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East Midlands Energy Re-Generation (EMERGE) Centre

Environmental Statement Volume 1 Main Report

June 2020

NCC received 29.06.2020

PROPOSED DEVELOPMENT OF THE EAST MIDLANDS ENERGY RE-GENERATION (EMERGE) CENTRE ON LAND AT THE RATCLIFFE-ON-SOAR POWER STATION, NOTTINGHAMSHIRE

ENVIRONMENTAL STATEMENT
VOLUME 1: MAIN REPORT

This Document has been prepared in support of the application of full planning permission in accordance with the provisions of the Town and Country Planning Act 1990 for the development of the proposed East Midlands Energy Re-Generation (EMERGE) Centre on land at the Ratcliffe-on-Soar Power Station, Nottinghamshire. The application and associated documentation have been produced and co-ordinated by AXIS with technical inputs from:

- AXIS – Traffic and Transportation and Landscape and Visual;
- Uniper Technologies – Noise, Air Quality and Human Health, Ground Conditions and Socio-Economics;
- Argus Ecology – Ecology and Nature Conservation;
- AOC Archaeology – Archaeology and Cultural Heritage; and
- KRS Environmental – Surface Waters and Flood Risk Assessment.

JUNE 2020

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APPENDICES

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ACRONYMS

AAD	Ambient Air Directive
ACC	Air Cooled Condenser
ADMS	Atmospheric Dispersion Modelling System
AEL	Associated Emission Level
AER	Air Emissions Risk
AOD	Above Ordnance Datum
APC	Air Pollution Control
APCR	Air Pollution Control Residue
APIS	Air Pollution Information System
AQA	Air Quality Assessment
AQAL	Air Quality Assessment Level
AQAP	Air Quality Action Plan
AQMA	Air Quality Management Area
AQS	Air Quality Strategy
ATT	Advanced Thermal Treatment
AW	Ancient Woodland
BAT	Best Available Technique
BGS	British Geological Survey
BH	Bore Hole
BMF	Branscombe Mudstone Formation
BREF	Best Available Techniques Reference Document
BS	British Standard
C&D	Construction and Demolition
C&I	Commercial and Industrial
CCTV	Close Circuit Television
CEH	Centre for Ecology and Hydrology
CEMP	Construction Environmental Management Plan
CEMS	Continuous Emissions Monitoring System
CERC	Cambridge Environmental Research Consultants
CHP	Combined Heat and Power
CIEEM	Chartered Institute of Ecology and Environmental Management
CIfA	Chartered Institute for Archaeologists
CIRIA	Construction Industry Research and Information Association
CIWEM	Chartered Institute of Water and Environmental Management
CL:AIRE	Contaminated Land Applications for Real Environments
CMLI	Chartered Member of the Landscape Institute
COMAH	Control of Major Accident Hazards
CRTN	Calculation of Road Traffic Noise
CSM	Conceptual Site Model
CTMP	Construction Traffic Management Plan
CV	Calorific Value
DCC	Derbyshire County Council
Defra	Department for Environment, Food and Rural Affairs
DMCS	Department for Media Culture and Sport
DMRB	Design Manual for Roads and Bridges
DSM	Digital Surface Model
EA	Environment Agency
EAL	Environmental Assessment Level
EDMC	East Midlands Development Corporation
EfW	Energy from Waste
EHO	Environmental Health Officer
EIA	Environmental Impact Assessment

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ELC	European Landscape Convention
ELV	Emission Limit Value
EMERGE	East Midlands Energy Re-Generation
EMP	Environmental Management Plan
EMS	Environmental Management System
EP	Environmental Permit
EPC	Engineering, Procurement and Construction
EPUK	Environmental Protection United Kingdom
ERF	Energy Recovery Facility
ES	Environmental Statement
EU	European Union
FEED	Front End Engineering Design
FEH	Flood Estimation Handbook
FGD	Flue Gas Desulphurisation
FGT	Flue Gas Treatment
FRA	Flood Risk Assessment
FTE	Full Time Equivalent
GAC	Generic Assessment Criteria
GDPO	General Permitted Development Order
GNLCA	Greater Nottingham Landscape Character Assessment
GLVIA	Guidelines for Landscape and Visual Impact Assessment
GT	Gas Turbine
GTA	Guidance on Transport Assessments
GVA	Gross Value Added
HE	Highways England or Historic England
HER	Historic Environment Record
HGV	Heavy Goods Vehicle
HS2	High Speed 2 Rail
IAQM	Institute of Air Quality Management
IBA	Incinerator Bottom Ash
IBC	Intermediate Bulk Container
IED	Industrial Emissions Directive
IEMA	Institute of Environmental Management and Assessment
ILE	Institute of Lighting Engineers
IMS	Integrated Management Systems
IPPC	Integrated Pollution Prevention and Control
IRAP	Industrial Risk Assessment Programme
LA	Local Authority
LACW	Local Authority Collected Waste
LAQM	Local Air Quality Management
LCC	Leicestershire County Council
LED	Light Emitting Diode
LEP	Local Enterprise Partnership
LLFA	Lead Local Flood Authority
LNG	Liquefied Natural Gas
LNR	Local Nature Reserve
LOAEL	Lowest Observable Adverse Effect Level
LPA	Local Planning Authority
LVIA	Landscape and Visual Impact Assessment
LWS	Local Wildlife Site
MAGIC	Multi-Agency Geographic Information for the Countryside
MSOA	Middle Super Output Area
MW	Megawatt
NCA	National Character Area
NCC	Nottinghamshire County Council

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NCV	Net Calorific Value
NGR	National Grid Reference
NHLE	National Heritage List for England
NLS	National Library Scotland
NNR	National Nature Reserve
NOEL	No Observed Effect Level
NOMIS	National Official Labour Market Statistics
NPPF	National Planning Policy Framework
NPPG	National Planning Practice Guidance
NPSE	Noise Policy Statement for England
NSIP	Nationally Significant Infrastructure Project
NSR	Noise Sensitive Receptor
NVQ	National Vocational Qualification
NVZ	Nitrate Vulnerable Zones
OCGT	Open Cycle Gas Turbine
ONS	Office for National Statistics
OS	Ordnance Survey
PAH	Polycyclic Aromatic Hydrocarbons
PAN	Planning Advice Note
PC	Process Contribution
PCB	Dioxin-like Polychlorinated Biphenyls
PEA	Preliminary Ecological Appraisal
PEC	Predicted Environmental Concentration
PM	Particulate Matter
PPE	Personal Protective Equipment
PPG	Planning Practice Guidance
PRoW	Public Rights of Way
RBC	Rushcliffe Borough Council
RBD	River Basin District
RCV	Refuse Collection Vehicle
RDF	Refuse Derived Fuel
RLCT	Regional Landscape Character Types
ROMP	Review of Mineral Permission
RPG	Registered Parks and Gardens
SAAR	Standard Average Annual Rainfall
SAC	Special Area of Conservation
SCR	Selective Catalytic Reduction
SPA	Special Protection Area
SPR	Source Pathway Receptor
SPZ	Source Protection Zone
SSSI	Site of Special Scientific Interest
STW	Severn Trent Water
SuDs	Sustainable Drainage Systems
SVOC	Semi-Volatile Organic Compounds
SWMP	Site Waste Management Plan
TA	Transport Assessment
TDI	Tolerable Daily Intake
UK	United Kingdom
USEPA	United States Environmental Protection Agency
UXO	Unexploded Ordinance Survey
VOC	Volatile Organic Compounds
WDES	Working Draft Environmental Statement
WFD	Water Framework Directive
WHO	World Health Organisation
WI	Waste Incineration

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ZTV ....Zone of Theoretical Visibility

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FOREWORD

This Environmental Statement is submitted in support of a planning application made by Uniper UK Limited for the construction and operation of the proposed East Midlands Energy Re-Generation (EMERGE) Centre on land at the Ratcliffe-on-Soar Power Station, Nottinghamshire.

The ES has been prepared in accordance with the Town and County Planning (Environmental Impact Assessment) Regulations 2017 and comprises the following documents:

- The Environmental Statement (ES) Main Report (Volume 1), which contains the detailed project description; an evaluation of the current environment in the area of the EMERGE Centre; the likely significant environmental impacts of the scheme; and details of the proposed mitigation measures which would alleviate, compensate for, or remove adverse impacts identified in the study. Volume 1 also includes a summary of the overall likely significant environmental impacts of the EMERGE Centre;

- Illustrative Figures (Volume 2) which contains all relevant schematics, diagrams and illustrative figures;

- Technical Appendices (Volume 3), which includes details of the methodology and information used in the assessment, detailed technical schedules and, where appropriate, raw data; and

- A Non-Technical Summary (Volume 4), containing a brief description of the EMERGE Centre and a summary of the ES, expressed in non-technical language.

Hard copies of the ES, as a four Volume set, are available at a cost of £300 by writing to AXIS, Camellia House, Water Lane, Wilmslow, Cheshire, SK9 5BB. Alternatively, the Non-Technical Summary can be purchased on its own from the same point of contact for £15, with the entire ES available for purchase on a CD for £15. Finally, all of the planning application documentation, including the ES, can be downloaded free of charge from the planning portal on Nottinghamshire County Council’s website.

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CHAPTER 1.0 INTRODUCTION AND BACKGROUND

FIGURES (Volume 2 bound separately)

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1.0 INTRODUCTION AND BACKGROUND

1.1 Introduction

1.1.1 This Environmental Statement (ES) has been prepared on behalf of Uniper UK Limited (hereafter referred to as 'Uniper' or the 'Applicant') in support of a detailed planning application for the East Midlands Energy Re-Generation ('EMERGE') Centre ('the Proposed Development') on land at Ratcliffe-on-Soar Power Station (the 'Application Site' or 'Site'). The Site lies wholly within the administrative areas of Rushcliffe Borough Council ('RBC') and Nottinghamshire County Council ('NCC'), the latter being the planning authority for waste management related development. The location of the Site is shown in Figure 1.1.

1.1.2 The ES has been prepared in accordance with the Town and Country Planning (Environmental Impact Assessment) Regulations 2017 ('the EIA Regulations 2017').

1.1.3 The Applicant intends to submit the corresponding environmental permit application around a month after submission of the planning application.

1.1.4 This introductory Chapter provides an outline description of the Proposed Development, describes the Site and its context, provides details of the Applicant, outlines the structure of the ES and identifies the expert organisations that have undertaken the EIA.

1.2 The Proposed Development

1.2.1 The Proposed Development is a multifuel Energy Recovery Facility ('ERF'), recovering energy from waste material. It would be a conventional twin line combustion plant, based on grate technology. It is proposed to operate as a merchant facility (at the point of development) and is anticipated to accept non-hazardous residual commercial and industrial (C&I) wastes and local authority collected wastes (LACW), including in the form of refused derived fuel (RDF). It would also have the potential to treat the combustible fraction of construction and demolition (C&D) waste and is also intended to be capable of accepting certain waste biomass fuels. The Proposed Development would have a gross electricity generating capacity of 49.9 megawatts (MW) and the anticipated waste throughput would be

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circa 472,100 tonnes per annum (tpa), based on a combination of the forecast plant availability and the waste characteristics (namely its calorific value – CV).

1.2.2 The Proposed Development would generate electricity by way of steam turbines which would be driven through the controlled combustion of residual waste. The gross power generating capacity of the Proposed Development would be 49.9 MW. After subtracting the power used to run the facility itself, it would have the ability to export approximately 43.4 MW of electricity to the local electricity grid, a significant proportion of which would be classed as renewable. This is sufficient to meet the average annual domestic electricity needs of about 90,000 homes. Whilst the Proposed Development would have a grid connection, it could also supply power to individual customers via a private wire system. Finally, it would, in the event that viable opportunities for the supply of heat do not exist from the outset, also be combined heat and power (CHP) ready and capable of providing heat in the form of steam (or possibly hot water) for use by local heat users. The short to medium term objective is that the Proposed Development could serve a site heat network, and potentially also (via heat exchangers) a cooling network.

1.2.3 The EMERGE Centre would be located within a main building, up to 49.5 m high at its highest point (over the boiler), that would include:

- A Reception / Tipping Hall, with points of access and egress set at ground level;
- A below ground Bunker;
- A Boiler Hall;
- A Turbine Hall, with two turbines for resilience;
- A Flue Gas Treatment (FGT) facility;
- An Incinerator Bottom Ash (IBA) bay; and
- Offices, workshop, stores and staff welfare facilities.

1.2.4 The Air Cooled Condenser (ACC) is proposed to be located to the west of the main building and north of the Turbine Hall. It would form a separate standalone structure in order to enable sufficient air flow through the units.

1.2.5 The twin side by side stacks would protrude through the FGT facility roof and extend to a height of circa 110 m. Each stack would be circa 2.25 m in diameter, braced together near the top and include an external continuous emissions monitoring system (CEMS) platform.

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1.2.6 The Proposed Development would also include the following ancillary / infrastructure:

- Vehicle weighbridges and weighbridge office;
- Substation (within its own enclosure);
- Fire water tank and associated pump house;
- Tanks / silos (containing fuel oil and FGT reagent);
- Internal circulation roadways and manoeuvring areas;
- Employee and visitor parking for cars, motorbikes and cycles;
- Fencing and gating;
- Service connections;
- Surface water drainage;
- Lighting and CCTV; and
- New areas of hard and soft landscaping.

1.2.7 On the basis that the planning application is approved, the overall construction period for the Proposed Development would last circa 36 months, with operation starting in December 2024. The Proposed Development would have a design life of approximately 30 years, although in reality many elements would last beyond this period. For the avoidance of doubt, planning permission is being sought for a permanent development and, therefore, as elements of the Proposed Development require repair, refurbishment or replacement this would be carried out.

1.2.8 The Proposed Development would make an important contribution to the acknowledged shortfall in waste recovery capacity within the United Kingdom (UK). This shortage is resulting in approximately 11 million tonnes per annum (2018) [1] of residual waste, capable of being subject to energy recovery, being sent to landfill. On top of this, England exported over 2.7 million tonnes of Refuse Derived Fuel to energy recovery facilities in mainland Europe in 2019.[2] The Proposed Development would contribute significantly to the diversion of waste from landfill and the utilisation of indigenous residual waste to generate energy (including renewable energy) within England, as opposed to in mainland Europe.

1.2.9 The Proposed Development would represent a capital investment of circa £330 million during construction, with 600 construction worker jobs at the peak period of

[1] *Approximate figure calculated from Tolvik Consulting – UK Energy from Waste Statistics – 2018 (June 2019).*
[2] *Based on Environment Agency statistics see: https://www.letsrecycle.com/news/latest-news/drop-in-2019-rdf-exports-confirmed/*

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construction. Once operational, the Proposed Development would create 45 new permanent full-time jobs and it is expected that there will be a further circa £18.8 million of spending each year in terms of operations and maintenance, including consumables and residue management costs. Both vehicle movements to and from the Proposed Development and operational activities are proposed to take place 24 hours a day, 7 days a week.

1.2.10 A detailed description of the Proposed Development, including its construction and operation, is provided within Chapter 4.0 of this ES. Full details of the need for the Proposed Development and its benefits are contained within the Planning Statement, which forms a separate standalone document.

1.3 The Site and Its Context

The Power Station Site

1.3.1 The Power Station site covers an overall area of circa 273 hectares (ha). As illustrated on Figure 1.2, this includes circa 167 ha lying to the north of the A453 Remembrance Way and circa 106 ha to the south of the A453. The main built elements of the Power Station and its related infrastructure are located in the northern part of the site ('the Northern Site'). Land to the south of the A453 is used for the handling and storage of by-products, predominantly ash.

1.3.2 The coal-fired Power Station was constructed in the 1960s and commenced commercial operations in late 1967. It has an export capacity of approximately 2,000 megawatt electrical (MW_e) and is fitted with Flue Gas Desulphurisation and Selective Catalytic Reduction. At present, the Power Station operates under a 'Capacity Market' contract, and it is operated to meet commercial trading requirements in addition to being available to National Grid to support reliable operation of the power network. In accordance with the UK Government's coal phase-out strategy, it is planned to cease operations before October 2025.[3]

[3] This phase-out strategy is currently under review with proposals to bring forward the date of coal phase-out into 2024, and also options for the Government to introduce emergency measures to extend the date if required to ensure security of electricity supply.

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1.3.3 As things presently stand, it is fully envisaged that the Power Station will be demolished after closure. However, a significant quantum of development would be retained on the Site. The likely status of the main existing buildings and structures is illustrated on Figure 1.3. Significant components that will be retained on the Power Station site include:

- The large 400 kilovolt (kV) and 132 kV substations;
- The associated 400 kV and 132 kV power lines and pylons;
- The 35 MW Gas Turbine (GT) generating facility, which has its own independent gas oil-fired system and 95 m high concrete stack, and also has its own contract to supply power to the grid at times of demand in addition to providing Black Start capability;
- Various offices and stores, including the offices for Uniper's Technology Centre and its Engineering Academy;
- The site's rail line, sidings and associated infrastructure; and
- Other essential site infrastructure such as the road access points and drainage systems, including the surface water lagoons.

