9DY, Ollerton	63.9	65	70	Less than 10 m	80.1 - 83.5 dB(A)	10.1 - 13.5 dB(A)	Major
R3: 3 Forest Side, NG22 9DY, Ollerton	63.6	65	70	Less than 10 m	80.1 - 83.5 dB(A)	10.1 - 13.5 dB(A)	Major
R4: The Coombs, Mansfield Road, NG22 9DU, Ollerton	61.8	60	65	Less than 10 m	80.1 - 83.5 dB(A)	15.1 - 18.5 dB(A)	Major

10.7.3 Table 10-10 considers the four closest NSRs and indicates a major impact from construction noise activities due to the proximity of the NSRs to the nearest assessment boundary. A review of the preliminary design drawings suggests that the construction activities that may occur at a distance of 10 m or less are drainage/ ducting and surfacing works.

10.7.4 In reality the majority of the construction works will occur at a distance greater than 10 m from the four NSRs, with a typical average distance greater than 50 m. At 50 m the magnitude of noise impact is predicted to be minor adverse**.**

10.7.5 DMRB states that construction noise, shall constitute a significant effect where a major or moderate magnitude of impact would occur for a duration of:

- 10 or more working days (or evenings/weekends or nights) in any 15 consecutive days; or
- more than 40 days (or evenings/weekends or nights) in any 6 consecutive months.

10.7.6 At this stage there is insufficient information on the construction activities and programme to discount the possibility that the timescales outlined would be exceeded. Therefore, it is conceivable that a significant adverse effect due to construction noise may occur at these four NSRs.

10.7.7 Given the calculated noise levels at all other NSRs being 53 dB (LAeq,1hr) or less, the resulting magnitude of impact would be negligible to minor for daytime and evening activities, with the potential for a moderate to major magnitude of impact to occur during any night-time working dependent on pre-existing ambient night-time noise levels. Therefore, there is potential for a significant adverse effect at other NSRs dependent on the duration of night-time working and precise location of the construction activities taking place.

10.7.8 Consideration will therefore need to be given to additional controls to mitigate noise through the employment of Best Practicable Means (BPM) techniques by the

Principal Contractor. This is discussed further in Section 10.8.

Construction Vibration

10.7.9 The potential for temporary construction vibration impacts is dependent on the need for construction activities which are a potentially significant source of vibration, such as earthworks and road construction (pavement) works using hydraulic breakers and vibratory rollers.

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

10.7.11 The effects of vibration can vary according to a number of factors including: the magnitude of the vibration source, the particular ground conditions between the source and receiver, the foundation-to-footing interaction and the large range of structures that exist in terms of design (e.g. dimensions, materials, type and quality of construction, and footing conditions). The intensity, duration, frequency, and number of occurrences of a vibration all play an important role in both the annoyance levels caused and the strains induced in structures.

10.7.12 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.

10.7.13 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).

10.7.14 Receptors R1 to R4 are located within 20 m of the assessment boundary where using a large vibratory roller and a medium sized towed roller has the potential to generate vibration levels in excess of SOAEL for periods during the works.

10.7.15 The magnitude of the impact is considered moderate adverse at receptors R1 to R4 in accordance with the Magnitude of the Impacts for Construction Vibration in Table 10-3. Even when working at the closest assessment boundary, vibration levels are not expected to exceed the threshold for major adverse impact of 10 mms^{-1}

10.7.16 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.

10.7.17 As highlighted with noise impacts from construction, in reality the majority of the construction works will occur at distances greater than 50 m. At 50 m the magnitude of vibration impact is predicted to be negligible to minor adverse**.**

Operation

10.7.18 Detailed predictions have been carried out for a total of 662 receptors identified within the study area (which includes two other NSRs – Creative Care East Midlands (Care Home) and St Gilles Church.

10.7.19 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

10.7.20 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	12	0	11	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	199	0	215	0
Decrease in noise level dB $LA_{10,18hr}/L_{night}$ (beneficial)	0.1 - 0.9	Negligible	447	2	432	2
	1.0 - 2.9	Minor	2	0	2	0
	3.0 - 4.9	Moderate	0	0	0	0
	> 5	Major	0	0	0	0

10.7.21 During the daytime in the opening year of 2023, 67.8% of receptors within the 600 m study area are anticipated to experience a negligible beneficial impact (0.1 - 0.9 dB decrease) in traffic noise levels due to the Scheme. 1.8% are anticipated to experience a negligible adverse impact (0.1 - 0.9 dB increase) from traffic noise levels. Two receptors (0.3%) are anticipated to experience a minor beneficial impact (1.0 - 2.9 dB decrease) in traffic noise levels (receptors R1 and R3). The remaining 30.1% of receptors are anticipated to experience no change in traffic noise levels.

10.7.22 During the night-time, 65.5% of receptors within the 600 m calculation area are anticipated to experience a negligible beneficial impact (0.1 - 0.9 dB decrease) from traffic noise levels due to the Scheme. A further 1.7% are anticipated to experience a negligible adverse impact (0.1 - 0.9 dB increase) from traffic noise levels. Again, two receptors (0.3%) are anticipated to experience a minor beneficial impact (1.0 - 2.9 dB decrease) from traffic noise levels (receptors R1 and R3). The remaining 32.5% of receptors are anticipated to experience no change in traffic noise levels.

10.7.23 In the short-term, the overall trend is for either no change or a negligible to minor beneficial impact due to the introduction of the Scheme. This is likely to be primarily due to the larger gyratory, reduction in speed limits on approaches, and in the case of the two receptors experiencing a minor beneficial impact (receptors R1 & R3), due to the north bound exit on the A614 Blyth Road moving slightly further west.

10.7.24 Noise contours illustrating the predicted short-term (DMOY to DSOY) noise level change within the 600 m study area are presented in Figures 10-2 and 10-3 of Volume 2A.

Long-term

10.7.25 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	623	2	619	2
	3.0 - 4.9	Minor	0		0	
	5.0 - 9.9	Moderate	0		0	
	> 10	Major	0		0	
No Change	0	No Change	18		23	
Decrease in noise level dB $LA_{10,18hr}/L_{night}$ (beneficial)	0.1 - 2.9	Negligible	19		18	
	3.0 - 4.9	Minor	0		0	
	5.0 - 9.9	Moderate	0		0	
	> 10	Major	0		0	

10.7.26 During the daytime in the DMOY vs DSFY, 94.4% of receptors within the 600 m study area are anticipated to experience a negligible adverse impact (0.1 - 2.9 dB increase) from traffic noise levels. A further 2.9% are anticipated to experience a negligible beneficial impact (0.1 - 2.9 dB decrease) while the remaining 2.7% of receptors are anticipated to experience no change in traffic noise levels.

10.7.27 During the night-time (DMOY vs DSFY) similar results are obtained when compared to daytime. 93.8% of receptors within the 600 m study area are anticipated to experience a negligible adverse impact (0.1 - 2.9 dB increase) from traffic noise levels. A further 2.7% are anticipated to experience a negligible beneficial impact (0.1 - 2.9 dB decrease) from traffic noise levels, while the remaining 3.5% of receptors are anticipated to experience no change in traffic noise levels.

10.7.28 It should be noted that the negligible adverse impacts in the long-term will be mainly attributable to traffic growth over this period as illustrated in Table 10-8 of the Baseline Assessment.

10.7.29 As no receptors are expected to experience any adverse impact greater than a negligible adverse impact in both the short and long-term, it can be concluded that there would be no significant adverse effects during the daytime or night-time due to operational noise as a result of the implementation of the Scheme. Any beneficial impacts from the implementation of the Scheme would also not be significant.