The Future Site

1.3.4 In the context of over 50 years of coal-fired energy production drawing to a close, the emerging East Midlands Development Corporation (EMDC) has identified the Power Station site as one of three strategically important locations for future economic growth in the East Midlands, the other two being around the proposed High Speed 2 (HS2) station at Toton and the existing East Midlands Airport.

1.3.5 The vision for the Power Station after it ceases operating is to create an employment site based around modern industrial and manufacturing uses, underpinned by a sustainable energy theme. Whilst this vision is in its early stages, the Proposed Development is viewed as the catalyst, being the first new build on the redeveloped Power Station site, by virtue of generating lower carbon and partially renewable energy for the future industry and manufacturing uses. Some further details of this site vision are set out in the Planning Statement.

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The Northern Site, Surroundings and the Application Site

1.3.6 The 167 ha Northern Site sits broadly at 30–38 m above ordinance datum (AOD) and is bounded by:

- Wood Hill and Wright's Hill to the north which extends to height of circa 75 m AOD, beyond which is the village of Thrumpton and the River Trent;
- The A453 to the east, beyond which, on rising land, is a mixture of agricultural land and woodland;
- The A453 to the south, beyond which, at broadly the same level as the site, is the southern Power Station site followed by a mixture of agricultural land and woodland, which also contain the pylons and overhead transmission lines from the Power Station; and
- Immediately to the west, the main East Midlands main line railway and Parkway Station (including its associated Park and Ride facility), beyond which is more agricultural land containing the River Soar, a tributary of the River Trent, and a Marina. Further west still, at just over 2 kilometre (km) distance, is the M1 and its Junctions 24 / 24a.

1.3.7 The Northern Site (see Figure 1.3 and Figure 1.5) is dominated by a wide range of large-scale built development and structures, including:

- A centrally located Boiler House with, immediately to the north, the Flue Gas Treatment (FGT) facility. These two elements are interconnected through a series of large ducts which ultimately connect to a 199 m high concrete stack;
- A building containing the GT generating facility with second concrete stack that extends to 95 m in height;
- Eight concrete cooling towers (each 114 m high) which are located on the western part of the site;
- A range of storage buildings, including for gypsum, some of which are interconnected via high level conveyors;
- Two large substation buildings (400 kV and 132 kV) owned and operated by National Grid as part of the electricity distribution network;
- Its own railway line (off the East Midlands main line) which runs in a loop between the Electrostatic Precipitators and FGT facility and around the coal stockpile area, which sits on the eastern side of the site. The line includes sidings, associated unloading infrastructure and conveyor belts; and

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- Other buildings, including offices, an engineering academy, engineering services and stores; plus, other infrastructure such as roadways, car parking, laydown / storage areas, lagoons and soft landscaping.

1.3.8 The main entrance to the Northern Site is at the south-western corner of the site, by way of an unnamed road which provides a connection, via a grade separated interchange, to the A453. A second access for heavy goods vehicles (HGVs) is via a further grade separated junction off the A453 on to Barton Lane, which is signed as the Power Station HGV entrance. This entrance is located at the south-eastern end of the Power Station site.

1.3.9 The EMERGE Centre is proposed to be located at the central northern end of the Northern Site, on an open area covering circa 4 ha. The extent of the planning application boundary is illustrated in Figure 1.4.

1.3.10 The Application Site has never previously been fully ‘developed’, but has been utilised as a laydown area and car park for contractors working on the wider Power Station site. As a consequence of this activity, it is surfaced with a mixture of tarmac and compacted stone hardstanding. The Application Site is effectively level and bounded to the north and east by the electrified Power Station perimeter security fence and to the south and west by a combination of Power Station related, large-scale development, and a further open area formerly used by contractors.

1.3.11 The nearest residential properties to the Site are the isolated Winking Hill Farm, located circa 750 m to the south, and, at approximately the same distance (to the nearest house) to the north-east, beyond Wright’s Hill, properties in the village of Thrumpton.

1.3.12 The Application Site falls within Flood Zone 1 (the lowest category of flood risk), is not directly constrained by any statutory or non-statutory ecological designations, nor does it contain or form part of any designated heritage asset, such as a Scheduled Monument or a Listed Building. There are no public footpaths or rights of way within the Site.

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1.4 The Applicant

1.4.1 Uniper is a leading international energy company with around 11,500 employees and activities in more than 40 countries. In the UK, Uniper operates a flexible generation portfolio of seven power stations, and a fast-cycle gas storage facility. A broad range of commercial activities are offered through the Engineering Services division, while the Uniper Engineering Academy delivers high-quality technical training and government-accredited apprenticeship programmes for the utility, manufacturing and heavy industry sectors. Uniper owns and operates the Ratcliffe-on-Soar Power Station.

1.5 This Document

1.5.1 This ES (**Main Report, Volume 1**) has been prepared to support a detailed planning application for the EMERGE Centre. The remaining Chapters of the ES are as follows:

Chapter 2.0:	Approach to the Environmental Statement
Chapter 3.0:	Alternatives Considered
Chapter 4.0:	Scheme Description and Construction Methods
Chapter 5.0:	Landscape and Visual Effects
Chapter 6.0:	Ecology and Nature Conservation
Chapter 7.0:	Noise
Chapter 8.0:	Air Quality and Human Health
Chapter 9.0:	Ground Conditions
Chapter 10.0:	Surface Water and Flood Risk
Chapter 11.0:	Transport
Chapter 12.0:	Socio-Economics
Chapter 13.0:	Archaeology and Cultural Heritage
Chapter 14.0:	Cumulative Effects
Chapter 15.0:	Summary of Effects

1.5.2 The Illustrative Figures that support the ES are contained within **Volume 2**.

1.5.3 A series of **Technical Appendices (Volume 3)** are provided that include details of the methodology and information used in the assessment, detailed technical schedules and, where appropriate, raw data.

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1.5.4 All the Chapters of the ES are summarised in a **Non-Technical Summary (Volume 4)** to provide a review of the Proposed Development, and the possible environmental implications, in concise lay terms.

1.6 Assessment Team

1.6.1 In accordance with Regulation 18(5) of the EIA Regulations 2017, Uniper has engaged competent experts to prepare the ES. As per Regulation 18(5)(b), each of the technical assessment Chapters (Chapters 5.0 to 13.0) include a statement outlining the relevant expertise and / or qualifications of the expert(s) that prepared the Chapter.

1.6.2 The ES was compiled and coordinated by AXIS, a multi-disciplinary planning, environmental and transportation consultancy which has prepared in excess of 250 EIAs. AXIS has prepared Chapter 1.0 to 4.0 of the ES and undertaken the traffic and transportation and landscape and visual assessments. A wider team of specialist consultants have provided expert assessment in respect of the following:

- Uniper Technologies – Noise, Air Quality and Human Health, Ground Conditions and Socio-Economic Assessments;
- Argus Ecology – Ecology and Nature Conservation Assessment;
- AOC Archaeology – Archaeology and Cultural Heritage Assessment; and
- KRS Environmental – Surface Waters and Flood Risk Assessment.

1.6.3 AXIS is one of the UK's leading consultancies with regard to the planning of energy recovery facilities (from waste and biomass fuels), having secured planning permission for over 45 such projects. The AXIS project team for the EMERGE Centre project includes: Chartered Town Planners; Members of the Chartered Institute of Ecology and Environmental Management; Members of the Chartered Institute of Highways and Transportation; Chartered Engineers; and Chartered Landscape Architects.

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CHAPTER 2.0 APPROACH TO THE ENVIRONMENTAL STATEMENT

FIGURES (Volume 2 bound separately)

APPENDICES (Volume 3 bound separately)

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2.0 APPROACH TO THE ENVIRONMENTAL STATEMENT

2.1 Introduction

2.1.1 This Chapter sets out the legislative requirement for the application to be supported by an ES; outlines the general approach to the assessment and the scoping process; describes the broad approach to the assessment that has been undertaken in relation to the topics that have been identified as having the potential to result in significant environmental effects; and finally, sets how the ES complies with the requirements of the EIA Regulations.

2.2 Need for Environmental Impact Assessment

2.2.1 The requirement for EIA was first prescribed by European law under Council Directive 85/337/EEC. This Directive has been amended four times, with the latest amendment, the Environmental Impact Assessment (EIA) Directive (2014/52/EU) entering into force on 15 May 2014.

2.2.2 In England, the Directive has been enacted most recently into law by the Town and Country Planning (Environmental Impact Assessment) Regulations 2017 [SI 2017 No. 571] – referred to hereafter as 'the EIA Regulations 2017'. These Regulations came into force on 16 May 2017.

2.2.3 Schedule 1 of the EIA Regulations 2017 lists categories of developments for which EIA is mandatory, whilst Schedule 2 lists categories of development for which EIA may be required depending upon, inter alia, whether the development is likely to have significant environmental effects.

2.2.4 With regard to the need for an EIA, the Proposed Development is included within Schedule 1 of the EIA Regulations 2017 under Part 10 as follows: *"10. Waste disposal installations for the incineration or chemical treatment (as defined in Annex IIA to Council Directive 75/442/EEC under heading D9) of non-hazardous waste with a capacity exceeding 100 tonnes per day."* As such, the Proposed Development is deemed to be a Schedule 1 development and therefore EIA is mandatory.

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2.3 Scope of the Environmental Statement

2.3.1 The information to be included in an ES is set out in Schedule 4 of the EIA Regulations 2017. References to Chapters in the ES where information relevant to the requirements of Schedule 4 can be found are listed within Table 2.1.

Table 2.1: Review of Schedule 4 Requirements

Para	Requirement	Where Addressed Within the ES
1	A description of the development, including in particular: (a) a description of the location of the development; (b) a description of the physical characteristics of the whole development, including, where relevant, requisite demolition works, and the land-use requirements during the construction and operational phases; (c) a description of the main characteristics of the operational phase of the development (in particular any production process), for instance, energy demand and energy used, nature and quantity of the materials and natural resources (including water, land, soil and biodiversity) used; (d) an estimate, by type and quantity, of expected residues and emissions (such as water, air, soil and subsoil pollution), noise, vibration, light, heat, radiation and quantities and types of waste produced during the construction and operation phases.	(a) Chapter 1.0 (b & c) Chapter 4.0 (d) Chapter 4.0 as it relates to the scheme description and within Chapters 5.0 to 14.0 as it relates to individual topic areas
2	A description of the reasonable alternatives (for example in terms of development design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects.	Chapter 3.0
3	A description of the relevant aspects of the current state of the environment (baseline scenario) and an outline of the likely evolution thereof without implementation of the development as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge.	Chapters 5.0 to 14.0 as it relates to individual topic areas
4	A description of the factors specified in regulation 4(2) likely to be significantly affected by the development: population, human health, biodiversity (for example fauna and flora), land (for example land take), soil (for example organic matter, erosion, compaction, sealing), water (for example hydromorphological changes, quantity and quality), air, climate (for example greenhouse gas emissions, impacts relevant to adaptation), material assets, cultural heritage, including architectural and archaeological aspects, and landscape.	Chapters 5.0 to 14.0 as they relate to individual topic areas. Matters relating to human health are addressed in a series of topic specific chapters (e.g. noise, air quality, water quality)

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Para	Requirement	Where Addressed Within the ES
5	A description of the likely significant effects of the development on the environment resulting from, inter alia: (a) the construction and existence of the development, including, where relevant, demolition works; (b) the use of natural resources, in particular land, soil, water and biodiversity, considering as far as possible the sustainable availability of these resources; (c) the emission of pollutants, noise, vibration, light, heat and radiation, the creation of nuisances, and the disposal and recovery of waste; (d) the risks to human health, cultural heritage or the environment (for example due to accidents or disasters); (e) the cumulation of effects with other existing and/or approved projects, taking into account any existing environmental problems relating to areas of particular environmental importance likely to be affected or the use of natural resources; (f) the impact of the project on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project to climate change; (g) the technologies and the substances used. The description of the likely significant effects on the factors specified in regulation 4(2) should cover the direct effects and any indirect, secondary, cumulative, transboundary, short-term, medium-term and long-term, permanent and temporary, positive and negative effects of the development. This description should take into account the environmental protection objectives established at Union or Member State level which are relevant to the project, including in particular those established under Council Directive 92/43/EEC and Directive 2009/147/EC.	Chapter 4.0 as it relates to the scheme description and within Chapters 5.0 to 14.0 as it relates to individual topic areas
6	A description of the forecasting methods or evidence, used to identify and assess the significant effects on the environment, including details of difficulties (for example technical deficiencies or lack of knowledge) encountered compiling the required information and the main uncertainties involved.	The overall EIA methodology and approach to assessment is described in Chapter 2.0. The specific technical methodologies used to identify and assess effects are fully described (or referenced) within Chapters 5.0 to 14.0 as they relate to individual topic areas
7	A description of the measures envisaged to avoid, prevent, reduce or, if possible, offset any identified significant adverse effects on the environment and, where appropriate, of any proposed monitoring arrangements (for example the preparation of a post-project analysis). That description should explain the extent, to which significant adverse effects on the environment are avoided, prevented, reduced or offset, and should cover both the construction and operational phases.	'Incorporated Mitigation' which forms part of the scheme design is described in the detailed scheme description provided in Chapter 4.0. Mitigation measures, as they apply to individual environmental topic areas, are described in Chapters 5.0 to 14.0 as they relate to each topic

Para	Requirement	Where Addressed Within the ES
8	A description of the expected significant adverse effects of the development on the environment deriving from the vulnerability of the development to risks of major accidents and/or disasters which are relevant to the project concerned. Relevant information available and obtained through risk assessments pursuant to EU legislation such as Directive 2012/18/EU of the European Parliament and of the Council or Council Directive 2009/71/Euratom or UK environmental assessments may be used for this purpose provided that the requirements of this Directive are met. Where appropriate, this description should include measures envisaged to prevent or mitigate the significant adverse effects of such events on the environment and details of the preparedness for and proposed response to such emergencies.	This matter was formally scoped out of the EIA through the formal scoping process with NCC. Further details are provided after this table
9	A non-technical summary of the information provided under paragraphs 1 to 8.	A separate Non-Technical Summary is contained as ES Volume 4.
10	A reference list detailing the sources used for the descriptions and assessments included in the ES.	References are provided as footnotes and / or reference document lists within, or at the end of each ES Chapter, as appropriate

Consultation

2.3.2 Regulation 15 of the EIA Regulations 2017 states that prospective applicant(s) may request a Scoping Opinion from the relevant planning authority, in this instance Nottinghamshire County Council (NCC). This is a written confirmation as to the information that, in the opinion of the planning authority, ought to be provided within the ES.

2.3.3 A formal EIA Scoping Report was submitted to NCC on 14 February 2020. A copy of the report is provided in **Appendix 2-1**. The report outlined the proposed approach to the EIA and highlighted those environmental topics that have the potential to be affected by the Proposed Development and were therefore proposed to be scoped into the EIA and those topics that were proposed to be scoped out.

2.3.4 NCC provided their formal EIA Scoping Opinion on 6 April 2020. A copy of the Opinion is provided in **Appendix 2-2**. This confirmed that: *"It is the County Council's formal opinion that an Environmental Statement accompanying a planning application for the EMERGE Facility should meet the requirements of Part 5 Regulation 18(3) and Schedule 4 of the Town and Country Planning (Environmental Impact Assessment) Regulations 2017 and also include information, assessment and analysis, and the development of mitigation measures where appropriate, based*

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on the scoping opinion set out above…" Table 2.2 sets out the additional matters raised within the Opinion and how these have been addressed within this ES.

Table 2.2: Additional Matters Identified by the Scoping Opinion

Requirement	Where Addressed Within the ES
During the Scoping process the viewpoints supporting the landscape and visual assessment were updated and agreed with NCC.	Chapter 5.0 and associated figures are based on the agreed viewpoints.
In terms of ecology and nature conservation, the Opinion sets out that: *"The Waste Planning Authority request you consider the matters raised by Nottinghamshire Wildlife Trust (NWT) when you prepare your ecological impact assessment. If you believe NWT's observations are not appropriate, and you do not intend to undertake the extent of work they suggest it would be helpful if you could include your reasoning/explanation why you consider this information is not required."*	Chapter 6.0 considers the matters raised by the NWT and where relevant includes a reasoned justification on why information has / has not been provided.
Under the topic heading of air quality and human health, the Opinion references the consultation response from Public Health England and specifically that the appendix incorporates a series of generic considerations which they request are addressed or where it is determined that it is not necessary to undertake a detailed assessment the rational for this is provided.	Chapter 8.0 considers the generic considerations from Public Health England.
NCC Highways Department agreed with the proposed scope of the transportation assessment subject to one minor change that in an addition to the application IEMIA guidelines with regard to thresholds for detailed assessment, they would also wish to see NCC's own guidelines for assessment applied whereby any junction which see's any increase of 30 or more trips in an hour should be considered as part of a detailed assessment. Network Rail requested that the EIA should consider effect to the operational railway safety both during construction and once operation.	Chapter 11.0 includes consideration of NCC's own guidelines for assessment and considers Network Rail's request.
In terms of archaeology and cultural heritage, the Opinion reports that NCC's Archaeological Officer questions whether a desk-based assessment would sufficiently clarify whether archaeological remains survive on the site. The officer identified that the Geotechnical investigation may provide a simpler way of demonstrating absence of archaeology, on the basis it could be used to assess levels of made ground, previous ground disturbance and to model subsurface deposits, including the presence / absence of natural deposits.	Chapter 13.0 includes an assessment of the geotechnical investigation work reported in Chapter 9.0 and includes a deposit model so that reliable conclusions can be reached regarding the potential level of archaeological value of the Site.
The Opinion also identifies further topics requiring detailed assessment within the environmental assessment relates to climate change, energy efficiency and sustainability.	Chapter 8.0 and the Planning Statement (which forms a standalone document alongside the ES) provides detailed assessment of the topic of climate change, energy efficiency and sustainability.

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Requirement	Where Addressed Within the ES
The Opinion also encourages the submission of a design specification R1 application.	The R1 calculation is provided in Appendix 4-1 attached to the Planning Statement which forms a standalone document alongside the ES.

2.3.5 The Opinion also agreed that topics (i.e. the environmental effects associated with potential impacts to statutory landscape designations, vibration and vulnerability to risks of major accidents and / or disasters) could be scoped out of ES. The ES is based on the Scoping Opinion in accordance with Regulation 18(4)(a) of the EIA Regulations 2017.

2.4 Environmental Impact Assessment Methodology

2.4.1 The approach to EIA is not standardised, but there are established and recognised approaches set out by professional institutions as to methods to be used for the assessment of environmental effects. Where appropriate, the environmental effects of the Proposed Development have been assessed using definitive standards, legislation and guidance applicable to each of the technical topics covered within this ES.

2.4.2 In order to provide a clear and robust assessment, each of the technical Chapters presented in this ES follow the structure set out in the following paragraphs.

Introduction

2.4.3 A brief summary of the approach to the topic is provided outlining any key issues relevant to the subject area being assessed. The introduction also includes details of the professional competence of the person(s) undertaking the assessment.

Methodology

2.4.4 This section provides details of the assessment method followed and provides the following information:

- A description of any relevant legislation, policy or guidance which has been considered in the assessment;

- The findings from any consultations undertaken when compiling the assessment;
- The approach taken to gathering of any desk-based or field data. Where specific surveys have been undertaken, an outline of the assessment methodology is provided;
- The approach to the impact assessment is defined. This includes how the topic has defined impact magnitude, receptor sensitivity and how these relate to the overall level effect / significance; and
- Any limitations or assumptions made in the assessment.

Baseline

2.4.5 This section provides a description of the baseline conditions of the Site relevant to the topic being assessed. The baseline conditions have been established through consultation, collation and analysis of existing datasets and reports, and gathering of site-specific field data. The baseline assessment identifies any particular sensitive receptors that are evaluated in the assessment of effects.

2.4.6 EIA needs to be undertaken against a clear baseline. Schedule 4 (3) of the EIA Regulations (information for inclusion in an ES) deals with baseline matters and states that the EIA should include: *"A description of the relevant aspects of the current state of the environment (baseline scenario) and an outline of the likely evolution thereof without implementation of the development as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge."*

2.4.7 In essence, this is interpreted as meaning the baseline is the current state of the environment (i.e. the Site and its context as now exist). Further, that in terms of a future baseline, this relates to 'natural changes', as best they can be assessed.

2.4.8 Notwithstanding the foregoing, it is recognised that the situation at the Power Station site is slightly more fluid. As a consequence, the effects of the Proposed Development are assessed against two baseline scenarios, as described below.

2.4.9 **Baseline 1 – 'Current Baseline'**: This would comprise the application site and its context as they now exist, including the operational coal-fired Power Station, with

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both Proposed Development construction and operational phases. Under Baseline 1, both the Power Station and the Proposed Development would operate for a 9-month period before the Power Station closes in September 2025. This would mean that any identified effects occurring during both the operation of the Power Station and the Proposed Development, would be temporary in duration.

2.4.10 **Baseline 2 – 'Future Baseline'**: This would comprise the operational Proposed Development, but assumes that the Power Station and related components have been removed. However, the following development / infrastructure would remain (as shown on Figure 2.1): the Uniper Engineering Services offices; the National Grid Substations and power lines, the Gas Turbine generating facility; the railway sidings; the gypsum and limestone storage buildings and their conveyor links to the sidings; and other lesser elements of infrastructure such as internal roads linking the preceding elements.

2.4.11 It is not proposed to consider the position during the actual demolition works of the Power Station site. This is because there is presently no clear idea how demolition will occur and, in all likelihood, the Power Station decommissioning and demolition will require its own planning application and EIA in the future. This should be considered on its merits and will need to take account of the Proposed Development in its baseline. Similarly, it is considered premature to include the future EMDC vision for the Power Station site as a future baseline scenario. This approach was set out within the Scoping Report and agreed through the EIA Scoping Opinion.

Assessment of Effects

2.4.12 This section describes the predicted environmental effects of the Proposed Development on the baseline conditions of the Site and the local environment relevant to the assessment topic. The assessment will include a description of the nature, extent and significance of these effects. The assessment will consider any mitigation measures that have been specifically incorporated into the development proposals to reduce the environmental effects of the Proposed Development.

2.4.13 As described in baseline subsection above, the Applicant is applying for permanent development and as such the assessment of effects will consider the construction and operational phases of the development only. As such a detailed assessment of decommissioning has not been provided. Any effects associated with

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decommissioning works are considered likely to be similar in nature to construction phase effects.

2.4.14 The EIA Regulations do not provide definitive methods for the assessment of significance and a variety of methods are employed within EIAs. The method used to assess the effects will be specific to each discipline. Where available and appropriate, the assessments will follow impact assessment criteria and methodology set out by relevant professional institutions, e.g. Institute of Ecology and Environmental Management, Landscape Institute, etc. Where such guidance is not available or prescriptive methods are not set out by the relevant professional body, then assessment criteria will be developed by the technical specialists to enable a clear and structured assessment to be undertaken.

2.4.15 The nature of the effect of the Proposed Development on the environment will, in general, be derived by considering the magnitude of the impact and the sensitivity of the receptor to a change resulting from the project.

2.4.16 Depending on the discipline there will be a number of factors that will need to be taken into account when establishing the type and magnitude of impact, including:

- Whether the impact is adverse or beneficial;
- Whether it is temporary or permanent;
- Extent or spatial scale of the impact;
- Duration of the impact;
- Whether the effect is reversible; and
- Probability / likelihood of the impact.

2.4.17 Similarly, the sensitivity of a receptor will be the function of a number of elements dependent on the discipline and impact being assessed, these could include:

- Designation and legal status;
- Quality;
- Rarity; and
- Ability to adapt to change.

2.4.18 Having established the magnitude of the impact and the sensitivity of the receptor, the level of the effect will then be defined. For some disciplines a matrix will be used

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to classify the level of effect by correlating magnitude and sensitivity, an example matrix is shown in Table 2.3.

Table 2.3: Example Level of Effect Matrix

		Magnitude of Impact			
		High	**Medium**	**Low**	**Negligible**
Receptor Sensitivity	**High**	Major	Moderate	Minor to Moderate	Negligible or Minor
	Medium	Moderate	Minor to Moderate	Minor	Negligible
	Low	Minor to Moderate	Minor	Negligible or Minor	Negligible
	Negligible	Negligible or Minor	Negligible	Negligible	Negligible

2.4.19 Where a matrix is not used, the magnitude of change and the sensitivity of the receptor will be used to make a reasoned judgement to establish the level of the effect and whether it is considered to be significant or not significant. For some topics, an environmental risk assessment approach may be used to establish the potential environmental effects of the Proposed Development.

2.4.20 It should be noted that there is no statutory definition of what level of effect is considered to be significant and there is often not a single, definitive, correct answer as to whether an effect is significant or not. However, it is considered that a significant effect is one which is likely to be a key material factor in the decision-making process. A significant effect does not necessarily mean that such an effect is unacceptable to decision-makers. This is a matter to be weighed in the planning balance alongside other factors. What is important is that the likely effects of any proposal are transparently assessed and described in such a way to enable the relevant determining authority to bring a balanced and well-informed judgement to bear as part of the decision-making process.

2.4.21 Where the findings of an assessment are set out as different levels of effect (e.g. major, moderate, minor, etc.) the assessment will clearly set out where an effect is considered to be significant. This approach will be used to assist the decision-maker, consultees and other interested parties in establishing the most important environmental effects of the Proposed Development.

2.4.22 In all instances, the assessment will set out the basis of the judgements made so that the readers of the ES can appreciate the weight attached to the different factors

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and understand the rationale of the assessment. In this sense, the ES clearly explains how the impact significance has been derived.

Mitigation

2.4.23 It is a requirement of the EIA Regulations 2017 to describe the measures envisaged to prevent, reduce and, where possible, offset any significant effects on the environment. Whilst not a requirement of the EIA Regulations 2017, mitigation measures can be used to reduce or avoid any adverse effect, whether or not that effect is deemed to be 'significant'. Mitigation can be achieved in a number of ways as listed below. This approach is often referred to as the mitigation hierarchy with mitigation being selected as high up the hierarchy as possible.

Avoid
Reduce
Remediate
Offset / Compensate

2.4.24 Many of the mitigation measures within the Proposed Development have been incorporated into the Proposed Development as a result of decisions undertaken during the design process. Key 'incorporated' mitigation measures relevant to the technical assessments are described in each technical chapter. On the basis that these mitigation measures are considered to be imbedded into the project they have been taken into account when coming to a judgement of the significance of the effects of the Proposed Development.

2.4.25 Where additional mitigation, compensation or enhancement measures are proposed to prevent, reduce or offset adverse effects unavoidable through design, or to provide benefits to the scheme / local environment, these are described separately within the mitigation section of each Chapter. Where such measures have been defined, an explanation is provided of how these measures will mitigate / reduce the identified effects of the Proposed Development.

Cumulative Effects

2.4.26 The EIA regulations require that a description of the likely significant effects of the development on the environment should be included in the ES, including cumulative

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effects. The EIA Regulations 2017 do not define cumulative effects; however, a commonly accepted description is: *"Impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions together with the project."* (European Commission, 1999)

2.4.27 There is no defined methodology in the UK as to how cumulative effects should be assessed. In determining the approach to be adopted, reference will be made to the following guidance:

- Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions (European Commission 1999);
- Cumulative Effects Assessment Practitioners Guide (Canadian Environmental Assessment Agency 1999);
- Guidelines for Environmental Impact Assessment (Institute of Environmental Management and Assessment 2006);
- The State of Environmental Impact Assessment Practice in the UK (Institute of Environmental Management and Assessment 2011); and
- Advice note seventeen: Cumulative effects assessment relevant to nationally significant infrastructure projects (The Planning Inspectorate 2015).

2.4.28 Paragraph 5(e) of Schedule 4 of the EIA Regulations 2017 require a: *"description of the likely significant effects of the development on the environment resulting from … the culmination of effects with other existing and/or approved projects."* In this regard the Regulations are specific about the projects that should be considered to result in cumulative effects, i.e. existing and / or approved projects. However, it is proposed to also include projects that are currently awaiting determination within the cumulative assessment as there is a possibility that these projects could be approved whilst the application for the Proposed Development is being determined. Accordingly, the assessment of cumulative impacts encompass the effects of the Proposed Development in combination with:

- Existing development, either built or under construction;
- Approved development, awaiting implementation; and
- Schemes awaiting determination within the planning process.

2.4.29 The presence of operational schemes (and for some disciplines, schemes that are under construction, but not yet operational) is an established influence upon the environment, which will be taken into account when determining the baseline for the

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non-cumulative assessment for each discipline Chapter. The assessment of effects subsection of each Chapter has had full regard to the presence of such schemes when arriving at any conclusions.

2.4.30 As such, the additional schemes that form part of the assessment of cumulative effects should, in the Applicant's view, be limited to major projects that have either been granted planning consent but have not yet been constructed and major projects for which a planning application is awaiting determination. Major projects are considered to be developments with a floor space of 10,000 m^2 in size or greater and projects that have been subject to EIA. Projects that fall outside the above criteria are only included in the assessment if specifically requested by NCC.

2.4.31 Each topic will have a different spatial zone where potential cumulative significant effects could occur. As illustrated on Figure 2.2, a search area of 3 km from the application site was used to identify schemes that could have the potential to result in cumulative effects. The search was undertaken via the interactive search facilities on Nottinghamshire and Leicestershire County Council websites; Rushcliffe, Broxtowe, Erewash Borough and North West Leicestershire District Council websites; and focussed on those planning applications that had been determined since January 2017. Additionally, a search was undertaken on the Planning Inspectorate website to identify and upon any Nationally Significant Infrastructure Projects (NSIPs). The schemes identified by the Applicant are set out in Table 2.4.

Table 2.4: Cumulative Schemes

Ref	Description	Comments
A	Extraction of sand and gravel, relocation of conveyor and bridge, use of existing processing plant and ancillary facilities, importation of inert restoration materials with restoration to agriculture and nature conservation at Lockington Quarry, Warren Lane, Lockington, DE74 2RG. (2019/CM/0244/LCC / 2019/2358/07) Validated 12 / 11 / 2019 but has not been determined at the time of preparing this Report.	The application is supported by an ES which seeks to extend the quarry into a new area of circa 57 ha to enable circa 3.3 Mt of sand / gravel to be won. The material would be extracted at a rate of 330,000 tpa (as existing) and is proposed to be carried out over a 15-year period. With the exception of a field conveyor it is understood that the existing quarry infrastructure would be used. Access to the quarry is provided directly off the A50 / M1 (J24a) with vehicles traveling along a haul road to J24 of the M1 when leaving the site. Existing operations are included in the baseline assessment. The currently undetermined application is not considered to result in any cumulative effects and is not proposed to be considered.

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Ref	Description	Comments
B	To vary condition 4 of planning permission 8/11/01544/CMA to extend the operation of the mine until 22/02/2042 at the Marblaegis Mine, Gotham Road, East Leak. (8/16/01433/CMA / V/3517). Approved 23 February 2017. To vary condition 2 of planning permission 8/00/01321/CMA to extend the operation of the mine until 22 February 2042 at the Marblaegis Mine, Gotham Road, East Leak (8/16/01432/CMA / V/3516). Approved 23 February 2017. Period Review of Mineral Permissions (8/16/01430CMA / MRA/3509) The online planning register illustrates that the application was returned on 28 April 2016. However, the ROMP was considered at the 21 February 2017 Planning and Licensing Committee alongside the two Section 73 applications above.	The Marblaegis Mine covers circa 3,852 hectares. The two Section 73 applications and ROMP were considered at the 21 February 2017 Planning and Licensing Committee. The above ground mine infrastructure is located to the north of East Leake which is outside of the defined area of search. However, due to the size of the underground workings, the application site extends into the area of search and around the northern and western boundaries of the Power Station. The mine is not considered to result in any cumulative effects and is not proposed to be considered.
C	High Speed Rail Phase 2b West Midlands to Leeds.	The working draft HS2b Environmental Statement Volume 2 Community Area Report LA05 Ratcliffe-on-Soar to Long Eaton (October 2018) includes an indicative construction programme within Figure 7. This illustrates that construction works near to the Power Station are scheduled to begin in Quarter 3 and 4 of 2025. This is 9 months after the Proposed Development is anticipated to be fully completed and operational. It should be noted that the Bill seeking powers to construct and operate Phase 2b has not progressed through Parliament, and this process is anticipated to take place this year (2020). As such, the scheme has no formal 'consent'. Notwithstanding, the Proposed Development ES will include a high-level appraisal of the proposed HS2b where the two schemes are in proximity. This will be reliant on using the best available information for the HS2b scheme and will (where possible) ensure any potential significant cumulative effects are identified within the ES.

2.4.32 On the basis of the above review, the Applicant identified (within the EIA Scoping Report) a single cumulative assessment scheme that it is considered should be covered within the ES. This relates to HS2b. The EIA Scoping Opinion confirmed that only the HS2b scheme should be assessed and as such the cumulative effects assessments only consider this project.