Operational traffic noise – above SOAEL

10.7.30 Details of the number of residential receptors in the 600 m study area which are predicted to have one or more facades exposed to noise levels above the daytime or night-time SOAEL (68 dB(A) $LA_{10,18hr}$ or 55 dB(A) L_{night}) respectively in any of the four assessment scenarios are provided in Table 10-13.

Table 10-13 Number of residential buildings above the SOAEL

Scenario	Day ($LA_{10,18hr}$)	Night (L_{night})
DMOY	3	11
DSOY	3	10
DMFY	5	12
DSFY	4	11

10.7.31 For daytime traffic noise, the Scheme is predicted to result in no change (3no.) in receptors with one or more façades experiencing traffic noise levels above SOAEL in the short-term, with an overall reduction (from 5no. to 4no.) above SOAEL (68dB $LA_{10,18hr}$) in the long-term.

10.7.32 For night-time noise, the Scheme is predicted to result in an overall reduction (from 11no. to 10no.) receptors with one or more façades experiencing traffic noise levels above SOAEL (55dB L_{night}) in the short-term, and a reduction (from 12no. to 11no.) in receptors with one or more façades experiencing traffic noise levels above SOAEL (55dB L_{night}) in the long-term.

10.7.33 This demonstrates compliance with the NPPF which aims to ensure that development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment.

10.7.34 It is also demonstrated that the Scheme complies with the aims of the Noise Policy Statement for England (NPSE) which introduced LOAEL and SOAEL and sets out the Government's policy on noise and long-term vision of sustainable development to achieve the following:

- avoid significant adverse impacts on health and quality of life;
- mitigate and minimise adverse impacts on health and quality of life; and
- where possible, contribute to the improvement of health and quality of life.

Noise Important Areas

10.7.35 In the short-term, the three receptors which experience daytime traffic noise levels above the SOAEL are located in NIA 7780. The assessment indicates no change in noise levels at these receptors in the short-term (DMOY vs DSOY).

10.7.36 In the short-term, of the eleven receptors identified as experiencing night-time traffic noise levels above the SOAEL, eight are located in NIA 7780. Of these, seven would experience no change in night-time noise level whilst one would experience a negligible beneficial impact.

10.7.37 In the long-term (DMOY Vs DSFY), all receptors in the NIAs identified above would experience a negligible adverse impact during both the daytime and night-time. However, this is mainly attributable to traffic growth over the period rather than the direct implementation of the Scheme.

10.7.38 Overall, the Scheme would have no significant adverse impacts on any receptors within any of the identified NIAs within the study area in the short and long-term during both the daytime and night-time.

Noise Insulation Regulations

10.7.39 An initial assessment indicates that there are no receptors which would be eligible for noise insulation, as the assessment indicates that the 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;
- 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;
- undertake milling of pavement surfaces where possible which produces lower levels of non-damaging vibration compared to other breaking out methods; and
- where mechanical excavators and associated equipment is used to break up pavement surfaces ensure good practices are adopted and non-approved practices such as pounding large tarmac sections with excavator buckets and dropping from height to break into smaller pieces are prohibited.

10.8.2 There is also the potential for additional attenuation of noise from construction activities using localised temporary noise screening. This has not been included in the assessment of construction noise in order to represent a worst-case scenario. BS 5228 (Ref 11.16) advises that such screening can provide a reduction in noise levels of 5 dB when the top of the plant is just visible over the noise screening, and 10 dB when the plant is completely screened from a receptor. The effectiveness of a noise barrier depends upon its length, effective height, position relative to the noise source and to the receptors, and the material from which it is constructed. Therefore, the potential attenuation provided by any such additional localised screening cannot be quantified at this stage. Proposals for the use of localised temporary noise screening would be developed at the detailed design stage and implemented during the works.

10.8.3 In accordance with the aims of the NPSE and ProPG, the Scheme could potentially

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 4no. receptors (R1-R4)	Up to Major	Significant Adverse	BPM & temporary screening where feasible	Significant Adverse
Construction Vibration	High	Temporary 4no. receptors (R1-R4)	Up to Major	Significant Adverse	BPM	Significant Adverse
Construction Noise	High	Temporary 115no. receptors across study area	Negligible - Minor	Not Significant	-	Not Significant
Operational Traffic	High	Long-term. Local across study area (662 NSRs)	Negligible Adverse to Minor 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, 2020i). 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 to 11-3 in Volume 2A and Appendices 11-1 and 11-2 in Volume 3A. 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 Ollerton Roundabout.

Table 11-1: Scoping Response Summary

Consultee	Comment	Response and where addressed in the ES
NCC (Scoping Opinion)	Consultee states a Flood Risk Assessment is required, and also the need for a controlled waters risk assessment with regard to groundwater.	The FRA is included in Appendix 4-3 of Volume 3. A preliminary risk assessment for controlled waters has been undertaken based on the preliminary conceptual model within Appendix 9-1 in Volume 3A. 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.
Environment Agency	A detailed Flood Risk Assessment (FRA) will be required which needs to contain a plan identifying rivers and water bodies, a topographical survey of the existing and proposed site levels, information about historical flood risk, and the flood risk from all sources. The site overlies alluvium and Chester Sandstone Formation, Secondary A and Principal Aquifers respectively. The site also lies within Source Protection Zone 3. Drainage strategies were not available at the time of writing the scoping report (June 2021). 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 (in the scoping report) indicates that areas of infilled land may exist at the site, together with potential coal mining waste. Furthermore, the proposed scheme encroaches onto the fuel station 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.	The FRA is included in Appendix 4-3 of Volume 3. This includes the drainage strategy document. A preliminary risk assessment for controlled waters has been undertaken based on the preliminary conceptual model within Appendix 9-1 in Volume 3A. 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:

- existing scheme information, topographical data, site reports and consultations;
- Environment Agency data requests, received January 2021 (Environment Agency Reference EMD-191101) (EA, 2021a);
- online Ordnance Survey (OS, 2021) and aerial maps (Bing, 2021);
- Met Office (2021) website;
- British Geological Survey Geoindex website (BGS, 2021);
- 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);
- Highways England Drainage Data Management System (HADDMS) (Highways England, 2021a);
- 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. 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 have been no aquatic ecology surveys undertaken within the study area as noted in Chapter 8: Biodiversity. A desk study undertaken by Baker Consultants Ltd (2020) recorded no suitable habitat within 500 m and no protected aquatic invertebrates (see Appendix 4-5 of Volume 3).

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); and
- 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) (Highways England, 2020k) 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 these 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. The 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.

Evaluation of receptor importance

11.4.12 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 11-2 based on professional judgement.

11.4.13 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.

11.4.14 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

11.4.15 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 EC and 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 realigned or channelised with hard bank protection, or	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
			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, 2016b) 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 (Highways England, 2020i) 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

11.4.16 The magnitude of impact on the water environment has been established using the criteria outlined in Table 3.71 of DMRB 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 <+/- 10 mm.
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). ▪ Reduction or groundwater hazards to existing structures.

Magnitude of Impact	Criteria	Description
		▪ Reductions in waterlogging and groundwater flooding. Flood Risk: ▪ Creation of flood storage and decrease in peak flood level (>10 mm).
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 (>50 mm).
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 (>100 mm).
No change		No loss or alteration of characteristics, features, or elements; no observable impact in either direction.

Significance Criteria

11.4.17 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.

11.4.18 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.

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

Assumptions and Limitations

11.4.20 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 River Maun. There will be no new outfalls constructed into the ditch (Ollerton Brook) on Ollerton Road. The existing outfalls will be used.

11.4.21 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.

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

11.5 Baseline Conditions

Topography, Rainfall and Land Use

11.5.1 The area is characterised by the topography sloping generally from west to east, as the site is on the western side of the River Maun floodplain. Elevations in the area on the Ordnance Survey mapping on the A616 show 44 m and 47 m aOD east and west of the junction respectively.