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Residual Effects and Conclusions

2.4.33 This section of each Chapter provides a textual description of the residual effects of the Proposed Development following the implementation of any additional mitigation or enhancement measures.

2.4.34 The conclusions summarise the key elements of the assessment and include a statement on whether the Proposed Development is considered likely to result in any significant environmental effects.

2.5 Structure of the Environmental Statement

2.5.1 **Volume 1 (Main Report)** provides an introduction to the project and details the technical assessments that have been undertaken to determine the likely impacts of the project. The chapters of the Main Report are as follows:

Chapter 1.0: Introduction and Background
Chapter 2.0: Approach to the Environmental Statement
Chapter 3.0: Alternatives Considered
Chapter 4.0: Scheme Description and Construction Methods
Chapter 5.0: Landscape and Visual Effects
Chapter 6.0: Ecology and Nature Conservation
Chapter 7.0: Noise
Chapter 8.0: Air Quality and Human Health
Chapter 9.0: Ground Conditions
Chapter 10.0: Surface Water and Flood Risk
Chapter 11.0: Transport
Chapter 12.0: Socio-Economics
Chapter 13.0: Archaeology and Cultural Heritage
Chapter 14.0: Cumulative Effects
Chapter 15.0: Summary of Effects

2.5.2 **Illustrative Figures (Volume 2)** includes the illustrative figures associated with the technical assessments.

2.5.3 A series of **Technical Appendices (Volume 3)** are provided that include details of the methodology and information used in the assessment, detailed technical schedules and, where appropriate, raw data.

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2.5.4 All the Chapters of the Main Report are summarised in a **Non-Technical Summary (Volume 4)** to provide a review of the development proposals, and the possible environmental implications, in concise lay terms.

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CHAPTER 3.0 ALTERNATIVES CONSIDERED

APPENDICES (Volume 3 bound separately)

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3.0 ALTERNATIVES CONSIDERED

3.1 Introduction

3.1.1 Schedule 4 of the EIA Regulations 2017 identifies the information for inclusion in an ES, of which paragraph 2 requires: *"A description of the reasonable alternatives (for example in terms of development design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects."*

3.1.2 It should be noted that the Regulations place no specific obligation on an Applicant to study alternatives, but simply to describe them in the manner specified, where they have been considered.

3.1.3 In the case of the Proposed Development, and specifically the work undertaken leading up to the application, a number of alternatives have been considered by the Applicant. The subsequent sections provide a summary of each of the alternatives considered under the following headings:

- Alternative Technology Solutions;
- Alternative Direct Combustion Technologies; and
- Alternative Design Solutions.

3.1.4 It should be noted that the vision for the Power Station site is to create an employment site based around modern industrial and manufacturing uses, underpinned by a sustainable energy theme. Whilst this vision is in its early stages, the Proposed Development is viewed as the catalyst, being the first new build on the redeveloped Power Station site, and by virtue of generating low-carbon and partially renewable energy for the future industry and manufacturing uses. Accordingly, the Applicant has not given any regard to alternative sites.

3.2 Alternative Technology Solutions

3.2.1 The Applicant has considered a number of potential alternative technology options in relation to waste recovery, the principal technology types being:

- Advanced Thermal Treatment (i.e. pyrolysis and gasification); and

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- Direct Combustion.

Advanced Thermal Treatment (ATT)

3.2.2 In relation to ATT experience in the UK, there are no known *'fully functioning'* gasification plants treating mixed residual wastes at the scale necessary to meet project economic conditions. The required scale up for the available gasification technologies in the market would introduce considerable technical risk and uncertainty to future performance of the plant, forming a significant viability hurdle. There are also some well-known UK gasification projects which have recently faced problems during construction, with a range of construction contractors and technology providers facing significant losses and a number no longer active in the UK market. There is therefore currently a very limited market for Engineering, Procurement and Construction (EPC) Contractors with the capability to provide the required construction solution for gasification and pyrolysis projects.

3.2.3 The Applicant was also concerned about the potential loss of fuel flexibility associated with ATT plants. A particular challenge for this technology is the variability of mixed wastes as a fuel and the difficulty this creates in controlling process parameters. A proposed solution is tight specification and / or pre-sorting of the incoming feedstock. However, the Applicant expects the composition of residual waste to evolve in future due to increased source separation and changes in recycling capabilities. Therefore, a technology is preferred that has a greater tolerance to changes in waste composition.

3.2.4 Due to historic delivery risks associated with ATT plants and the consequent limitation to the EPC contracting market, there are currently significant issues with securing funding for large-scale gasification projects. Due to the combination of delivery and contracting / technical risks associated with the required technology scale-up, reductions in available subsidy support and the associated issues with securing funding, the Applicant has decided that ATT was unlikely to result in the delivery of a viable project and thus the use of an ATT technology has been discounted.

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Direct Combustion

3.2.5 Direct waste combustion in a modern thermal treatment EfW facility is a proven technology capable of delivering a flexible and sustainable waste management solution. EfW is used throughout the UK and Europe for the management of municipal / household waste, similar commercial and industrial wastes, and residual waste from such waste streams. The technology is, by a very significant margin, the most widely deployed waste recovery solution in Europe (with circa 450 operating plants). An EfW facility would be capable of managing the requisite residual waste volume and would effectively treat the likely composition of the waste predicted to be managed at the EMERGE Centre. Given the technology is well proven, it is also significantly less complex to fund. On this basis, the use of a modern EfW facility was considered to be the most appropriate waste recovery technology option currently available.

Alternative Direct Combustion Technologies

3.2.6 Direct waste combustion EfW facilities can be delivered through a variety of sub-technologies. The Applicant has considered these technologies and a synopsis of this assessment is set out below.

3.2.7 A fixed hearth furnace is generally not considered to be suitable for the management of large volumes of residual waste and is best suited to low volumes of a more consistent waste. Therefore, they have not been used for the combustion of residual waste in the UK.

3.2.8 Pulsed hearth technology has been used for municipal waste in the past, as well as other solid wastes. However, there have been difficulties in achieving reliable and effective burnout of waste and it is considered that the burnout criteria required by the Industrial Emissions Directive (IED) would be difficult to achieve.

3.2.9 Rotary kilns have achieved good results with clinical waste, but they are not commonly used in the UK for municipal / household waste, similar commercial and industrial wastes, and residual waste from such waste streams. There is a rotary kiln in use for municipal waste at Grimsby, which has a design throughput of 56,000 tpa. In general, this technology is suitable only in the throughput range of 40,000 tpa to 80,000 tpa and thus would not be appropriate for the EMERGE Centre. The energy

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conversion efficiency of a rotary kiln is lower than that of a moving grate (see below) due to the large areas of a refractory lined combustion chamber.

3.2.10 Fluidised bed technology has been used for municipal / household waste and similar commercial and industrial wastes at a very few sites in Europe. In the UK, there are only two operating facilities which are located in Dundee and at Allington in Kent. The former has a long history of significant operational difficulties and is going to be rebuilt using grate technology.

3.2.11 Fluidised bed technology has several advantages over moving grate technology, including lower nitrogen oxide (NO_x) formation, slightly higher thermal efficiency and the lack of moving parts within the combustion chamber. However, there are also several disadvantages:

- The waste stream needs to be homogenised and therefore would need to be pretreated before feeding to the fluidised bed. This would lead to additional energy consumption and a larger building. The additional energy consumption tends to outweigh the combustion efficiency advantage;
- High fluidisation velocities can lead to the carryover of fine particulate material. This can lead to a higher particulate loading in the flue gases, so leading to higher quantities of flue gas treatment residues, which need to be disposed of as waste, and in particular as hazardous waste. However, the bottom ash tends to be of finer quality;
- When the fuel preparation is included, the operational and capital costs of a fluidised bed can be higher than the equivalent costs for a moving grate incinerator; and
- Reliability in UK fluidised bed plants has been lower than for other EfW options in a number of circumstances.

3.2.12 Moving grate is the leading technology in the UK and Europe for the combustion of municipal and other similar wastes (including residual waste), being installed on over 90 % of fully operating UK EfW plants and some circa 98 % of European plants. It is a proven and developed design, with several suppliers available. The various designs are proven to achieve the burnout requirements for IED compliance. For these reasons the Applicant has selected this particular EfW technology.

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Single Line vs Twin Line

3.2.13 Having decided to progress with a moving grate EfW solution, the Applicant reviewed the option of developing a single line solution or a twin line solution. A single line solution involves constructing a single moving grate furnace, boiler and FGT facility that would handle the entire waste stream. A twin line solution would involve the construction of two moving grate furnaces, two boilers and two FGT facilities which would run in parallel, each dealing with half the overall residual waste volume. A twin line solution could operate with a single or twin turbine arrangement.

3.2.14 There are multiple examples of both single and twin line plants throughout the UK and the rationale for selecting different options depends on the project specific delivery requirements including: overall capacity requirement; the solutions offered by technology contractors; site size and constraints, requirements for building in operational redundancy and cost. Most notable is that the largest single line technology available is circa 350,000 tpa capacity (possibly a little larger dependent on the waste characteristics).

3.2.15 The EMERGE Centre is proposed to have an operating capacity of circa 472,100 tpa. Accordingly, in order to provide this capacity, a twin line solution is essential, with each line operating up to 236,050 tpa. Further, and more unusually, the Proposed Development would also have 2 turbines to provide a higher degree of redundancy.

3.2.16 In summary, a twin line, twin turbine, moving grate solution was selected due to the following environmental reasons:

- A twin line solution allows the plant to continue to operate if there is a problem with one of the lines, or whilst one line is shut down / undergoing maintenance. The twin turbines further maximise this continuity of operation and should mean that the facility is capable of near permanent operation to provide power and / or heat to high criticality customers. This means that the facility can recover energy and manage waste more consistently than a single line solution, thus maximising the continuity of waste being treated further up the waste hierarchy and energy being generated and made available to off takers as heat or power; and
- A moving grate solution represents the leading technology for the combustion of residual waste. This technology is the most reliable and can treat significant

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volumes of waste more efficiently than other solutions. Moving grate technology also provides environmental certainty in relation to emissions.

3.3 Alternative Design Solutions

3.3.1 The project architect, GSDA, worked through a variety of design solutions, prior to the currently Proposed Development being fixed. This design evolution encompassed:

- Overall facility layout;
- Shape and form of the main building;
- Maximising the most efficient use of land; and
- Proximity of receptors and overall appearance of the facility in the Site's context.

3.3.2 The alternative design solutions and rationale for selecting the current design are set out in the Design Statement contained at **Appendix 3-1**.

3.3.3 In summary, the design of the Proposed Development was selected due to the following reasons:

- Existing access and weighbridge arrangements leading to the wider Power Station site are located adjacent to the Site and their operation would have to be maintained. On the Site the layout retains the existing infrastructure and seeks to segregate as far as possible operational vehicles (operating on a one-way clockwise traffic system) from staff / visitor vehicle movements;
- The broadly 'triangular' plan shape of the Site restricts the extent to which built development can be located within its narrowing corners. Therefore, a logical and efficient 'linear' process arrangement in the main building was developed. This sought to minimise the building footprint and height / volumes wherever possible;
- Expressing the varying heights of the different 'cubic' forms allowed the scale of the building to step down towards the north and south, thereby reducing the overall scale of the building when seen from the east and west. Also, enclosing all high-level roofs behind parapet walls helps to visually shield rooftop mounted equipment from view and avoided overshadowing;
- Locating the majority of outdoor plant and equipment on the western side of the main building meant the eastern half of the Site is more 'open' and visually

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uncluttered. Whilst locating the twin stacks at the southern end of the Site meant that they are located away from receptors;

- The location of outdoor equipment (ACC) is positioned on the Site to acoustically shield them from residential receptors. The AACs are also located close to the turbine hall to maximise efficiency, thus minimising the amount of energy required to operate the ACC system effectively;
- Rotating the Administration Offices at 90 degrees to the main building and raising it above ground level on columns better balanced the scale between it and the main building, and created a principal facade that added visual interest and presented a 'civic' frontage to the Power Station site; and
- Developing a landscaping strategy which visually enhances the 'civic' frontage of the Administration Offices and at the same time offers biodiversity enhancement and a relaxation area for staff.

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CHAPTER 4.0 SCHEME DESCRIPTION AND CONSTRUCTION METHODS

FIGURES (Volume 2 bound separately)

APPENDICES (Volume 3 bound separately)

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4.0 SCHEME DESCRIPTION AND CONSTRUCTION METHODS

4.1 Introduction

4.1.1 This Chapter provides a description of the layout and design of various components of the EMERGE Centre along with operational processes that would occur. A description of the construction methods, including the measures to mitigate potential construction phase effects, is also provided.

4.2 EMERGE Centre

4.2.1 The Proposed Development (see Figure 4.1) would be a conventional twin line combustion plant, based on grate technology. It is proposed to operate as a merchant facility (at the point of development) and is anticipated to accept non-hazardous residual commercial and industrial (C&I) wastes and local authority collected wastes (LACW), including in the form of refused derived fuel (RDF). It would also have the potential to treat the combustible fraction of construction and demolition (C&D) waste and is also intended to be capable of accepting certain waste biomass fuels. The facility would have a gross electricity generating capacity of 49.9 MW and the anticipated waste throughput would be circa 472,100 tpa, based on a combination of the forecast plant availability and the waste characteristics (namely its calorific value – CV).

4.2.2 It is important to note that the tonnage throughput at the facility is dictated by a combination of the thermal capacity of the plant, the number of hours per year it operates (i.e. the availability) and the CV of the waste treated. As stated above, based on the anticipated, likely parameters (90 % operating availability and a waste net CV (NCV) of 10 MJ/kg), the facility throughput would be circa 472,100 tpa. However, for the purposes of the EIA, and to ensure a worst-case scenario is considered, the EIA will also include a ‘sensitivity scenario’ whereby the waste NCV is assumed to fall to 9 MJ/kg (with availability remaining the same). In the ‘sensitivity scenario’, the theoretical waste throughput would rise to 524,550 tpa. This worst-case ‘sensitivity scenario’ figure will be considered in certain ES assessments, including, for example, transport effects.

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4.2.3 The facility would be located within a main building, up to 49.5 m high at its highest point (over the boiler), that would comprise:

- A Reception / Tipping Hall, with points of access and egress set at ground level;
- A below ground bunker;
- A Boiler Hall;
- A Turbine Hall, with two turbines for resilience;
- A Flue Gas Treatment (FGT) Facility;
- An Incinerator Bottom Ash (IBA) bay; and
- Offices, workshop, stores and staff welfare facilities.

4.2.4 A series of elevations and an illustrative 3D view of the EMERGE Centre are provided on Figures 4.2 to 4.6.

4.2.5 The EMERGE Centre has an area of circa 4 ha. The main building would be circa 178 m long and typically circa 73 m in width. However, due to the overall scheme design being 2 perpendicular blocks, with the Administration Offices extending (circa 76 m) to the east and the Turbine Hall extending (circa 32 m) to the west, at its widest point the building extends to circa 181 m.

4.2.6 The building would be subdivided into various process areas (running north to south, see Figures 4.7 and 4.8a-b). These areas include:

- Waste Reception Hall which extends to a height of 20 m to the parapet;
- Waste Bunker Hall which extends to a height of 35 m to the parapet;
- Boiler Hall has two levels: the boiler pop-up extends to a height of 49.5 m and the tapered facade extends to a height of 45 m to the parapet. Items of rooftop equipment would extend circa 2 m above the roof;
- Turbine Hall (located immediately to the west of the boiler hall) which extends to a height of 25 m to the parapet; and
- FGT facility which extends to a height of 35 m to the parapet.

4.2.7 The twin side by side stacks would protrude through the FGT facility roof and extend to a height of circa 110 m. Each stack would be circa 2.25 m in diameter, braced together near the top and include an external continuous emissions monitoring system (CEMS) platform.

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4.2.8 The Air Cooled Condenser (ACC) is proposed to be located to the west of the main building and north of the Turbine Hall. It would comprise a separate structure in order to ensure sufficient air flow through the units. The ACC would be circa 60 m long, circa 30 m wide. The units would be supported by metal columns with the underside of the cladding set at 10 m and extending to a height of 25 m. It would be connected to the Turbine Hall via ductwork.

4.2.9 The Administration Offices would extend circa 76 m from the eastern elevation of the main building, off the Boiler Hall. The offices would be elevated above ground level and extend to a height of circa 20 m to the parapet. Floorspace would be provided over two levels (set at 10 m and 14.5 m) with access achieved from ground level by an entrance foyer at the eastern end of the building.

4.2.10 A standalone Workshop building is proposed to be located to the east of the main building and north of the Administration Offices. The Workshop would be circa 47 m long, 19 m wide and extend to a height of circa 10 m to the parapet.