11.5.2 The land use in the area is characterised by forestry to the west of the A6075 (to north-west, west and south-west of the junction), agricultural grassland within the floodplain of the River Maun, and east of the river the town of Ollerton with residential housing.

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 Features

11.5.4 The Scheme falls within one WFD (HMSO, 2015) water body catchment; ‘Maun from Rainworth Water to Poulter’ (GB104028058080), which is part of the Idle River operational catchment of the Humber River Basin Management Plan. There are two other WFD catchments within the study area, these are upstream of the main Scheme WFD catchment.

11.5.5 These are ‘Maun from Vicar Water to Rainworth Water’ (GB104028058040), and ‘Rainworth Water from Gallow Hole Dyke to Maun’ (GB104028052970). Their classifications are summarised in Table 11-4 below.

11.5.6 A main river, the River Maun, is located 250 m east of the existing roundabout and flows northwards under the A616 approximately 360 m east of the junction. There is also a spur of the River Maun culverted under the A614 approximately 80 m south of the roundabout. Approximately 250 m south of the junction there is the confluence of the River Maun and Rainworth water.

11.5.7 According to the Environment Agency's Catchment Data Explorer website (Environment Agency, 2021b) the 'Maun from Rainworth to Poulton' 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 urban and transport, water industry intermittent sewage discharges and agricultural and rural land management runoff. This has led to failures for mercury and its compounds, perfluorooctane sulfonate (PFOS) and polybrominated diphenyl ethers (PDBE). Within physico-chemical elements, all are noted as being High, with the exception of phosphate which is Poor.

11.5.8 According to the Environment Agency's Catchment Data Explorer, the 'Maun from Vicar Water to Rainworth Water' (GB104028058040) 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 urban and transport, water industry intermittent and continuous discharges and agricultural and rural land management runoff. This has led to failures for mercury and its compounds, PFOS and PDBE. Within physico-chemical elements, all are noted as being High, with the exception of phosphate which is Poor, and ammonia which is Moderate.

11.5.9 According to the Environment Agency's Catchment Data Explorer, 'Rainworth Water from Gallow Hole Dyke to Maun' (GB104028052970) is Poor Ecological Status (2019, with a target status of Poor by 2015, which it has met). Reasons for not achieving Good status are stated as water industry continuous discharges, and groundwater abstractions, and agricultural and rural land management runoff. This has led to a Poor status for macrophytes and phytobenthos combined, dissolved oxygen and phosphate. There are also failures for mercury and its compounds, and PDBE.

Table 11-4: WFD Classifications for study area waterbodies

Parameter	Maun from Rainworth Water to Poulter	Maun from Vicar Water to Rainworth Water	Rainworth Water from Gallow Hole Dyke to Maun
Designation	Main River	Main River	Ordinary Watercourse
WFD Catchment	Maun from Rainworth Water to Poulter	Maun from Vicar Water to Rainworth Water	Rainworth Water from Gallow Hole Dyke to Main
ID	GB104028058080	GB104028058040	GB104028052970
Hydromorphological Designation	Heavily modified	Heavily modified	Not designated artificial or heavily modified
Area	2806.3 ha	1195.8 ha	624.9 ha
Length	16.06 km	5.61 km	3.1 m
Overall Status (2019)	Moderate	Moderate	Poor
Ecological Status	Moderate	Moderate	Poor
Chemical Status	Fail	Fail	Fail
Overall Waterbody Objective	Moderate by 2015	Moderate by 2015	Poor by 2015

11.5.10 From the Environment Agency Water Quality Archive website there are a number of data points in the study area. The closest locations (to the north-west of the Ollerton Roundabout) are for sewage discharges. Upstream on the River Idle (Maun) is a

monitoring location at Blackhills Farm. This is located 900 m south-west, and upstream of the Scheme, and also is downstream of a Sewage Treatment Works. The only parameters monitored at this location are polyaromatic hydrocarbons (PAHs), tributyl tin, a phenol and an antibacterial agent triclosan. The data from a monitoring location located 3 km downstream at Whitewater Bridge is summarised below in Table 11-5.

Table 11-5: Summary of Water Quality Data from Whitewater Bridge (2016 – 2020)

Determinand	Unit	Min	Max	Average
pH		7.8	8.9	8.2
Temperature of Water	°C	4.2	19.7	10.2
Conductivity at 25°C	µs/cm	958	997	978.3
Ammoniacal Nitrogen as N	mg/l	0.1	0.4	0.1
Nitrogen, Total Oxidised as N	mg/l	11.0	19.8	15.4
Nitrate as N	mg/l	10.9	19.7	15.3
Nitrite as N	mg/l	0.0	0.5	0.1
Ammonia un-ionised as N	mg/l	0	0.01	0.0
Alkalinity to pH 4.5 as $CaCO_3$	mg/l	125	180	154.6
Orthophosphate, reactive as P	mg/l	0.31	0.68	0.48
Oxygen, Dissolved, % Saturation	%	67.6	142	100.7
Oxygen, Dissolved as O_2	mg/l	7.09	14.6	11.4

11.5.11 However, in order to carry out the HEWRAT calculations, data is also required on copper, zinc, dissolved organic carbon, and calcium concentrations. Information on these data points for monitoring data is obtained at two water monitoring locations downstream. dissolved organic carbon and calcium is obtained from the River Idle (Maun) at Markham Moor, located 9 km downstream. The data for dissolved copper and zinc is obtained from River Idle (Maun) at Haughton, 6 km north-east and downstream:

- pH average: 7.8 (River Idle (Maun) at Markham Moor);
- dissolved organic carbon average: 4.9 mg/l (River Idle (Maun) at Markham Moor);
- dissolved calcium average: 94.3 mg/l (River Idle (Maun) at Markham Moor);
- dissolved copper: 2.64 µg/l (River Idle (Maun) at Haughton); and
- zinc: 14.9 µg/l (River Idle (Maun) at Haughton).

11.5.12 There is a river flow gauge located on the River Maun at Whitewater bridge, approximately 2.5 km downstream (and north) of the site. This has a flow measured Q95 of 0.49 m^3/sec for a catchment area of 157 km^2 (UK Centre for Ecology and Hydrology, 2021). This flow would be expected to be similar to that within the study area.

11.5.13 There are ponds located within the study area, listed below in Table 11-6 and shown on Figure 11-1 within Volume 2A. These are private fishing ponds, or ponds in open space which are not hydrologically connected to the surface watercourses in the

study area.

Table 11-6: Ponds within 1 km of Ollerton Roundabout

Pond No.	National Grid Reference	Description
Pond Number 1	X: 464402 Y: 367674	700 m to north-west, pond located within forestry. Offline.
Pond Number 2	X: 465542 Y: 367874	550 m north-east, private fishing lake, part of Little John Lakes
Pond Number 3	X: 465564 Y: 367994	650 m north-east, offline private fishing lake, part of Little John Lakes
Pond Number 4	X: 465636 Y: 368033	650 m north-east, offline private fishing lake, part of Little John Lakes
Pond Number 5	X: 465648 Y: 368134	800 m north-east, offline private fishing lake, part of Little John Lakes
Pond Number 6	X: 465658 Y: 368162	800 m north-east, offline private fishing lake, part of Little John Lakes
Pond Number 7	X: 465709 Y: 368134	800 m north-east, offline private fishing lake, part of Little John Lakes
Pond Number 8	X: 465692 Y: 367446	600 m east, offline pond within woodland
Pond Number 9	X: 465735 Y: 367402	650 m east, offline pond within open space
Pond Number 10	X: 465756 Y: 367403	670 m east, offline pond within open space
Pond Number 11	X: 465768 Y: 367403	670 m east, offline pond within open space
Pond Number 12	X: 465797 Y: 367408	700 m east, offline pond within open space
Pond Number 13	X: 465818 Y: 367408	730 m east, offline pond within open space
Pond Number 14	X: 465836 Y: 367409	750 m east, offline pond within open space
Pond Number 15	X: 465849 Y: 367410	755 m east, offline pond within open space

11.5.14 No further water bodies with hydraulic connectivity were identified from a review of OS mapping or the site survey, although there may be minor drainage ditches that remain unknown, which have been assessed generically.

11.5.15 During a review of baseline information, a known socio-economic use of the River Maun was identified 3.5 km north of the A6075 crossing of the River Maun. The Nottinghamshire Anglers Association have a venue for fishing within the Walesby Forest Scout Camp, north of Ollerton.

11.5.16 Additionally, there are private fishing lakes known as Little John Lakes, these are noted above as Pond Numbers 2 – 7. These are offline to the River Maun and range from 550 m to 850 m north-west of the Scheme.

Water Resources

11.5.17 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 were requested from NSDC, and no PWS abstractions are located within 2 km of the site.

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

11.5.19 The study area is not contained within a drinking water protected or safeguard zone for surface water. The area is not within a drinking water safeguard zone for groundwater, though there is one located approximately 1.3 km north-east and downstream of the site.

11.5.20 There are seven surface water abstractions within the 1 km study area from the River Maun. These are for general agriculture, amenity use and for the production of energy as per Table 11-7.

Table 11-7: Surface Water Abstractions within 1 km of Ollerton Roundabout

Abstraction No.	Distance to Scheme	Description
1	Outside of 1 km study area, to south-west	General agriculture – spray irrigation, upstream on River Maun
2	850 m south-west	General agriculture – spray irrigation, upstream Rainworth Water
3	370 m south-west	General agriculture – spray irrigation, upstream River Maun
4	Outside of 1 km study area, to south-west	General agriculture – spray irrigation, upstream River Maun
5	170 m to south-east	Production of Energy, Mechanical Non Electrical, downstream River Maun (The Mill)
6	250 m to north-east	General agriculture – spray irrigation, downstream River Maun
7	Outside of 1 km study area	General agriculture – spray irrigation, upstream River Maun
8	Outside of 1 km study area, to south-west	General agriculture – spray irrigation, upstream River Maun
9	800 m north-east	Located downstream to north-east on River Maun, Maida Lane Lakes

11.5.21 From the information received from the Environment Agency, there are no groundwater abstraction licences in the study area.

11.5.22 There is one discharge consent that has been identified, although this is outside of the 1 km study area. This is private discharge located 2 km upstream on Rainworth Water from Gallow Hole Dyke to Main (GB104028052970).

Hydromorphology

11.5.23 Under the WFD 'Maun from Rainworth Water to Poulter' (GB104028058080) is described as heavily modified, with the hydromorphological supporting elements as 'Supporting Good' potential.

11.5.24 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 inform potential opportunities for mitigation or enhancements. The watercourses in close proximity to the site were identified as River Maun, Rainworth Water and two unnamed watercourses (drainage ditches, including the locally known 'Ollerton Brook'). These are described further in Appendix 11-1 of Volume 3A.

Nature Conservation and Aquatic Ecology

11.5.25 No records for protected aquatic species were returned from the Nottinghamshire Biological and Geological Records Centre (NBGRC), but the River Maun is known to contain protected European Eel. Further information is contained within Chapter 8: Biodiversity.

Geology, Hydrogeology and Soils

11.5.26 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).

11.5.27 From the geology and soils baseline (Chapter 9: Geology and Soils), the Ollerton Roundabout is underlain by alluvial deposits (clay, silt, sand and gravel), and to the north-east, east and south-west. Glaciofluvial deposits (sands and gravel) are located to the north-west of the study area. The superficial deposits are overlying the Sherwood Sandstone Group, Chester Formation (pinkish red or buff-grey, medium- to coarse-grained, pebbly, cross-bedded, friable sandstone). Whilst no manmade ground is shown on the geological mapping it is expected that made ground would be present across much of the area of the Scheme as a result of the construction of the road.

11.5.28 The bedrock geology is classified as Principal Aquifer, with the areas of superficial alluvium being designated as Secondary A Aquifer.

11.5.29 The Scheme and study area lie 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.

11.5.30 The whole area is contained within a Zone 3 (total catchment area) Source Protection Zone (SPZ) for abstractions.

11.5.31 There are records of three boreholes in the area to the south of the roundabout, west of the A614. SK66NE104 – 106 were drilled to 6 m below ground level in the area of the current filling station in 1967. Borehole 104 and 105 encountered 2.2 m of made ground overlying dense red slightly gravelly sand. Borehole 106 encountered 0.95 m of made ground overlying 1.45 m of alluvial deposits overlying the dense red slightly gravelly sand. No water strikes were noted.

11.5.32 From the Soilscapes website, the study area consists of 'freely draining slightly acid sandy soils' with 'naturally wet very acid sandy and loamy soils' being located in the

area of the alluvial deposits. The latter are described as naturally wet.

11.5.33 A ground investigation has recently been undertaken by Nichols Colton Group for Via (see Appendix 9-2 of Volume 3A). As part of the ground investigation groundwater seepage for noted in borehole WS09 at 6 m below ground level (bgl) at National Grid Reference 465157, 367534, 40 m east of the current circulatory of the roundabout. As a result, a piezometer was installed with a response zone of 1 – 10 m bgl. Subsequent groundwater level monitoring from 15th June to 10th September 2021 has monitored groundwater levels of 5.29 m to 5.40 m bgl within the borehole. The borehole was formed at 41.2 m aOD, which gives a groundwater level of approximately 35.8 m aOD.

Road Drainage

11.5.34 The existing road catchment comprises four catchments, two of which drain eastwards to ditches alongside the A616 and two of which drain to the ditch tributary (Ollerton Brook) which crosses under Newark Road. The existing drainage includes gullies and catchpits. The catchment areas of the four catchments are listed below:

- Catchment 1: 3,004 m^2;
- Catchment 2: 3,256 m^2;
- Catchment 3: 784 m^2; and
- Catchment 4: 259 m^2.

11.5.35 The total catchment area for the outfalls is 7,303 m^2, or 0.73 ha. The outfalls into ditches discharge to the River Maun.

Water Dependent Ecological Areas and Relevant Protected Species

11.5.36 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 Ollerton Roundabout Study Area. The reasons for designation do not appear to have water dependent habitats. These are shown on Figure 11-1.

11.5.37 These sites are scoped out of further assessment based on extent of Scheme design and the designations not being water based, e.g. not marshes or wet woodland habitats.

Flood Risk

Fluvial flood risk

11.5.38 The Environment Agency Flood Map for Planning shows the roundabout to be partially in Flood Zone 2 and Flood Zone 3, with some of the south and eastern approach roads shown to be Flood Zone 3. The western approach road is in Flood Zone 2 and the northern approach roads in Flood Zone 1. The fluvial flood risk associated with these Flood Zones is from the River Maun, approximately 100 m from the Scheme at its closest point, which flows in a south-west to north-east direction along the edge of the village of Ollerton. The stretch of the river passing through Ollerton has been heavily managed. At Newark Road the River Maun has been split into two separate channels, one channel flows under a bridge on Newark Road and the other channel is culverted under the road where it later opens. The River then joins back up just before passing under the A616 (Ollerton Road) and continuing its course towards Haughton.

11.5.39 The Environment Agency flood map does not show the Scheme to be located in an area that benefits from flood defences.

11.5.40 The 2007 Environment Agency flood model of the River Maun was available for use in the FRA. Based on this, most of the roundabout is at low risk of flooding except parts of the southern two arms which are at a high risk of flooding. More details of the modelled flood levels are available within the FRA (Appendix 4-3 of Volume 3).