4.2.11 There would be external tanks / containers for the storage of ammonia and fuel, but the main air pollution control residue (APCR) silos would be located internally. In addition, there would be an external fire water tank and pump house. Other supporting infrastructure would include an electricity connection compound, combined heat and power (CHP) building, roads, car parking and a gatehouse / weighbridge complex.

4.2.12 As described above, the EMERGE Centre would have an installed electricity generating capacity of 49.9 MW and, if operating in power only mode, would be capable of exporting circa 43.4 MW of electricity. Based on typical operating hours (circa 7,884 hours per year – being 90 % availability) it could provide sufficient electricity to meet the domestic power requirements of about 90,000 households.[1] Whilst the facility would have a grid connection, it could also supply power to individual customers via a private wire system. Finally, the facility would, in the event that viable opportunities for the supply of heat do not exist from the outset, also be CHP ready and capable of providing heat in the form of steam (or possibly hot water) for use by local heat users. The short to medium term objective is that the Proposed

[1] *Calculation based upon the EMERGE Centre operating 7,884 hours a year × 43.4 MW then divided by the average domestic electricity consumption for the East Midlands Region (i.e. 3,639 kWh). The latter figure is referenced from the following documentation: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/853760/sub-national-electricity-and-gas-consumption-summary-report-2018.pdf*

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Development could serve a site heat network, and potentially also (via heat exchangers) a cooling network.

4.2.13 The Proposed Development would have a design life of circa 30 years, although in reality many elements of the plant would last beyond this period. Planning permission is being sought for a permanent development and, therefore, as elements of the facility require repair / refurbishment / replacement, this would be carried out.

4.2.14 The subsequent subsections describe the EMERGE Centre under the following headings:

- Employment;
- Access;
- Drainage;
- Utilities;
- Lighting;
- Security fencing and gating;
- Parking provision; and
- Landscaping.

4.2.15 Thereafter, a description of the main operational features of the EMERGE Centre is provided under the following headings:

- Proposed site operations;
- Waste inputs including sources and quantities;
- Energy recovery operations;
- Electricity grid connection;
- Heat off-take;
- Delivering net zero greenhouse gas emissions by 2050; and
- Operational environmental management.

4.2.16 Finally, a description of the construction phase is provided, including construction environmental management measures.

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Employment

4.2.17 The EMERGE Centre would provide employment for circa 45 people. The roles can broadly be subdivided into the following categories:

- Supervisory (Managers / Engineers): 7;
- Operators and Technicians: 17;
- Plant Assistants: 13; and
- Support Staff: 8.

4.2.18 Employees would work on a shift basis. It is anticipated that 12 hour shifts would operate on a typical pattern (07:00 and 19:00). This is based on four shift teams in total each consisting of a shift team leader plus two: operators; assistant operators; maintenance technicians (day shift only); operations and maintenance assistants (day shift only); and industrial cleaners (day shift only).

4.2.19 In terms of the remainder of employees, all supervisory staff; environmental technicians; storekeeper and support staff (excluding industrial cleaners) would work normal daytime hours, anticipated to be 08:00 to 17:00.

4.2.20 The construction of the EMERGE Centre would also provide temporary employment. Whilst the number of construction workers employed at the site would vary throughout the construction period (as shown on Figure 4.12), it is anticipated that during the peak construction phase (plant installation and fit out), there would be circa 600 construction workers at the site. The construction workforce profile would vary depending on the approach of the main contractor. However, a typical employment staffing profile, for a project of this type and scale, is contained in the Transport Assessment (TA), which forms a standalone document in support of the application. It is proposed that construction work would be able to occur 24 hours per day, 365 days of the year, but subject to various noise restrictions during the daytime, evening and night-time periods.

4.2.21 Subject to the grant of planning permission, construction is anticipated to start in January 2022, with a circa 3-year construction period resulting in the EMERGE Centre being operational in December 2024.

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Access

4.2.22 Vehicular access to the EMERGE Centre (for both construction and operational phases) would be provided via the existing dumb-bell grade separated junction off the A453 Remembrance Way. From this junction an unnamed road leads directly to the perimeter access barriers for the Power Station, circa 115 m from the roundabout. Once beyond the access barriers an existing internal tarmac access road leads to the EMERGE Centre site. This access point would cater for all vehicle movements associated with the proposal. Full details of access and the surrounding highway network are set out in the TA. As is currently the case for other delivery vehicles, it is proposed that waste deliveries would be able to take place 24 hours, 365 days per year.

4.2.23 The Environmental Impact Assessment (EIA) has been carried out on the basis that all the residual waste would be delivered to the EMERGE Centre by road. However, as the Power Station site includes its own railway sidings (which connect into the East Midlands mainline), there is the potential for rail deliveries to occur in the future. For the purposes of considering the delivery of residual waste by rail within the EIA, it has been assumed that rail deliveries could occur 24 hours 365 days per year. The unloading and transfer of sealed containers to the EMERGE Centre (via crane and flat-bed slave vehicles) would take place between the hours of 07:00 and 23:00.

Drainage

4.2.24 Preliminary surface water and foul drainage designs have been prepared in support of the EMERGE Centre. The designs are provided on Figure 4.9, and described in greater detail in Chapter 10.0 (Surface Water and Flood Risk) of this ES.

Surface Water

4.2.25 The EMERGE Centre would give rise to surface water run-off from on-site roads, vehicle parking areas, roofs of buildings and other hardstanding. Most surface water would flow into the proposed surface water drainage system. However, some of the roof water would be diverted to a rainwater harvesting tank located in the main building. Surface water collected from the site would pass into an on-site attenuation (underground storage system) before connecting into the wider drainage system which serves the existing Power Station site.

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4.2.26 As illustrated in Figure 4.9, the wider Power Station already benefits from a drainage network of underground pipework which leads (via an existing grit trap, interceptor and pumping station) to the existing settling lagoons located to the north of the cooling towers. Once discharged into the lagoon, water travels in a clockwise direction over weirs and into two further lagoons before reaching a central discharge point which enables water to drain (via gravity) through pipework to the River Trent. The existing surface water drainage system would be retained during the decommissioning of the Power Station and therefore would be utilised by the EMERGE Centre.

Foul Water

4.2.27 Foul water generated by the EMERGE Centre would be collected on the site via a series or pipes which would connect to a septic tank (see Figure 4.9). The contents of the tank would be emptied on a regular basis by a tanker and transported across the Power Station site to the existing sewage farm, where it would be treated. The treated foul water would then pass through an interceptor before being pumped through underground pipework (located to the west of the cooling towers) to the previously described settling lagoons and through pipework to the River Trent.

4.2.28 Due to the location of the existing foul water drainage system across the Power Station site, it is anticipated that it would be destroyed through the Power Station decommissioning process. However, post demolition and as further redevelopment proposals come forward at the Power Station site, it is anticipated that a new sewer system could be constructed which would enable the EMERGE Centre to be fully connected to the retained sewage farm. At this juncture, the septic tank and haulage tanker arrangement would be discontinued.

Utilities

Water

4.2.29 Whilst the steam cycle energy generation process is a closed loop system (i.e. boiler water is converted into steam and then condensed back to water for reuse), the EMERGE Centre would be a net user of water. Water would be sourced from the existing town main and private water system that serves the Power Station site, which is anticipated to be retained following the decommissioning of the Power

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Station, and from the rainwater harvesting tank. The precise point of connection and supply requirements would be established at the detailed design stage.

Telecommunications

4.2.30 The existing telecommunication network which serves the Power Station site would be extended through agreement with the relevant network operator to serve the EMERGE Centre.

Electricity

4.2.31 The EMERGE Centre is an electrical generating development and would meet its own operational electricity needs. On the rare occasions when the facility would need to import power, it would do so through the electrical connection described below.

4.2.32 The EMERGE Centre would export and import electrical power through the 11/132 kV transformer which is proposed to be constructed to the south of the main building and immediately beyond the overhead conveyors associated with the Power Station. From this transformer substation a connection to the existing electricity infrastructure at the Power Station site would be undertaken by a relevant statutory undertaker under permitted development rights.

Lighting

External Lighting

4.2.33 The EMERGE Centre would require external lighting for safe movement of vehicles and pedestrians, for any external amenity areas, and for the security of employees and visitors. The need to ensure safe working and operating conditions would be balanced against the requirement to reduce any unwanted visual prominence of the Proposed Development at night and to mitigate against general sky glow.

4.2.34 Once commissioned, the EMERGE Centre would operate on a continuous (24 hour / 7 day per week) basis. During hours of darkness or low-level natural illumination, there would therefore be a need for lighting commensurate with health and safety requirements to ensure a safe working environment for operatives on the site.

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4.2.35 The lighting design for the EMERGE Centre would seek to provide safe and well-lit external spaces and pedestrian walkways in accordance with the principles outlined in the best practice guidance below. Lighting levels would be designed to accord with best practice and to minimise the generation of obtrusive light beyond the development area. It is suggested that the detailed design for the lighting scheme should be the subject of a suitably worded planning condition based upon the principles for lighting design identified within this subsection of the ES.

4.2.36 There are a series of relevant documents and guidance that provide advice when developing internal and external lighting systems, including:

- Lighting Guide 6: Lighting the Outside Environment, CIBSE SLL 1992;
- Guidance Notes for the Reduction of Obtrusive Light, Institute of Lighting Engineers (ILE) 2000;
- Lighting Guide 12: Emergency Lighting Design Guide, CIBSE SLL 2004;
- Lighting Guide 7: Office Lighting, CIBSE SLL 2005 (with Addendum 2012);
- Lighting Against Crime. A guide for crime reduction professionals, Secured by Design 2011;
- BS 5489 Code of practice for the design of road lighting. Lighting of roads and public amenity areas, BSI 2013;
- BS EN 12464-2 Light and Lighting. Lighting of workplaces. Outdoor workplaces, BSI 2014; and
- Commercial Developments 2015 version 2, Secured by Design 2015.

4.2.37 The lighting design should demonstrate compliance with the various guidance documents and standards set out above.

4.2.38 Light sources would typically be LED, or other high efficiency sources. This would maximise both energy efficiency and longevity. Luminaires would be chosen in order to prevent light output above the horizontal, minimising light pollution.

4.2.39 The particular type of lighting columns and bollards would be chosen in accordance with the optimum height and spacing to ensure an even and efficient distribution of light that fulfils the design requirements in terms of security and minimal light pollution.

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4.2.40 All non-essential external lighting would be turned off during hours of darkness outside of normal working hours. Lighting would be controlled via a timer system with photocell override (e.g. timer could be overridden if sufficient ambient light is available).

4.2.41 The lighting design would incorporate the following mitigation measures:

- The use of low-level lighting as far as possible to reduce night-time visibility;
- The use of carefully located directional lighting incorporating light shields / or full cut off luminaires to avoid unwanted light spray / upward light and possible glare / sky glow effects;
- Digital programmable switches including timers and / or movement sensors;
- Avoid unnecessary or unplanned lighting of building facades; and
- Lighting to be concentrated in locations essential to night-time operations; use of low-level lighting bollards with low energy fittings to reduce the impact of lighting around amenity areas and pedestrian routes.

Internal Lighting

4.2.42 During hours of darkness or low-level natural illumination, there would be a degree of lighting required within the buildings, which would be necessary to support the 24-hour operations of the EMERGE Centre. Where lighting may be visible externally, e.g. in the office space where external walls include glazing, this internal lighting would be designed to reduce light spill outside the building. For example, internal building lighting to the floors of the proposed Administration Offices, which would be vacant outside of the normal working day, would incorporate intelligent lighting control systems and as such would switch off after operational hours. Lighting would be designed and installed to comply with relevant best practice guidance and standards.

4.2.43 General and specific lighting would also be required during daylight hours where necessary, either to supplement natural lighting, or to provide lighting where natural light is not present or otherwise inadequate.

4.2.44 As illustrated on the elevational plans (Figure 4.2 to 4.5), profiled glass is proposed to be included on the main building. The internal lighting would be designed to reduce light spill outside the building.

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CCTV

4.2.45 Any CCTV systems deemed necessary by the operator would be installed, maintained and operated in accordance with British Standard 7958:2005 – Closed Circuit Television (CCTV) Management and Operation Code of Practice. CCTV cameras would be positioned to give clear surveillance of the Site including access points and car parking areas. CCTV cameras would be mounted on lighting columns, canopies and building walls as appropriate to ensure that comprehensive coverage is achieved.

Security Fencing and Gating

4.2.46 The EMERGE Centre is located within the wider Power Station site which is protected through an existing electrified circa 3.5 m high green weldmesh perimeter fencing with matching gates. It is not proposed to amend the existing Power Station site perimeter fencing which would provide the fencing along the northern and eastern edge of the Application Site. The existing 1.8 m and 1.9 m high weldmesh fencing running along the southern (next to the conveyors) and western (next to the storage barn) would also be retained.

4.2.47 In terms of new fencing, 1.9 m high weldmesh fencing would be installed along the western boundary, between the existing weldmesh fence and the Power Station site perimeter fencing. The same fencing would also be installed along the southern edge of Application Site entrance road. It would connect to the existing weldmesh fencing which currently stops at the conveyor system. New 1.9 m high weldmesh fencing and associated lockable gates would also be installed next to the weighbridge compound, around the area of soft landscaping and along the internal access road which leads to the workshop building. The same fencing would also be installed between the workshop and the Power Station site perimeter fencing. This new fencing would ensure that the operational area and non-operational areas are clearly demarcated.

4.2.48 The substation would be secured by 2.4 m high weldmesh fencing and associated double leaf lockable gates.

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Parking Provision

4.2.49 A total of 43 employee and visitor car parking spaces (including 3 accessibility and 3 electric car charging spaces) are proposed underneath and to the north of the Administration Offices. This level of car parking has been provided to accommodate the proposed employees, taking account of the shift change requirements. There would also be motorcycle parking and a bicycle parking shelter located near to the entrance to the Administration Offices.

Landscaping

4.2.50 The EMERGE Centre would include hard and soft landscaping as referenced in Chapter 5.0 (Landscape and Visual) of this ES and illustrated on Figures 5.5a-b. These figures illustrate that:

- Along the eastern boundary of the Site, soft landscaping is proposed to include a combination of species-rich mown grassland, native woodland copse and hedgerow; and
- To the south of the Administration Offices a range of species-rich mown grassland; herbaceous perennial meadow; birch woodland with herbaceous understorey; native hedgerow and semi-mature fastigiate oak are proposed. This area would also include a swale feature with reedbed and footpath (including benches).

4.2.51 It is suggested that the detailed soft landscaping design and planting specification could be controlled through a suitably worded planning condition.

4.3 Operations

4.3.1 This subsection describes the operations and processes that would be undertaken at the EMERGE Centre. Figure 4.10 provides a simplified process diagram of the operation of the EMERGE Centre.

Operating Hours

4.3.2 The EMERGE Centre would operate on a 24 hour 365 days per year basis.

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Reception and Handling

4.3.3 Residual waste would be delivered to the EMERGE Centre by HGVs. Incoming vehicles would use the Power Station's existing HGV access via the grade separated junction off the A453 on to Barton Lane. Once within the Power Station site, vehicles would use the existing tarmac internal access roads to reach the incoming weighbridges located to the south of the gatehouse. At the weighbridges, details of the vehicle and weight would be checked and recorded. Loads would also be inspected on a random periodical basis to confirm the nature of the incoming material. There is queuing capacity for up to 8 HGVs at the weighbridge (including a vehicle on each weighbridge).

4.3.4 Once checked and recorded, the vehicles would travel around the main building in a clockwise direction before reaching the entrance doorway on the western elevation of the Waste Reception Hall. Once within the hall, vehicles would be directed to a vacant tipping bay and discharge the load into the Bunker. On completion of tipping operations, vehicles would leave the Waste Reception Hall through a doorway in the eastern elevation. Vehicles would then continue in a clockwise direction along the internal access road (which runs immediately adjacent to the main building and passes underneath the Administration Offices) before reaching the exit weighbridge. Records would again be taken before the vehicle travels back along the Power Station site's internal access road and exits onto the public highway network.

4.3.5 The Waste Reception Hall would include 6 tipping bays to allow multiple vehicles to discharge at the same time. The entry and exit doors would be equipped with fast acting vertical folding roller doors, which would be kept closed except for vehicle access and egress.

4.3.6 The Bunker would be constructed from concrete and completely housed within the main building. It would provide storage capacity for 5 days (without stacking).

4.3.7 Above the Bunker would be overhead traveling cranes equipped with petal grabs. These would be used to mix, stack and load the waste into the feed chutes of the furnaces. The cranes would be operated automatically during normal operations.