Historical flooding

11.5.41 Within the Nottinghamshire Local Flood Risk Management Strategy 2016 – 2021 (NCC, 2016) flooding events are noted within the Ollerton area for 2007, 2013, 2014-early 2015. These flood events were noted as being mainly surface water and ordinary watercourse events. Additionally, in 2012 a flood event caused problems in Ollerton where the A616 Worksop Road was shut for several days in both directions at the junction with the A614 Blyth Road.

Surface water flood risk

11.5.42 The Environment Agency Risk of Flooding from Surface Water map indicates that the risk of surface water flooding at Ollerton Roundabout is generally classed as very low to low. Surface water runoff generated on the A616, A614 and Newark Road is drained via gullies and kerb outlets either directly back into the River Maun through a series of pipes or into a small heavily vegetated tributary which runs south of the A616.

11.5.43 On a site visit, it was observed that the site is at risk of surface water flooding. The roundabout sits at the bottom of a depression with the surrounding roads feeding down into it which is likely to lead to a large collection of standing water at the base of the roundabout in the event of a flood. This was confirmed on a topographic map of Ollerton which shows the roundabout sits at 44 m above sea level whereas the incoming roads sit around 3 m higher on average.

Flooding from artificial water bodies

11.5.44 The Environment Agency Risk of Flooding from Reservoirs map indicates that the proposed Scheme at Ollerton lies on the edge of an area considered to be at risk from reservoir flooding. The area shown to be at risk of reservoir flooding is along the River Maun corridor and covers a similar extent to the fluvial Flood Zones. The maximum flood depth likely from the reservoir has been assessed as low (<0.3 m) and medium (0.3 – 3 m).

Flooding from groundwater

11.5.45 The soils within the study area are largely described as freely draining, slightly acid sandy soils. Soils associated with the River Maun, to the east of the existing roundabout, are described as naturally wet, very acid, sandy and loamy soils. The groundwater level monitoring shows ground water levels at between 5.29 m to 5.40 m below ground level.

Tidal flooding

11.5.46 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

11.5.47 The risk of flooding from drains and sewers is considered to be related to surface water flooding, and is low.

Future Baseline Conditions

11.5.48 There are no other developments to consider for the future baseline within the study area for the Scheme.

Opening year baseline (2024)

11.5.49 The surface WFD waterbodies have currently met their current target objectives and are unlikely to be improved before 2024. 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 baseline.

11.5.50 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)

11.5.51 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 2022. 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.

11.5.52 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

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

Table 11-8: Water Body Importance

Receptor Name	Receptor Type	Importance	Justification
River Maun	Water quality	High	River Maun is a WFD waterbody, classified as being of Moderate potential. A flow gauge downstream has a Q95 of 0.49 m^3/s (i.e. <1.0 m^3/s). This is a watercourse, whose quality will be affected by local industry, road runoff, sewage discharges, and agricultural runoff. European Eel are recorded within the River Maun.
	Hydromorphology	High	River Maun is designated as heavily modified and sections have been altered by culverting under the roads in the area, as well as a network of sluices and weirs associated with historic mill buildings.
	Flood risk	Medium	Majority of Flood Zone 2/3 within the Environment Agency Flood Map for planning. The area is mainly undeveloped and consists of open space (water compatible) and agricultural land (less vulnerable). However, the area of the junction is located within Flood Zone 2/3, and adjacent to the junction there is a Public House, a fast-food outlet and petrol station all located within the Flood Zone 3. The 2007 Environment Agency flood map shows less likelihood of flooding in the area of the junction.

Receptor Name	Receptor Type	Importance	Justification
Rainworth Water	Water quality	High	Rainworth Water is a WFD waterbody, classified as being of Poor potential. A flow gauge downstream on the Maun has a Q95 of 0.49 m^3/s (i.e. <1.0 m^3/s). This is a watercourse, whose quality will be affected by local industry, sewage discharges, and agricultural runoff.
	Hydromorphology	High	Rainworth Water is designated as not artificial or heavily modified and sections have been altered by culverting under the roads and a railway in the area, with Rufford Lake contained a dam structure.
	Flood risk	High	Majority of Flood Zone 2/3 is undeveloped and consists of open space (water compatible) and agricultural land (less vulnerable). However, the area of the junction is located within Flood Zone 2/3 associated with the River Maun to which Rainworth Water Flow would contribute. Where construction workers may be present in areas of flood risk, it is considered the importance of this temporary land use is considered a very high
Local ponds	Water quality	Medium	Various water body ponds in the local area.
Drainage Ditches	Water quality	Low	Roadside drainage ditches which discharge to the River Maun
	Hydromorphology	Low	Roadside drainage ditches which discharge to the River Maun
Idle Torne – pT Sandstone Nottinghamshire & Doncaster (GB40401G301500) WFD groundwater body	Groundwater	High	The bedrock is a Principal Aquifer providing a locally important resource, with potential for use as local water supplies, also as potential feeds to watercourses. The Poor WFD status should not detract from the water resources importance.

Floodplain Sensitivity for Impact Assessment

11.5.54 Most of the Scheme area for works is within Flood Zone 3. The majority of the Flood Zone 2/3 is undeveloped, with areas of open space (water compatible) and agricultural land (less vulnerable). However, the area of the roundabout is located within Flood Zone 2/3, and adjacent to this there is a Public House, a McDonald's outlet and petrol station all located within the Flood Zone 3. These areas are within flood warning and flood alert areas. The 2007 Environment Agency flood modelling shows less risk of flooding in the area of the roundabout, the importance is considered to be medium.

11.5.55 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, with localised areas of medium importance within the Scheme boundary;
- flooding from groundwater sources is considered to be low importance; and
- flooding from artificial sources is considered to be of low importance.

11.6 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 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 Water Management Plan (WMP) that would be included as a technical appendix. The WMP 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, 2009a);
- British Standards Institute (2013) BS8582 Code of Practice for Surface Water Management of Development Sites (BSI, 2013b);
- C753F (2015) The SuDS Manual (second edition) (CIRIA, 2015a);
- C741 (2015) Environmental good practice on site guide (fourth edition) (CIRIA, 2015b);
- 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 with 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' (Ref 50). 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 20 m 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 the River Maun.

11.6.13 The drainage design comprises pipework with a rectangular buried attenuation tank 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. There is currently no attenuation for routine runoff of rainwater from this junction. The proposed five catchments have the following areas and characteristics:

- Catchment 1: 1,622 m^3 discharges into existing system at a catchpit on north side of A616 eastern arm;
- Catchment 2: 986 m^3 discharges into existing ditch system on south side of A616 eastern arm;
- Catchment 3: 405 m^3 new bus lane discharges into existing ditch to north side of Newark Road;
- Catchment 4: 741 m^3 discharges from the southbound side of Old Rufford Road into existing system at a catchpit on Newark Road, then into existing ditch via outlet into the drainage ditch passing under Newark Road;
- Catchment 5: 5,202 m^3 runoff from this catchment is directed to the attenuation tank located within the middle of the roundabout junction. The flow is then directed through a flow control chamber into the existing system discharges via outlet into the drainage ditch passing under Newark Road.

11.6.14 The drainage ditch passing under Newark Road was viewed during the field survey. This passes underneath Newark Road, is culverted to the south-west underneath the businesses to the south of the roundabout and passes north-west to cross under the A616 240 m east of the roundabout. The drain is a grassed channel passing through horse fields/ hobby farm fields. It was dry on the day of the visit, and looks like it is mainly a dry ditch from the established grass vegetation.

11.6.15 From information received from the current maintaining agent, the roundabout does flood during sustained heavy rainfall events. It is believed there may be a soakaway in the verge between the A616 and A614 northbound exits, though this evidence of this was not seen during the site visit. The proposed drainage plan does not discharge to this potential feature.

11.6.16 The existing impermeable area is 7,303 m^2, with the proposed impermeable area measuring 8,956 m^2 – an increase of increase of 1,653 m^2. As a result of the roundabout improvement scheme there is an increase of 23% impermeable area within the assessment boundary of the Scheme.

11.6.17 Without attenuation increased flows may result in bank erosion, increased sediment loading, greater flooding and increased pollution to the receiving River Maun. The specific treatment approach adopted for each road catchment has been designed to reflect the extent of flow attenuation required. The largest catchment is Catchment 5 with over 5,000 m^2 thus this catchment contains the flow attenuation.

11.6.18 Drainage from the Scheme will tie into the existing drainage at the site. The design includes using the existing outfalls to adjacent ditches, with no new outfalls to watercourses or WFD watercourse the River Maun. There is a new outfall from the 405 m^2 of bus lane into a ditch on north side of Newark Road. This feeds into the drainage ditch that crosses under Newark Road.

11.6.19 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 the drainage discharges to existing ditches adjacent to the southern and northern side of A616 and Newark Road, both to the east of the roundabout junction. These ditches provide the opportunity for water quality mitigation before the runoff water discharges to the River Maun WFD waterbody.

11.6.20 The drainage for the improvement Scheme will discharge to the ditches using the existing outfalls, with the exception on the small Catchment 4. This will discharge into a roadside ditch. No new outfalls are required to be constructed within watercourse.

11.6.21 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.

11.6.22 The FRA concludes that no mitigation is required within the design for fluvial flooding, groundwater, sewer or artificial sources flooding. Mitigation is included within the design for surface water flooding. A surface water attenuation tank will collect water and then release the surface water using a flow control chamber into the existing system that discharges into an existing ditch on Newark Road. No further mitigation is required for the Scheme.

Watercourse crossings, realignments, diversions, and culverts

11.6.23 The design of the Scheme ensures no works to be taken place in parts of the road network which cross the River Maun, or the local drainage ditch linked to the River Maun. There will be no diversions or construction of new culverts.

Relevant permits, consents and licences

11.6.24 The improvement Scheme does not cross any ordinary watercourses of main rivers. As they are located within an area at risk of flooding, the works will require a flood risk activity permit from the Environment Agency under the Environmental Permitting (England and Wales) Regulations 2016, where exemptions do not apply. The requirement for these will be determined during discussion with Environment Agency during pre-construction planning for the Scheme.

11.6.25 Temporary discharges of ‘unclean’ runoff may also require a water activity permit under the Environmental Permitting (England and Wales) Regulations 2016 (HMSO, 2016b) 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 the River Maun as this is hydrologically connected to the existing drainage system and the unnamed ditched (known locally as Ollerton Brook) which passes under Newark Road south-east of the roundabout.

11.7.5 Construction works for the Scheme have 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 River Maun which is of high importance, and drainage ditches in the study area which are of low importance would be negligible. This gives a temporary slight adverse effect (not significant) for River Maun and a neutral effect (not significant) for the local drainage ditch crossing Newark Road.

11.7.8 The waterbody knows as Rainworth Water is upstream of potential impacts from the Scheme. As there is no pathway for impacts to affect this watercourse it was scoped out of further assessment.

Groundwater flow and quality

11.7.9 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. Groundwater levels within BGS logs indicate a low potential for groundwater to be located within 2 m of ground level. However, a subsequent ground investigation has monitored groundwater at over 5 m bgl east of the roundabout.

11.7.10 The Scheme comprises improvements to an at-grade junction and therefore there would be minimal impact on groundwater level, flow and quality. The construction of the attenuation tank requires excavation for the 0.8 m high structure to be buried within the roundabout. Based on the groundwater level monitoring, the temporary excavation is unlikely to reach the groundwater table. Therefore, this excavation

and construction is unlikely to locally affect the flows and quality in adjacent watercourses. However, there is a limited potential for the excavation to intercept a perched groundwater table which would require temporary dewatering during construction.

11.7.11 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 high importance receptor, this results in a slight adverse effect (not significant).

Potential risk of flooding from fluvial sources during construction

11.7.12 The construction phase of the Scheme would involve works in Flood Zone 2 and 3. However, there will be no works to highway ditches close to the existing watercourse drainage network. Should a fluvial flood event occur during construction this could create a significant risk to construction workers in the vicinity of these drainage assets. The baseline risk could be exacerbated during construction by the temporary increase in the rate and volume of surface water runoff from an increase in impermeable areas such as compacted soils, and the presence of stockpiled materials and equipment temporarily stored on the site. Sediment, construction materials and equipment could be washed downstream where it may block the drainage network and lead to or increase the risk of flooding.

11.7.13 However, with the implementation of standard construction methods and mitigation as described in the CEMP this risk can be effectively managed (for example by monitoring weather forecasts and Environment Agency flood warnings; undertaking works to the drainage network during periods of dry weather; ensuring an adequate temporary drainage system is in place and maintained throughout the construction phase; and avoiding stockpiling material on floodplains). As such, the magnitude of flooding from these sources on site and further downstream is ‘no change’ resulting in a neutral effect (not significant).

Potential risk of flooding from surface water sources during construction

11.7.14 The Scheme is in generally at a low risk from surface water flooding with some areas at medium risk. 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 11.7), this risk can be effectively managed. As such, the impact of flooding from these sources, in comparison to the existing roundabout junction, is ‘no change’ 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. The construction of this Scheme will not change the potential flood risk from these sources. As such, with the implementation of the measures outlined in the CEMP and WMP, flooding from these sources is considered to be ‘no change’ , resulting in a neutral effect (not significant).

Potential risk of flooding from groundwater sources during construction

11.7.16 The Scheme is 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. The quantity of excavation with this Scheme is minimal, and groundwater has been monitored over 5 m below ground level. Therefore, it is considered there is, a negligible magnitude of impact 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 1650 m^2 in the area of the roundabout where pollutants (including hydrocarbons, heavy metals and sediments) can accumulate and be washed into receiving watercourses as routine road runoff, if not treated. The drainage design proposes to tie into the existing drainage system for the road network, which drains to the existing roadside ditches to north and south of the A616, and to a drain which passes under Newark Road. These subsequently drain to the River Maun. This would occur through two existing outfalls and so there would be no direct works to watercourses. There is a new roadside ditch to be constructed as part of Catchment 4, the new bus link road, with a small 405 m^2 catchment area.

11.7.18 Catchments 1 to 5 discharge to ditches as their pathway to the River Maun. 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 the River Maun.

11.7.19 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 3A contains the detail of the HEWRAT assessment.

11.7.20 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 for the proposed Scheme layout.

11.7.21 Additionally, a sensitivity analysis has been carried out to cover the uncertainty of the extra area of roads outside of the assessment boundary that feed into this drainage system and therefore contribute to the impermeable area supplying the runoff to the outfalls. This has been carried out by increasing the area of impermeable area up to a total of 10 ha. Due to the high dilution available within the River Maun there was no significant change in the results seen in the results.

11.7.22 However, because the ambient copper concentration in the receiving watercourses is currently high (2.64 µg/l), the assessment of annual average copper against the environmental quality standard (EQS) fails for the combined outfall to the River Maun. However, the addition of road drainage has only increased the ambient copper concentration by 0.04 µg /l over and above that already monitored within the River Maun by the Environment Agency (at 2.64 µg /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 River Maun is 0.14 µg /l. A concentration of over 1 µg /l would fail the annual EQS concentration for dissolved copper, therefore this value would pass the assessment.

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 within DMRB LA 113.