4.3.8 The EMERGE Centre is proposed as a twin line plant. As such, residual waste would be loaded into the feed chutes of the two furnaces by the petal grabs. Following

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loading into the feed shuts, the residual waste would be transferred onto each grate by a hydraulically powered feeding unit. The backward flow of combustion gases or the premature ignition of residual waste would be prevented by keeping the chute full of residual waste and by keeping the furnace under negative pressure. A level detector would monitor the amount of waste in each chute and an alarm sounded if the waste falls below the safe minimum level. The feed rate into the furnaces would be controlled by a combustion control system.

Combustion Process

4.3.9 The EMERGE Centre would use a moving grate system that moves the residual waste from the feed inlet to the residual discharge. This mixes the residual waste along the surface of the grate to ensure that all material is exposed to the combustion process. Auxiliary burners (which typically operate for up to 16 hours during a start-up event) would run on diesel / low sulphur fuel oil. Once operational, there should be no more than two cold start-ups per year and per line outside planned maintenance activities.

4.3.10 Primary air for combustion is fed to the underside of the grate. Secondary air is also admitted above the grate to create turbulence and ensure complete combustion with minimum levels of oxides of nitrogen (NO_x). The volume of both primary and secondary air is regulated by a combustion control system.

4.3.11 The combustion control system regulates combustion conditions (and thereby minimises the levels of pollutants and particulates in the flue gas before flue gas treatment) and controls the heat input to the boiler. The furnaces are also fitted with auxiliary burners, fuelled by diesel / low sulphur fuel oil, which would automatically maintain the temperature above 850 °C, on the very rare occasions, if ever, that temperatures start to fall below this. Combustion chambers, casings and ducts, and ancillary equipment are maintained under slight negative pressure to prevent the release of gases. The facility would meet the requirements set down in the Industrial Emissions Directive (IED), which would be reflected in the Environmental Permit (EP).

4.3.12 During operation, the temperature in the combustion chambers would be continuously monitored and recorded to demonstrate compliance with the requirements of the IED and the EP. The combustion control system would be an

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automated system, including the monitoring of combustion and temperature conditions of the grates, modification of the residual waste feed rates, and the control of primary and secondary air.

Energy Recovery

4.3.13 The energy generation process is founded upon hot gases from the furnace passing to a boiler which converts the energy from the gases into steam. The boiler would consist of evaporative tubes, superheaters and an economiser. As the EMERGE Centre comprises a twin line system, there would be two boilers working in parallel, albeit independently of one another.

4.3.14 Superheated steam would be piped from the boilers to the steam turbines that would power a generator to generate electricity. The electricity generated would route via the switch gear within the Turbine Hall and then onto the on-site substation described further below. The superheated steam from the boiler would cool as it passes through the turbine, reducing in pressure and temperature.

4.3.15 The low-pressure steam exiting the turbines would be piped to the ACC where the steam would be circulated around a network of pipes that would run above a series of fans. The air from the fans would pass over the pipes cooling and condensing the steam into condensate under a vacuum. The condensate would then be recirculated for use in the boiler system. The use of an ACC system means that there would be no visible plume generated from the cooling process.

4.3.16 Steam could also be extracted from the turbines and piped directly to heat users. Alternatively, lower pressure steam exiting the turbines could pass through an on-site heat exchanger to heat up water for use in a heat network. The volume of steam extracted would vary, depending on the heat load requirements of the heat users.

4.3.17 Further details on energy recovery are provided subsequently.

Boiler Water Treatment

4.3.18 A demineralisation plant would be provided as an integral part of the EMERGE Centre. Various chemicals, for example hydrochloric acid and caustic soda, would

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be required for the demineralisation process and for boiler water dosing (to prevent corrosion within the boiler).

4.3.19 The chemicals for demineralisation would be stored within a bunded area in the demineralisation plant. Chemicals will be delivered using bulk tankers or in intermediate bulk containers (IBCs).

Flue Gas Treatment

4.3.20 Gases generated during the combustion process would be cleaned before being released into the atmosphere to the standards required to protect human health and the environment. The EMERGE Centre would be served by a flue gas treatment system and associated reagent storage silos. The treatment system is likely to comprise a system that includes the injection of reagents, for example, activated carbon, lime, and fabric filters. This would be designed to ensure that the plant operates within the emission limits set out in the IED and associated Best Available Techniques (BAT) Reference Document for Waste Incineration (WI BREF).

4.3.21 Flue gas treatment (FGT) reagents and FGT residues would be stored in silos located within the main building. Vehicles would access the silos via a door on the eastern elevation of the main building (between the Turbine Hall and Ammonia Store) in order to deliver FGT reagents and export FGT residues. FGT reagents and residues would be transferred by sealed pumps into and out of the storage silos. Vehicles would then exit via a door on the western elevation of the main building (to the south of the Administration Offices).

Flue Gas Treatment – NO_x Reduction

4.3.22 NO_x [2] levels would be managed through careful control of combustion air and selective non-catalytic reduction. This involves the injection of ammonium hydroxide solution into the combustion chamber of the boiler. The ammonium hydroxide reacts with both nitrogen oxide (NO) and nitrogen dioxide (NO_2) to form nitrogen and water.

[2] *NO_x is the generic term which refers to NO and NO_2 gases formed during the combustion process.*

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Flue Gas Treatment – Reagent dosing

4.3.23 Acid gases produced during the combustion process would be removed by reacting the gas with hydrated lime or sodium bicarbonate as a reagent. Neutralisation of the acid gases takes place as they react with the reagent. The residual material would be recovered at the outlet of the flue gas scrubbing system.

4.3.24 Activated carbon would also be injected into the flue gas duct to minimise the flue gas emissions of dioxins, mercury and other heavy metals.

Flue Gas Treatment – Fabric Filtering

4.3.25 After reacting with the FGT reagents, the gases would be drawn through a fabric bag filter to remove particulates, including any reagent particles. The fabric filter would be divided into separate compartments with numerous filter bags, allowing for maintenance as described below. The treated flue gas passes through an induced draught (ID) fan into the stacks for release to the atmosphere.

4.3.26 Regular bag filter cleaning would be performed on-line by pulsing compressed air through the filter bags. The residues are known as FGT residues and would be collected in fully enclosed hoppers beneath the filters.

4.3.27 Bag failure, albeit an infrequent occurrence, would be identified by a sudden drop in pressure in the system and a small increase in particulate concentration at detection meters installed immediately downstream of the bag filter. The compartment containing the failed bag would be isolated and then replaced. The EMERGE Centre would be capable of operating at full capacity with one compartment off-line whilst maintenance was being undertaken. Spare bags would be held on site and installed immediately after a failure occurred.

Flue Gas Treatment – Stack

4.3.28 Following cleaning, the combustion gases would be released into the atmosphere via the stacks. Emissions from the stacks would be monitored continuously by an automatic computerised system and reported in accordance with the Environment Agency's requirements for the operation of the EMERGE Centre. The proposed stacks would be 110 m high. Details of the stack height and air quality modelling are

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provided in Chapter 8.0 Air Quality and Human Health of the ES Volume 1 Main Report.

By-Product Handling and Disposal

4.3.29 Two types of solid by-products would be produced from the operation of the EMERGE Centre, bottom ash and FGT residues, each of which would have separate handling and disposal arrangements as described below.

By-Product Handling and Disposal – Bottom Ash

4.3.30 Bottom ash, known as Incinerator Bottom Ash (IBA) – which may also include the ash collected from the boiler surfaces – is the inert burnt-out residue from the combustion process. Based on full load operations circa 116,609 tpa [3] of bottom ash would be produced. Bottom ash typically comprises a mixture of metals, glass, brick, rubble, sand, grit and metal as well as ash from combusted material.

4.3.31 Bottom ash would all be managed in the main building. It would be quenched as it leaves the combustion chamber to both cool the ash and also reduce potential for emissions of ash (dust) into the air. Any water not vaporised in the quenching process would be collected and recycled for continued use in the quenching process. The bottom ash would be deposited into a bunker where it would be stored prior to being loaded into HGVs within the bottom ash tunnel (located on the eastern side of the main building). HGVs would export the IBA to a re-processor where metals would be extracted, with the remaining material typically processed for use as a recycled aggregate.

By-Product Handling and Disposal – Flue Gas Treatment (FGT) Residues

4.3.32 FGT residues comprise fine particles of ash and residue from the flue gas treatment process, which are collected in the bag filters. It is estimated that the operations would generate circa 19,829 tpa [4] of FGT residues. FGT residues would be stored in silos within the main building. The FGT residue silos would have capacity for 5 days of storage, although at normal operating conditions less than half of this capacity would generally be used prior to export off-site.

[3] *472,100 divided by 100 times by 24.7 = 116,609*
[4] *472,100 divided by 100 times by 4.2 = 19,829*

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4.3.33 Due to the alkaline nature of the FGT residues, they are classified as hazardous waste (in much the same way as cement). The FGT residues would be transported off-site to a Permitted Hazardous Waste disposal facility. Alternatively, the residues may be taken to an appropriate treatment facility where, for example, they could be reused in the stabilisation of acid wastes or used in cement manufacture.

4.3.34 The reuse of FGT residues is an evolving market and as such the Applicant would continue to explore alternative options for the disposal or treatment of the FGT residues throughout the operational lifetime of the EMERGE Centre. This would be based upon a regular review of the market, taking full account of social, environmental and economic factors and also potential emerging technologies.

Raw Materials Handling and Storage

4.3.35 Apart from treating residual waste, the EMERGE Centre would use various raw materials during processing. Primarily, these would include hydrated lime or sodium bicarbonate, ammonium hydroxide, activated carbon and diesel / low sulphur fuel oil. Table 4.1 indicates the processes in which they would be used. This table also provides the quantities in which they are likely to be stored on site. The materials would be stored within appropriately designed silos and storage tanks.

Table 4.1: Proposed Raw Material Usage and Storage

Raw material (if required)	Process	On-site storage capacity
Hydrated Lime ($Ca(OH)_2$) / Sodium Bicarbonate ($NaHCO_3$)	Flue gas treatment – acid gas scrubbing	376 m^3
Ammonium Hydroxide (NH_4OH)	Flue gas treatment – NO_x reduction	38 m^3
Activated carbon	Flue gas treatment – dioxins / heavy metals	45 m^3
Diesel / low sulphur fuel oil	System firing	175 m^3

4.3.36 In addition, various other materials would be used for the operation and maintenance of the EMERGE Centre including:

- Hydraulic oils and silicone-based oils;
- Inert gases for electrical switchgear;
- Gas emptying and filling equipment;
- Refrigerant gases for air conditioning plant;

- Glycol / anti-freeze for cooling;
- Oxyacetylene, TIG, MIG welding gases; and
- CO_2 / fire-fighting foam agents.

4.3.37 In order to minimise the risks of contamination to process and surface water, all liquid chemicals stored on site would be kept in bunded controlled areas.

4.3.38 In addition to the raw materials described above, the EMERGE Centre would require materials necessary to maintain the boiler water demineralisation plant, these may include hydrochloric acid (35 % solution); caustic soda (30 % solution); and various boiler water dosing chemicals.

4.4 Residual Waste Inputs

Sources and Quantities

4.4.1 The EMERGE Centre has been designed to recover energy through the controlled combustion of typically 472,100 tpa of non-hazardous residual commercial and industrial (C&I) wastes and local authority collected wastes (LACW), including in the form of refused derived fuel (RDF). It would also have the potential to treat the combustible fraction of construction and demolition (C&D) waste and is also intended to be capable of accepting certain waste biomass fuels. Residual waste is that waste which remains after reuse and recycling / composting operations have taken place.[5] RDF comprises residual waste which has been subject to some form of pretreatment, often metals extraction and shredding.

4.4.2 The EMERGE Centre would be a 'merchant plant'. This means that it is not being brought forward primarily to serve a specific / single public sector waste contract, but to serve the wider market, including both public and private sectors. However, the input residual waste would be secured through a series of medium and long term contracts with a number of waste suppliers, with the waste being primarily from commercial and industrial (C&I) sources within the Nottinghamshire, Derbyshire and

[5] *Residual waste is more fully defined in Defra's 'Energy from Waste: A guide to the debate' (which forms one of the suite of documents sitting under the national waste strategy). This states (at paragraph 18): "Residual waste is mixed waste that cannot be usefully reused or recycled. It may contain materials that could theoretically be recycled, if they were perfectly separated and clean, but these materials are currently too contaminated for recycling to be economically or practically feasible. It may also be that there is currently no market for the material or it is uneconomic to take to market. An alternative way of describing residual waste is 'mixed waste which at that point in time would otherwise go to landfill'."*

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Leicestershire areas. Some of the input waste may also be municipal waste (MSW) [6], where the third-party suppliers have MSW contracts. All wastes received at the site would be classed as 'residual' having been subject to pretreatment, either through source segregation or direct pre-processing.

4.4.3 The 'need' for the waste recovery capacity that would be delivered by the EMERGE Centre is set out in detail within the separate Planning Statement, which is also submitted in support of the planning application.

Understanding Throughput

4.4.4 The EMERGE Centre has been planned to have a typical annual throughput / capacity of 472,100 tpa of residual waste. However, it is important to understand that thermal treatment plants, such as the EMERGE Centre, are actually sized on thermal capacity, not mass throughput, and that once a plant has been constructed its thermal capacity is fixed. The relationship between mass throughput and thermal size is dictated by the calorific value (CV) of the residual waste. The CV depends upon the mix of materials that is in the residual waste. The higher the CV of the residual waste, the lower the tonnage throughput of any given thermal treatment plant and vice versa (this relationship is independent of the thermal treatment technology selected).

4.4.5 Plant availability is the number of hours per year the plant is running and processing residual waste; this affects annual tonnage throughputs. Over the life of the facility there will be years of high availability and years of low availability. Typically, a well-run and reliable plant would achieve circa 90 % availability over a year. There are 8,760 hours in a year; therefore, for a plant achieving circa 90 % annual availability, this means it would operate for 7,884 hours in a year. However, some years may have (slightly) more operating hours and some less. For example: a plant processing around 60 tonnes per hour for 8,000 hours has an annual throughput of 480,000 tonnes, but if the same plant only operates for 7,500 hours (85 % availability), maybe due to increased maintenance needs that year, then the throughput would reduce to 450,000 tonnes.

[6] *MSW – Municipal Solid Waste*

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4.4.6 In light of the above, it should be understood that the plant throughput in any year is a combination of three factors: (1) thermal capacity; (2) residual waste CV; and (3) plant availability.

4.4.7 Given that once a plant has been constructed its thermal capacity is fixed, it is the other two variables that determine the residual waste throughput profile over the life of the plant, albeit the likely change in throughput would be very modest even if the variables shift.

4.4.8 This is a common issue faced in planning applications for thermal treatment plants, like the EMERGE Centre, where the Applicant must use the best available information to fix a throughput figure which accurately reflects current residual waste data. It is inappropriate to assess the effects of the scheme based upon theoretical outcomes (not reflecting the best available data) which could modestly either reduce or increase the actual throughput capacity.

4.4.9 As stated throughout, the nominal / typical capacity of the EMERGE Centre is 472,100 tpa. This is the annual tonnage of waste it is forecast to treat based on the following parameters:

- 7,884 operating hours per year (circa 90 % of the year); and
- A residual waste net CV of 10 MJ/kg.

4.4.10 This is considered to comprise a realistic number of operational hours per year and the anticipated average CV for the input residual waste material (i.e. it is the most likely and robust scenario) resulting in the throughput of 472,100 tpa. However, for additional robustness, the ES considers / assesses a ‘maximum tonnage scenario’ where the waste net CV drops to 9 MJ/kg. This is referred to as the ‘sensitivity test’; under this scenario, based upon the same operating hours (i.e. 90 % of the year), the total waste throughput would be 524,550 tpa.

4.5 Energy Recovery

4.5.1 As identified previously, the EMERGE Centre would recover energy from the combustion of residual waste by way of electricity and potentially heat production. For the avoidance of doubt, the development proposal includes for electricity generation and export to the grid. It could also supply power directly to end users via a ‘private wire’ arrangement.

4.5.2 The electricity generation component forms part of the planning application, but the connection (i.e. underground cables) to the local electricity network is not included within the formal application itself. This would be delivered through a separate consenting process as described subsequently. However, this ES does consider the potential environmental effects of grid connection. The proposed electricity grid connection and the potential for heat off-take are described in more detail below.

4.5.3 Based upon known residual waste compositional analysis (and as accepted in Government policy such as the Renewable Heat Incentive) circa 50 % of residual waste is deemed to comprise biodegradable (biogenic) waste, by energy content. Hence, circa 50 % of the energy generated at the EMERGE Centre would be classed as renewable energy.[7]

4.5.4 The energy generation process is founded upon hot gases from the combustion chamber passing to a boiler which converts the energy from the gases into steam. The EMERGE Centre includes a steam turbine that would have a generation capacity capable of exporting approximately 43.4 MW of electricity to the local electricity distribution network (of which 21.7 MW would be classed as renewable assuming a biogenic energy content in waste of 50 %). The EMERGE Centre would also have the capability to export heat to local heat users. To facilitate this, the turbine would be equipped with steam extraction points to allow steam to be supplied directly to consumers, or to be condensed in heat exchangers in order to provide hot water. An air-cooled condenser, located next to the main building, would then be used to condense the residual steam from the steam turbine to water that would then be reused in the boiler.