11.7.26 Results of the groundwater assessment for the ditch tributary of the River Maun, 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 quality. 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 River Maun. Furthermore, drainage occurs to this watercourse under the existing situation, and the extra impermeable area is not considered significant in the context of the local area. 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 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 600 mm)
4	Infiltration Method	15	Continuous – shallow linear, unlined ditch	River Maun = 0.49 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

11.7.27 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.

11.7.28 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 the River Maun. 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)	A616 west : 7044 / 3.7% A614 north : 10840 / 6.7% A616 east : 18987 / 2.8% A614 south : 19239 / 4.9% A6075 south-west : 9315 / 2.8%	AECOM Traffic data
AADT (2037 Design Year, two way) / % HGV (Do Something)	A616 west : 7469 / 3.6% A614 north : 11699 / 6.5% A616 east : 20967 / 2.8% A614 south : 22585 / 4.7% A6075 south-west : 13673 / 2.9%	AECOM Traffic data
Length of Road	Assumed 1 km for each arm, And 735m for the roundabout (with 100 m being on each arm)	Measured from Magic Maps
Road Type / urban or rural	A road / Rural trunk road	Ordnance Survey Map
Spillage Risk Factor	0.29 for each arm, and 3.09 for the roundabout and 100 m of each road leading to roundabout	Spillage Factor from HEWRAT Spillage Risk Tool
Emergency Response Time	<20 mins, as Mansfield 10 miles away	Estimated from distance to local large town

11.7.29 As the total length of road contributing to each catchment is not known at the time of writing, it has been assumed that there is 1 km of road from each arm contributing to the discharges from the outfalls to the River Maun in this area. This is likely to be higher than is currently the case for some of the roads based on topography and the road network. Even with the conservative increase in length of contributing roads, the result from the spillage assessment show that the risk of an accidental spillage resulting in a pollution incident is calculated at 0.0005, or 1 in 2078 years for the Do Minimum scenario design year.

11.7.30 For the Do Something scenario in the design year, the traffic flows increase which leads to a 0.0007, or 1 in 1501 years risk that a spillage would result in a significant pollution incident.

11.7.31 Both scenarios are less than 1%. The risk is therefore considered acceptable for the outfall to the River Maun 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.

11.7.32 A negligible impact to the River Maun high importance receptor results in a slight adverse effect (not significant) from accidental spillages to River Maun.

Surface water quality: surface de-icing

11.7.33 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.

11.7.34 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 is less active and dormant, 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.

11.7.35 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.

11.7.36 As a broad indication of spreading rates, the Highways Winter Maintenance: A Practical Guide (Institute of Civil Engineers, 2000) suggests 10 to 20 g/m^2 of salt in a precautionary salting, increasing to 20-40 g/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, the River Maun is of sufficient size in this area to provide dilution.

11.7.37 The NCC Gritting map (NCC, 2021b) shows the roundabout and its roads are all part of the main routes for gritting. While the Scheme increases the impermeable area at Ollerton Roundabout slightly in comparison to the existing situation (an additional approximately 1,650 m^2), this is not considered of significant area in the context of the local catchment area. Additionally, the flow from the largest catchment area will be directed through the attenuation tank to be constructed underneath the middle of the roundabout. 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 the River Maun.

Groundwater flow

11.7.38 Once the Scheme is operational and the ground re-profiled, the magnitude of impact to groundwater flow is considered to be negligible given that the Scheme is to be constructed at grade. As such, given that the groundwater body is of medium importance, and the magnitude of the impact is negligible, the significance of effect is neutral (not significant).

Flood Risk Effects

Potential increased risk of fluvial flooding

11.7.39 From the 2007 Environment Agency flood model, most of the roundabout is at low risk of flooding, except for the southern two arms, which are at high risk of flooding. Overall the flood risk from fluvial flooding is considered to be medium. The road improvement design will not change this, and is a small expansion of an existing roundabout junction. A drainage strategy has been incorporated which attenuates flow from Catchment 5 through a flow control chamber. Flood risk is not increased to the Scheme or elsewhere. As the impact on flood risk is negligible, this results in a slight adverse effect (not significant) given that fluvial flood risk is of medium importance, with some area of high importance, in parts of the site.

Potential increased risk of surface water flood risk

11.7.40 The site is considered as being at a low risk of surface water flooding, with some areas of medium risk. The addition of an attenuation tank to Catchment 5, with a flow control chamber, will mitigate the increase to the impermeable area within Catchment 5. Overall, a negligible impact is anticipated to surface water flood risk, both on and off site. This results in a neutral effect (not significant).

Potential increased risk of flooding from groundwater

11.7.41 The FRA (Appendix 4-3 in Volume 3) indicates that there is low risk of flooding from groundwater. As there is no change to the discharges for the proposed Scheme in comparison to the existing junction, a ‘no change’ impact on groundwater flooding is predicted resulting in a neutral effect (not significant)

Potential increased risk of flooding from artificial sources and sewers

11.7.42 The site is at low risk of flooding from artificial sources, sewers and other water supply infrastructure. As the proposed drainage strategy does not alter the location of the discharges, and Catchment 5 is attenuated, there would be ‘no change’ impact to the flood risk from existing sewers and drainage infrastructure. This would result in a neutral effect (not significant).

11.8 Additional Mitigation

11.8.1 No additional mitigation is considered to be required.

11.9 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 (River Maun)	High	Negligible	Slight adverse	Not required	Slight adverse
Surface water quality (Ollerton Brook)	Low	Negligible	Neutral	Not required	Neutral
Groundwater flow and quality	High	Negligible	Slight	Not required	Slight adverse
Flooding from fluvial sources	Medium	No change	Slight adverse	Not required	Slight adverse
Flooding from surface water sources	Low to Medium	No change	Neutral	Not required	Neutral
Flooding from drainage and artificial sources	Low	No change	Neutral	Not required	Neutral
Flooding from groundwater	Low	Negligible	Neutral	Not required	Neutral
Complete and Operational					
Surface water quality – routine run-off (River Maun)	High	Negligible	Slight	Not required	Slight adverse
Surface water quality – de-icing (River Maun)	High	Negligible	Slight	Not required	Slight adverse
Groundwater quality	High	Negligible	Slight	Not required	Slight adverse
Groundwater flow	High	Negligible	Neutral	Not required	Neutral
Accidental spillages	High	Negligible	Slight	Not required	Slight adverse
Flooding from fluvial sources	Medium	Negligible	Slight adverse	Not required	Slight adverse

Description of Effect	Sensitivity of Receptor	Magnitude of Impact	Initial Classification of Effect (with embedded mitigation)	Additional Mitigation	Residual Effect Significance
Flooding from surface water sources	Low to Medium	Negligible	Neutral	Not required	Neutral
Flooding from drainage and artificial sources	Low	No change	Neutral	Not required	Neutral
Flooding from groundwater	Low	No change	Neutral	Not required	Neutral

12. CLIMATE

12.1 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 Scheme at Ollerton Roundabout. It also considers the impacts of climate change on the Scheme. The overall Project summary detailing the cumulative impacts of all the Schemes which compose the Project are detailed in Volume 1 Chapter 12: Climate.

12.1.2 To align with the requirements of the EIA Regulations and DMRB LA 114 Climate (Highways England, 2021b), 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.

12.2 Legislation and Policy

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

12.3 Consultation

12.3.1 A summary of the climate related responses from the Scoping Opinion, which relate to the Scheme at Ollerton Roundabout, 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.

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 carbon 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 operational 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 to determine significance. Where a project stage extends over multiple carbon budget periods, the project's GHG emissions are considered against each carbon budget for each project stage. A project is only considered to have a significant effect where increases in GHG emissions will have a material impact on the ability of Government to meet its carbon reduction targets. Consideration will be given to how the Scheme will operate in line with the UK Government's target to achieve net zero emissions by 2050 since the current carbon budgets are based on the 80% reduction target up until 2032, the 5th carbon budget. The UK Carbon Budgets are detailed in Table 12-5.