4.5.5 Finally, for the purposes of Annex II of Directive 2008/98/EC on waste (the Waste Framework Directive) and the waste hierarchy, it can be confirmed that the EMERGE Centre would be classed as a 'recovery' facility. This is by virtue of it having a R1 energy efficiency value of greater than 0.65. As set out in **Appendix 4-1**, when the efficiency of the Proposed Development is calculated in accordance with the appropriate methodology [8], it achieves an efficiency coefficient (R1 value) of 0.76.

[7] For the design NCV of 10 MJ/kg, the waste composition used in the Carbon Assessment and Sustainability Report (**Appendix 8-4** of the ES) would correspond to a biogenic carbon content of 60 % on a mass basis. On an energy basis, the biogenic material would provide 56 % of the total energy input to the EMERGE Centre, which would be classed as renewable energy. It is important to note, however, that the actual biogenic carbon content and biogenic energy content are both very susceptible to changes in waste composition. Depending on the composition and NCV of individual waste components, the biogenic carbon content can be between 4 to 10 percentage points higher than the biogenic energy content.
[8] http://ec.europa.eu/environment/waste/framework/pdf/guidance.pdf

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4.6 Electricity Grid Connection

4.6.1 The EMERGE Centre includes a Transformer Compound located to the south of the main building, as shown on Figure 4.1. Electricity from the generator would be cabled underground to the Transformer where the voltage would be stepped up. The grid connection would then continue underground to the existing on-site substation, from where it would connect to the electricity network, as illustrated on Figure 4.11.

4.7 Potential Private Wire Distribution and Heat Off-take

4.7.1 Whilst the Proposed Development would have a connection to the local electricity network for the export of power, it could also supply power to individual customers via a private wire system.

4.7.2 Private wire systems are used to connect local power generation to a local power demand customer using privately owned cables rather than the public electricity grid. This can provide benefits to both the generator and the customer by agreeing a long-term contract for the off-take of power with an agreed price mechanism that is not subject to the volatility of wholesale markets.

4.7.3 Private wire systems can also be beneficial for the local grid operator as it removes power demand from the network which can remove or defer requirements for grid strengthening and improvement works. This would only likely be a suitable solution for a customer with a significant power demand (i.e. manufacturing, business, employment); however, it is this type of customer that may be attracted to locate business premises at the Power Station site as part of the planned redevelopment scheme.

4.7.4 This arrangement could also be suitable for an off-site customer within the local area with a high energy demand, and a private wire supply could provide a connection option at a preferable cost and schedule than network operators could provide.

4.7.5 As described previously, the EMERGE Centre would be capable of potentially exporting heat to local heat users, either in the form of steam or hot water. As such, it is fully capable of being a CHP plant and is described as ‘CHP ready’.

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4.7.6 At this stage of the project's lifecycle, no specific heat users have been identified, as is commonly the case. The government recognises that: *"Experience to date with CHP infrastructure has highlighted a potential difficulty in securing long term customers for heat ahead of construction of the plant."* [9]

4.7.7 Uniper has not started to actively promote the Site to prospective end users, preferring to wait until the planning application has been submitted and the East Midlands Development Corporation vision is clearer, identifying the true scale and intentions for the Power Station site. Despite this, Uniper has already received several separate approaches for use of land, one of which included a significant supply of CHP steam. This speculative approach was made under commercial confidentiality so cannot be described at the present time.

4.7.8 Uniper is also actively developing further site options to follow the EMERGE Centre, including waste recycling and reuse technologies, agriculture, data centres and further energy hub developments. These include technologies that would benefit from steam supply from the EMERGE Centre. It is therefore entirely possible that the first CHP customer for the EMERGE Centre could be a Uniper development.

4.7.9 Through the EIA Scoping process, it was requested that an assessment of the potential for the Proposed Development to export heat to surrounding users should be provided. The assessment in line with the questions set out in the scoping response can be found in **Appendix 4-2**.

4.8 Delivering Net Zero Greenhouse Gas Emissions by 2050

4.8.1 The UK Government has legislated to set a binding target of net zero greenhouse gas emissions by 2050. Uniper has also committed in its recent Sustainability Plan to achieve carbon neutrality for its power generation activities in Europe by 2035. It is therefore important that the Proposed Development is compatible with these goals. A detailed review of the credible options to deliver net zero carbon emissions from the Proposed Development in line with the UK Government's statutory target is presented in **Appendix 8-4** of the ES and summarised below.

[9] *Paragraph 237 - Government Review of Waste Policy in England 2011 (DEFRA 2011).*

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4.8.2 Decarbonisation of an energy recovery facility such as the Proposed Development can be achieved via either decarbonising the waste fuel or capturing CO_2 from the flue gases arising from combustion, or through a combination of both. The Climate Change Committee (CCC) report supporting the Government's 2050 net zero target recommends specific policy options aimed at reducing both the plastic and biogenic content of waste, which is expected to deliver significant additional decarbonisation of the waste stream when implemented. Similarly, recommended action in the transport sector involving electrification and hydrogen fuels should deliver significant decarbonisation of waste transport.

4.8.3 Carbon capture is costly and complex, but does hold the potential to deliver negative carbon emissions by also removing the biogenic emissions from the atmosphere. Again, Government policy will be required to provide the supporting infrastructure and investment to allow widespread implementation, but this approach is supported by the CCC recommendations. Carbon capture and storage is being implemented on a large-scale energy recovery plant in Norway, demonstrating that the sector is actively addressing this option.

4.8.4 The Proposed Development will initially support the transition to the Government's 2050 net zero target by:

- Achieving R1 status from the start of operations making it more energy efficient than many other existing energy recovery plants in the UK;
- Reducing the emissions of CO_2 relative to disposal in landfill;
- Proactively identifying and implementing Combined Heat and Power opportunities; and
- Providing an anchor facility to establish the wider Power Station site redevelopment as a low carbon and sustainable energy hub for the region.

4.8.5 Emissions of CO_2 from the Proposed Development will be reduced to net zero by 2050 through one or a combination of the following approaches:

- Elimination of non-biogenic carbon from the incoming waste stream;
- Implementation of on-site carbon capture from the EMERGE Centre and storage or usage;
- Implementation of on-site carbon capture from a separate biogenic waste stream to offset emissions of non-biogenic CO_2 from the EMERGE Centre, coupled with storage or usage; and / or

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- Bilateral or energy from waste sector agreements to offset overall CO_2 emissions by implementing bio-energy with carbon capture and storage (BECCS) at the most cost-effective energy from waste or other biomass fuelled plants.

4.8.6 Uniper could also contribute to the decarbonisation of other sectors, where there is the opportunity to displace emissions using carbon based products, manufactured using CO_2 captured from the EMERGE Centre.

4.8.7 Overall, whilst Uniper cannot predict what technologies will be available in thirty years' time, a road map has been developed to set out a journey to achieve a net zero future at the Power Station site. This is set out, with expectations of timelines, in Paragraphs 4.8.8 to 4.8.10. This journey is likely to feature a mix of the technologies that Uniper is exploring across the business which includes, but is not limited to, the approaches set out below. Ultimately full decarbonisation of the EMERGE Centre will be achieved using one, or a combination, of the three longer term measures.

4.8.8 Day 1 of Operations (2025)

- EMERGE Centre will operate with R1 compliance, reducing greenhouse gas emissions by diverting waste from landfill and export abroad; and
- EMERGE Centre designed to allow fuel flexibility should the nature of the incoming waste change over time and recycling levels increase.

4.8.9 Short Term (2025–2035)

- EMERGE Centre designed to be 'CHP ready' for connection to a district heating scheme, with industrial users or manufacturers to use lower carbon energy and heat generated by the facility;
- Changes to the composition of the fuel mix to reduce the non-biogenic carbon contained in the incoming waste stream driven by Government policy on recycling; and
- Potential co-location of a facility to recycle / reuse products extracted from the incoming waste stream reducing the non-biogenic content of the fuel mix and displacing CO_2 emissions associated with the production of products or feedstocks which the extracted products replace.

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4.8.10 Longer Term (2035–2050)

- Change in fuel stock to 100 % biomass waste (e.g. agricultural and construction industry wastes);
- Carbon capture and use (and potentially storage); and / or
- Bilateral or energy recovery sector agreements to offset overall CO_2 emissions by implementing BECCS.

4.9 Operational Environmental Management

4.9.1 The potential effects of waste management developments can be the subject of public concern with regard to environmental nuisance, e.g. generation of litter and odour or through attraction of vermin or other pests to the Site. However, a modern, well-run energy recovery facility should not give rise to such issues.

4.9.2 In order to ensure that the EMERGE Centre would be run in an acceptable manner, the operator would implement an Environmental Management System (EMS), certified to ISO 14001, for the facility. The EMS would form an integral part of the facility Integrated Management System (IMS) that would draw together all the policies and procedures for the facility that would include a site Environmental Management Plan (EMP).

4.9.3 The facility general manager would be responsible for the day to day management and compliance of the facility with the EMS and the control of these issues would be monitored and enforced by the EA through the EP. As set out in the introductory Chapter to this ES, the Applicant intends to submit the EP application around a month after the submission of the planning application.

Rodents, other Pests and Birds

4.9.4 Residual waste would be delivered within the enclosed Waste Reception Hall and deposited within the sealed concrete bunker. As described below, regular inspections of the EMERGE Centre would ensure litter within and adjacent to the facility, that could attract vermin, would be collected and disposed of. In addition, the Waste Reception Hall would be cleaned daily to ensure that material that could attract rodents or other pests does not accumulate.

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4.9.5 There is the possibility of fly infestation in periods of warm weather (when insect breeding cycles speed up) if unexpected events cause waste to remain in the bunker or face delays in the collection / transportation supply chain for extended periods. Should any fly eggs within the residual waste mature and hatch prior to combustion, insecticides would be used to ensure that fly issues are not experienced at the facility. A pest management plan will be in place as part of the EP.

4.9.6 As identified above, operations would take place inside a building which is the subject of regular inspections / cleaning. Furthermore, regular litter inspections within and adjacent to the facility would also take place. These processes would ensure that material which could potentially attract birds does not accumulate.

Dust and Odour

4.9.7 Whilst odour sources do exist at energy recovery facilities, such as that proposed, odour complaints and escape of odours beyond the Site boundary are highly unlikely on the basis that all operations occur within an enclosed building and there is no active venting from areas where putrescible waste would be stored. Odours would be prevented from escaping the Waste Reception Hall and Bunker, where most odour issues are likely to arise, as the air within the building is retained under negative pressure. This is achieved through the extraction of air from the Waste Reception Hall by fans which feed the combustion process.

4.9.8 As the Proposed Development has twin process lines and twin turbines, it should effectively operate continually. As such, the aforementioned odour control measures should always be active. However, in the event of an unplanned shutdown occurring, a dust suppression system fitted with deodorising solution would be employed across the Bunker and Waste Reception Hall.

4.9.9 The handling operators would be trained to operate a FIFO (first in, first out) system, so that residual waste is not routinely kept in the bunker for longer than two to three days. In addition, anaerobic conditions within the Bunker, which could cause odour, would be prevented by regular mixing of the residual waste by the crane operators.

4.9.10 No odours would be emitted from the stack as all odorous compounds would be destroyed due to the high temperatures achieved (850 °C) within the furnace. Deliveries of residual waste, which could give rise to odour, would be within enclosed

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or sheeted delivery vehicles. All delivery vehicles entering the EMERGE Centre would be inspected by the gatehouse operator to ensure that vehicles are appropriately enclosed. Any drivers failing to comply with Site regulations would be warned and breaches reported in the EMP. If repeated offences occur, then drivers would be banned from accessing the EMERGE Centre.

4.9.11 Dust emissions are unlikely to occur as all process operations are undertaken within enclosed buildings. During prolonged periods of dry weather, Site roads would be damped down / washed if the potential for fugitive dust impacts resulting from traffic movements are identified by the general manager.

Fire

4.9.12 Whist considered extremely unlikely; it is possible that residual waste loads being received at the EMERGE Centre may comprise elements of smouldering material. The site management plan would have procedures in place to deal with such events and records of any smouldering load incidents would be made within the EMP and monthly service report. A dedicated area would be provided within the Site that would be equipped to receive and extinguish smouldering loads delivered to the EMERGE Centre.

4.9.13 Once deposited in the bunker the residual waste would be inspected by the crane operator and, as described above, the waste would be mixed regularly to avoid anaerobic conditions developing. Inspections and regular mixing of the waste would help identify and prevent hot spots forming which could cause a fire.

4.9.14 Fire prevention and suppressions systems would operate at the EMERGE Centre. This may include the use of a specific water deluge system within the bunker and a fire water sprinkler system.

Litter

4.9.15 The operator would maintain the Site in a clean and tidy condition and measures would be defined within the EMP to prevent the release of litter from the buildings and from the Site boundary.

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4.9.16 All delivery vehicles to the Site would be required to be adequately covered, thus avoiding problems associated with residual waste escaping onto the public highway or other areas outside the boundary of the Site. Drivers would only be allowed to un-sheet vehicles after entering the Waste Reception Hall. As described above, any drivers failing to comply with Site regulations would be warned and breaches reported in the EMP. If repeated offences occur, then drivers would be banned from accessing the EMERGE Centre.

4.9.17 All unloading of residual waste would be undertaken within the enclosed Waste Reception Hall, which, as described above would be controlled under negative air pressure. This would assist in preventing any material from escaping the building.

4.9.18 The boundary of the Site would be securely fenced / contained, as described previously. This would further prevent any litter being blown beyond the Site boundary. The internal and external boundaries of the facility would be inspected daily, and waste material would be collected and disposed of.

4.10 Construction Phase

4.10.1 This subsection provides a summary of the key elements of the construction of EMERGE Centre. This description is not intended to be prescriptive and the exact construction methods, phasing and programme would be determined by the appointed designers and contractors. However, the following description enables the principal construction phases and methods to be understood.

Programme

4.10.2 The timing of the enabling works and core construction works would be dependent on the grant of planning permission for the EMERGE Centre and subsequent contract negotiations.

4.10.3 The overall construction period is anticipated to take circa 36 months; this includes, at each end of the overall construction programme, the initial enabling works and final commissioning of the plant. The programmed date for the opening of the EMERGE Centre is December 2024. An indicative construction programme is set out in Table 4.2.

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Table 4.2: Indicative Construction Programme

	Year 1				Year 2				Year 3			
	1	2	3	4	1	2	3	4	1	2	3	4
Activity												
Civil Construction												
Mechanical Erection												
Cold Commissioning												
Hot Commissioning												
Milestone												
First Fire with Primary Fuel										X		
Grid Synchronisation											X	
Operation												X

Construction Hours

4.10.4 It is proposed that construction operations could take place 24 hours per day, 365 days per year, as has happened historically at the Power Station site for many years. However, in reality, it is likely that the main focus of construction activity will be weekday daytime.

Site Access

4.10.5 Construction access would be same as for the operational phase (i.e. using the existing Power Station HGV delivery junction off the A453 Remembrance Way). Once within the Power Station site, construction vehicles would use the existing tarmac roads to reach the EMERGE Centre and / or construction compound.

Core Construction Works

4.10.6 The main construction phases of the project are described below.

Site Preparation

4.10.7 Once the Enabling Works have been completed, site establishment would take place. The construction compound would then be created for the initial site earthworks phase. The compound would provide temporary site offices, welfare facilities and material and plant storage areas. Dedicated refuelling areas and chemical and oil storage areas would also be provided within the compound.

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Earthworks, Foundations and Piling

4.10.8 The excavations would include creation of the void for the waste reception and bottom ash bunkers. Other excavated material would be generated from the piling and foundation works, development of external hard standing areas and utilities and drainage runs. It is anticipated that there will be a requirement to export excavation arisings from the Site.

Building Foundations

4.10.9 Foundations for the frame of the main building would be founded using a piled solution. Piling methods would be determined by the piling contractor but could be vibro or rotary augured.

4.10.10 Foundations for the ancillary buildings including the weighbridge, ACC, water pump house and substation would be determined following Site investigation and may comprise strip or pad footings.

4.10.11 Building slabs would be cast in situ and concrete would either be delivered directly to the Site via concrete mix lorry or concrete would be made from an on-site batching plant, with aggregates being supplied to site by HGV. Slabs may need to be supported on piled or vibro concrete foundations.

Erection and Cladding of Building Frames

4.10.12 The buildings are likely to be of steel frame construction with the external envelope formed from a combination of masonry blocks, cold rolled sheeting rails, metal cladding and glazing. The roofs of the buildings would be constructed of composite cladding panel.