Table 12-5 UK Carbon Budget

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.

Climatic Parameter	Scoped in or out	Rationale for inclusion conclusion
Temperature	In	Increased temperatures may increase cooling requirements of the Scheme and could impact on structural integrity of roads and materials.
Sea level rise	Out	The Scheme is not located in an area that is susceptible to sea level rise.
Precipitation	In	The Scheme may be vulnerable to changes in precipitation, for example, pressure on water supply during periods of reduced rainfall, and damage to structures and drainage systems during periods of heavy precipitation.
Wind	Out	The impacts of wind on receptors in the surrounding environment are likely to be no worse relative to baseline conditions.

Baseline Conditions

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 approximately 87 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 Scheme to climate change impacts in operation. It included all infrastructure and assets associated with the Scheme and assessed resilience against both gradual climate change, and the risks associated with an increased frequency of extreme weather events.

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
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 a matrix as detailed in Table 12-9, below. 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; and
- topsoil assumed in situ therefore 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 Scheme value; and
- the Scheme value has been calculated based on the cost of civils for each junction and one quarter of the total cost given for land and fees (cost for total works divided into four junctions evenly).

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, 30 km from Ollerton Roundabout) 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 (oC)	-	13.4
Warmest month on average (oC)	July	21.3
Coldest month on average (oC)	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 (oC)	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 greenhouse gas 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 (oC), 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 (-3.2 to +5.8)	-1.8 (-8.5 to +5.3)	-1.5 (-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;	SWMP by the Principal Contractor

	• Implementation of a 'just-in-time' material delivery system to avoid materials being 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 Principal Contractor would develop and implement a plan to prevent or reduce the likelihood of climatic hazards affecting construction staff and assets.	CEMP SWMP 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 of Volume 3A 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)
	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

Lifecycle Stage	Mitigation Measures	Delivery Mechanism
	The detailed landscaping proposals are to include drought, and extreme weather -tolerant species where appropriate.	Landscape Proposals (see Appendix 2-2 of Volume 3A)

12.8 Assessment of Likely Significant Effects

Construction

12.8.1 As described in ES Volume I Chapter 2: The Scheme, the construction stage is anticipated to take approximately 87 weeks for the junction improvements to Ollerton Roundabout.

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. As such, 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 1,288 tCO_2e over the course of the 92-week construction period. The majority of emissions are associated with embodied carbon of transport of materials to site accounting for approximately 53% 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	420	33%
Fuel usage onsite	37	3%
Transport of materials to site	686	53%
Disposal of construction waste	44	3%
Employee commuting	101	8%
Total emissions	1,288	

GHG Emissions Significance

12.8.6 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	0.001288	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 12.7, 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

Climate Variable	Potential Impacts from Climate Variables	Likelihood (Probability and Frequency of Occurrence) 2020-2039	Measure of Consequence	Significance Level
Increased winter precipitation	Flooding of construction site, damage to site assets, danger to construction workers, inaccessible work site	Medium	Minor Adverse	Not Significant
Decreased summer precipitation	Drought	Low	Negligible	Not Significant
Increased summer and winter temperatures	Heat stress to construction workers, deterioration of materials and assets, overheating of electrical equipment	Medium	Minor Adverse	Not Significant

Operation

12.9.3 During operation, receptors such as the road users, physical assets, maintenance workers, maintenance plant and maintenance vehicles may be vulnerable to a range of climate risks. These could include:

- inaccessible maintenance site due to severe weather event (flooding, snow and ice, storms) restricting working hours and delaying construction;
- health and safety risks to the workforce and road users during severe weather events;
- unsuitable conditions (due to very hot weather or very wet weather, for example) for certain construction activities; and
- damage to assets, landscaping, materials, plant and equipment as a result of stormy weather, flooding and excessive heat.

12.9.4 In consideration of the embedded and design mitigation and management measures described in Section 12.7, the resulting significance matrix for climate vulnerability has been undertaken in Table 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	Flooding and storm damage to site and site assets, danger to maintenance workers and road users, inaccessible work site,	Medium	Minor Adverse	Not Significant

Climate Variable	Potential Impacts from Climate Variables	Likelihood (Probability and Frequency of Occurrence) 2020-2039	Measure of Consequence	Significance Level
precipitation, storm events and heatwaves)	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			
Increased winter precipitation	Flooding of the site, damage to site assets, danger to maintenance workers and road users and drainage systems, inaccessible work site, damage to roads, land subsidence, damage to landscaping	Medium	Minor Adverse	Not Significant
Decreased summer precipitation	Drought, damage to landscaping	Medium	Negligible	Not Significant
Increased summer and winter temperatures	Heat stress to maintenance workers, deterioration of materials and assets, overheating of electrical equipment, thermal expansion and movement of bridge joints and paved surfaces, damage to landscaping	Medium	Minor Adverse	Not Significant

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 Residual effects are summarised in Table 12-20 and Table 12-21.

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	Medium	Long-term, isolated to the Scheme	Low	Minor Adverse	No further mitigation measures	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
extreme weather events (such as heavy and/or prolonged precipitation, storm events and heatwaves)					are proposed	
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;
- Geology and soils;
- 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:

- Landscape and visual; 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
Visual Effects	Residents at Forest Side (represented by photoviewpoint 2)	Construction	Standard mitigation measures, no additional mitigation.	Moderate adverse
Construction Noise	Temporary 4no. receptors (R1-R4) Blyth Road (A614)	Construction	BPM and temporary screening where feasible	Significant adverse
Construction Vibration	Temporary 4no. receptors (R1-R4) Blyth Road (A614)	Construction	BPM	Significant adverse

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15. ABBREVIATIONS

Abbreviation	Definition
AADT	Annual Average Daily Traffic
AAWT	Annual Average Weekday 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
CH_4	Methane
CIEEM	Chartered Institute of Ecology and Environmental Management
CL:AIRE	Contaminated Land: Application in Real Environments
CO_2	Carbon Dioxide
CoPA	Control of Pollution Act
CRTN	Calculation of Road Traffic Noise
cSAC	Candidate Special Area
CWS	County Wildlife Site

Abbreviation	Definition
dB	Decibel
DCP	Dynamic Cone Penetration
Defra	Department for the Environment Food and Rural Affairs
DfT	Department for Transport
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
EcIA	Ecological Impact Assessment
ECoW	Ecological Clerk of Works
EHTO	Environmental Health Technical Officer
EIA	Environmental Impact Assessment
EQS	Environment Quality Standard
ES	Environmental Statement
ESA	Environmentally Sensitive Area
ETRO	Environmental Health Technical Officer
EU	European Union
FRA	Flood Risk Assessment
GCN	Great Crested Newt
GHG	Greenhouse Gas
GLVIA	Guidelines for Landscape and Visual Impact Assessment
GPA	Good Practice Advice
GWDTE	Groundwater Dependent Terrestrial Ecosystem
HDV	Heavy Duty Vehicle
HE	Historic England
HER	Historic Environment Record
HEWRAT	Highways England Water Risk Assessment Tool
HFC	Hydrofluorocarbons
HGV	Heavy Goods Vehicle
HSI	Habitat Suitability Index

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
LGS	Local Geology Site
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
NERC	Natural Environment and Rural Communities
NF_3	Nitrogen Trifluoride
NGR	National Grid Reference
NHLE	National Heritage List for England
NIA	Nature Improvement Area

Abbreviation	Definition
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
OP	Overnight
OS	Ordnance Survey
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 Zones
RBC	Rushcliffe Borough Council
RBMP	River Basin Management Plan
RCP	Representative Concentration Pathway
RIGS	Regionally Important Geological Sites

Abbreviation	Definition
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 Hexafluride
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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