4.10.13 Steel work would be delivered to the Site by HGV. The construction is likely to be undertaken using a series of mobile truck mounted cranes and a fixed tower crane. Typically a tower crane with a 55 m boom and a span of 65 m to the hook would be used in such a construction. The height of the tower crane would typically be 40 m. The greatest lifting capacity is likely to be provided by a large crawler (500 t capacity) crane for boiler erection.

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Installation of Plant and Equipment

4.10.14 The installation of the main plant and equipment would be undertaken during the completion of the Boiler Hall and FGT Facility.

4.10.15 Commissioning of the EMERGE Centre would take a period of circa 6 months and would commence following installation of the main plant. The initial commissioning would involve a series of tests prior to the burning of any residual waste at the EMERGE Centre. Commissioning and performance testing would take a period of circa 4 months, after which the EMERGE Centre would be fully operational.

External Civil Engineering and Infrastructure (Roads, Car Parking Areas, Drainage and Utilities)

4.10.16 Much of the external civil engineering works are likely to be undertaken towards the end of the main construction works, in parallel with the installation of plant and the commissioning period. The works would comprise the laying of the car park, external hard standing areas to the buildings and the landscape scheme. The laying and installation of drainage and utilities would be phased, with much of the work being undertaken in the early phases of the project. Connections and finishing of service runs are likely to be undertaken towards the end of the construction phase. The external grid connection works, i.e. the construction of the cable route and cabling to the local substation, would be undertaken prior to the commissioning operations.

Site Compound and Operative Facilities

4.10.17 With regard to off-site compound / laydown / parking, the land located immediately to the west of the Application Site is proposed to be used. This land adjoins the Site and its temporary use during the construction period would be deemed permitted development (i.e. planning permission is deemed to be granted) by virtue of Schedule 2 Part 4 Class A: ‘Temporary Buildings and Uses’ of the General Permitted Development Order (GPDO) 2015.

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Lighting

4.10.18 Lighting during construction would need to be sufficient to satisfy health and safety requirements, whilst ensuring impacts on the surrounding environment, including from sky glow, glare and light spillage, are minimised.

4.10.19 Artificial lighting would only be used during the hours of darkness, low levels of natural light or during specific construction tasks to ensure the health, safety and welfare of those on site, including construction staff and visitors.

4.10.20 Appropriate lighting would be installed and operated to ensure that:

- Access / egress points are clearly visible during operational hours;
- Staff and visitors can move safely around site;
- Site security can be monitored and maintained; and
- Sufficient area lighting is provided for the Site office and lay down areas.

4.10.21 This would involve the installation of fixed lighting columns and the use of mobile task lighting.

4.10.22 Fixed lighting installations (columns) would typically be located around the outer edge of the main construction zones and the perimeter of the site compound / lay down areas. Where practicable, the luminaires would be mounted below 12 m in height, unless specific operations, construction methods, plant or equipment necessitate the mounting height to be increased.

4.10.23 Mobile lighting would be used to supplement column lighting and provide the additional lighting necessary to satisfy health and safety requirements. Mobile lighting would be mounted on telescopic poles.

Plant

4.10.24 The following items would be the principal elements of plant used during the construction period:

- Tracked excavators (excavation and loading);
- Articulated dump trucks;
- Wheeled backhoe loaders;

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- HGV wagons;
- Piling rigs;
- Mobile cranes and telescopic handlers;
- Tower cranes;
- Rollers and vibratory compactors;
- Generators and water pumps;
- Concrete batching plant and pump; and
- Cement mixer trucks.

Construction Environmental Management Plan (CEMP)

4.10.25 A CEMP would be developed for the construction phase of the EMERGE Centre. This is likely to comprise an overarching CEMP framework to be applied to all phases of the development and also a series of phase specific CEMP documents which define specific measures to be adopted during the construction of the various components of the scheme.

4.10.26 The purpose of the overall CEMP would be to manage and report environmental effects of the project during construction. The CEMP would set out how environmental issues would be managed in accordance with relevant legislation, regulations and best practice guidance. It would be the responsibility of the main contractor to develop and enforce the CEMP. It is suggested that the requirement for a CEMP to be prepared is subject to a planning condition.

4.10.27 The objectives of the CEMP would be to:

- Highlight environmental impacts resulting from the development and identify sensitive receptors within the development site to the construction team;
- Reduce and manage environmental impacts through appropriate construction methods;
- Reduce and manage environmental impacts through implementing environmental best practice during the construction period;
- Undertake ongoing monitoring and assessment during construction to ensure environmental objectives are achieved;
- Provide emergency procedures to protect against environmental damage;
- Provide an environmental management structure for the construction stage;

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- Recommend mechanisms to reduce risks of environmental damage occurring; and
- Ensure procedures are in place for consultation with the relevant regulatory bodies.

4.10.28 A CEMP for a project of this nature would typically cover the following key elements:

- Drainage, water quality and hydrology;
- Dust, emissions and odours;
- Health and safety / site management;
- Waste management;
- Traffic management;
- Natural features; and
- Contaminated material.

4.10.29 Prior to the commencement of Enabling Works and Core Construction Works, an environmental walkover assessment would be undertaken to establish any changes in the environmental baseline since the surveys undertaken as part of the EIA and to update any of the defined construction procedures as necessary.

4.10.30 Detailed construction method statements would be developed for the key construction phases, e.g. site preparation and development of site compound, foundations and piling activities. The method statements would outline the key construction processes, identify potential environmental and health and safety risks and define appropriate mitigation measures. In parallel to these method statements, a number of environmental management plans would be developed, these include but are not limited to the following:

- Waste and Resource Management Plan, including a Site Waste Management Plan (SWMP);
- Pollution Control and Contingency Plan – emergency procedures;
- Noise and Vibration Management Plan;
- Air Quality Plan; and
- Construction Traffic Management Plan (CTMP).

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4.10.31 The main contractor would take regard of the following guidelines in preparation of the CEMP and during the operation of the Site:

- Environment Agency (EA): Pollution Prevention Guidelines 1: General Guide to the Prevention of Pollution (PPG1);
- EA PPG 2: Above Ground Oil Storage Tanks (PPG2);
- EA PPG 6: Working at Construction and Demolition Sites (PPG6);
- EA PPG 7: Refuelling Facilities (PPG7);
- EA PPG 8: Storage and Disposal of Used Oils (PPG8);
- EA PPG 21: Pollution Incident Response Planning (PPG21);
- CIRIA [10]: Control of water pollution from construction sites C532 (2001); and
- CIRIA: Environmental Good Practice on Site C650 (2005).

[10] *Construction Industry Research and Information Association.*

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CHAPTER 5.0 LANDSCAPE AND VISUAL EFFECTS

FIGURES (Volume 2 bound separately)

APPENDICES (Volume 3 bound separately)

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5.0 LANDSCAPE AND VISUAL EFFECTS

5.1 Introduction

5.1.1 This Landscape and Visual Impact Assessment (LVIA) follows best practice guidance set out in Guidelines for Landscape and Visual Impact Assessment [1], hereafter referred to as the GLVIA.

5.1.2 Landscape and visual effects are separate, although closely related and interlinked issues.

5.1.3 Landscape effects are caused by physical changes to the landscape, which may result in changes to the distinctive character of that landscape and how it is perceived.

5.1.4 Visual effects are changes to what can be seen by people as a result of what is proposed. A visual assessment assesses the change in visual amenity undergone by people (either individually or in groups) that would arise from any change in the nature of views experienced.

5.1.5 In accordance with the guidance set out in the GLVIA, the LVIA adopts an approach proportionate to the likely significant effects of the Proposed Development. The conclusions of the LVIA have been determined via use of professional judgement, set within a structured assessment framework, and supported by reasoned justification.

5.1.6 The LVIA aims to establish the following:

- A clear understanding of the Site and its context, in respect of the physical and perceived landscape and in respect of views and visual amenity;
- An understanding of the Proposed Development in terms of how this would relate to the existing landscape and views;
- An identification of the likely significant effects of the Proposed Development upon the landscape and upon views, throughout the life-cycle of the Proposed Development;

[1] Landscape Institute and Institute for Environmental Management and Assessment, 3rd edition 2013. *Guidelines for Landscape and Visual Impact Assessment.* Abingdon: Routledge.

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- Potential for mitigation to reduce / eliminate any potential adverse effect on the landscape or views arising as a result of the Proposed Development; and
- A conclusion as to the residual likely significant landscape and visual effects of the Proposed Development.

5.1.7 The process follows a standard approach, namely:

- The establishment of the baseline conditions, against which the effects of the Proposed Development will be assessed;
- The determination of the nature of the receptor likely to be affected, i.e. its sensitivity;
- The prediction of the nature of the effect likely to occur, i.e. the magnitude of change; and
- An assessment of whether a likely significant landscape and visual effect would be experienced by any receptor, by considering the predicted magnitude of change together with the sensitivity of the receptor, taking into account any proposed mitigation measures.

5.1.8 Further details regarding the specific methodologies of assessment and determination of significance are included in **Appendix 5-1**. The LVIA has been informed by both desk and field-based studies.

5.1.9 It should be noted that the landscape (including the context in which views are experienced) is dynamic, i.e. it is affected by social, economic, technological and climatic changes, all of which can influence patterns of land use, land cover and land management. As such, the baseline context for the LVIA is not static.

5.1.10 An assessment of effects upon the setting of heritage assets is included in Chapter 13.0 (Archaeology and Cultural Heritage) of this Environmental Statement (ES). The LVIA and Cultural Heritage Assessments, whilst sometimes consider effects upon the same receptors, deal with different environmental effects using different methodologies.

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Proposed Development

5.1.11 The Proposed Development is described in Chapter 4.0 of this ES. Figure 4.1 shows the layout of the Proposed Development, and its location within the wider Ratcliffe-on-Soar Power Station site (hereafter referred to as the Power Station site).

5.1.12 In summary, the Proposed Development would comprise the following principal elements:

- Main building with a maximum roof height (boiler house) of 49.5 m above ground level;
- Twin emissions stacks with a height of 110 m above ground level;
- Associated smaller ancillary structures;
- Associated areas of hard standing; and
- Associated landscape treatments.

5.1.13 The landscape proposals for the Proposed Development are illustrated indicatively on Figures 5.5a and 5.5b. The main element of landscape treatment is located to the south-east of the main building, adjacent to the offices and visitor facilities and would consist of a perimeter hedgerow, areas of birch woodland underplanted with herbaceous perennial woodland species, and a perennial meadow. A swale forming part of the Site drainage system would run through the woodland area. Footpaths and benches would be provided to enable the area to be used for recreation by staff and visitors. A hedgerow is also proposed along the access road adjacent to the eastern Site boundary. An area of land in the north is proposed to be planted as a small copse. It is anticipated that full details of the landscape scheme would be provided in response to a planning condition. As demonstrated by the Biodiversity Metric Calculation (**Appendix 6-4**), the proposed landscaping would result in a biodiversity net gain.

Competence

5.1.14 The LVIA was undertaken by a Chartered Member of the Landscape Institute (CMLI) with over thirteen years' post qualification experience in the landscape and visual impact assessment of major infrastructure projects. The LVIA was directed and reviewed by a second CMLI with over twenty years' similar experience.

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5.2 Methodology and Scope of Assessment

Legislation

5.2.1 The UK Government is a signatory of the European Landscape Convention (ELC), which became binding in March 2007. The Convention is aimed at the protection, management and planning of all landscapes and raising awareness of the value of a living landscape. It relates chiefly to public bodies and to the policies, plans and programmes produced by these.

5.2.2 The LVIA is a development specific process which accords with Article 6C of the ELC. The LVIA is informed by extant Landscape Character Assessment studies (described in Subsection 5.3), which more directly relate to the provisions of Article 6C.

Planning Policy

5.2.3 Policy contained within the National Planning Policy Framework (NPPF) and the statutory Development Plan documents (i.e. those prepared by Nottinghamshire and Nottingham and Rushcliffe) are set out in the Planning Statement (submitted as a separate standalone document) and have not been repeated here.

Guidance

5.2.4 The LVIA has been undertaken in accordance with the following guidance documents:

- Guidelines for Landscape and Visual Impact Assessment (the GLVIA);[2] and
- Visual Representation of Development Proposals.[3]

Assessment Methodology

5.2.5 As noted in Subsection 5.1, this LVIA has followed a methodology which has been developed using the published good practice guidelines set out in the GLVIA. The detailed methodology followed in undertaking the LVIA is set out in **Appendix 5-1**.

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[2] *Landscape Institute and Institute for Environmental Management and Assessment, 3rd edition 2013. Guidelines for Landscape and Visual Impact Assessment. Abingdon: Routledge.*
[3] *Landscape Institute, 2019. Visual Representation of Development Proposals. Technical Guidance Note 06/19.*

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5.2.6 The methodology followed in the production of visualisation material is set out in **Appendix 5-2**.

The Study Area

5.2.7 The Study Area for the LVIA has been determined based upon the assessor's previous experience of similar developments, and understanding of the context of the Site (including the surrounding landform and existing large-scale development). It is considered that if any significant landscape and visual effects would be experienced, they would arise at relatively closer distances to the Proposed Development, most likely within 2.5 km. Some elements of the Proposed Development would potentially be visible at longer range, although it is less likely that this would give rise to significant effects upon either the landscape or upon views. Nonetheless, the Study Area has been extended to capture more sensitive receptors within approximately 5 km.

5.2.8 The extent of the Study Area was agreed with Nottinghamshire County Council (NCC) as part of the scoping process, and is illustrated on Figures 5.1 and 5.2.

Assessment of Significance / Assessment Criteria

5.2.9 Details of the approach used to identify the sensitivity of receptors, and the magnitude of change that these would experience are set out in **Appendix 5-1**.

5.2.10 Not all landscape and visual effects arising as a result of a particular proposal will be significant. Furthermore, where likely significant environmental effects are predicted, this does not automatically mean that such effects are unacceptable. The acceptability of landscape and visual effects is a matter to be weighed in the planning balance alongside other factors. What is important is that the likely environmental effects of any proposal are transparently assessed and described in order that the relevant determining authority can bring a balanced and well-informed judgement to bear as part of the decision-making process.

5.2.11 The judgement in relation to this LVIA is that a greater than 'moderate' level of effect is more likely to be significant. This is because such an effect would generally result from larger magnitudes of change on higher sensitivity receptors**.** This does not preclude a 'moderate' effect or lower being significant, or a greater than 'moderate'

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effect not being significant. The professional judgement made will depend on the specific circumstances being considered. Refer to **Appendix 5-1** for further details.

Scope of Assessment

5.2.12 The proposed scope of the LVIA was set out in the Scoping Report submitted to NCC in February 2019 (**Appendix 2-1**). A Scoping Opinion was received from NCC in March 2019 (**Appendix 2-2**). The LVIA has been undertaken in accordance with the scope set out in the report, as modified following receipt of the Scoping Opinion, and further post-scoping consultation (see below).

Consultation

5.2.13 Post-scoping consultation has been carried out with NCC and their landscape advisors to agree viewpoint locations, and the approach to the production of visualisation material. A request was made by NCC to state the rights of way references for Viewpoints 1, 2, and 8. Following a search for online rights of way mapping, these references were unable to be identified, and hence have not been stated in the LVIA.

5.2.14 Rushcliffe Borough Council (RBC) were also contacted regarding viewpoint locations and the approach to visualisations, but had not responded at the time of writing.

Limitations

5.2.15 Assessment work reflects the level of vegetation cover present at the time of the field visits to the Study Area (February 2020). Where relevant to its conclusions, the LVIA makes assumptions as to the likely visibility of the Proposed Development at other times of year.

5.3 Baseline

Data Collection

5.3.1 Baseline data for the LVIA has been gathered by both desk and field based surveys. These have included review of extant landscape character assessment studies (see

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below) and field visits to gain an understanding of the landscape and visual context of the Site.

The Approach to the Assessment Baseline

5.3.2 As set out in Chapter 1.0 of this ES, the Power Station is anticipated to close in September 2025, following which many of the existing structures would be demolished. For the avoidance of any doubt, the demolition of existing structures at the Power Station does not form part of the Proposed Development.

5.3.3 Features that would be retained post-2025 are illustrated on Figure 1.3, and include:

- The large 400 kilovolt (kV) and 132 kV substations;
- The associated 400 kV and 132 kV power lines and pylons;
- The 35 MW Gas Turbine (GT) generating facility, which has its own independent gas oil-fired system and 95 m high concrete stack, and also has its own contract to supply power to the grid at times of demand in addition to providing Black Start capability;
- Various offices and stores, including the offices for Uniper’s Technology Centre and its Engineering Academy;
- The site’s rail line, sidings and associated infrastructure; and
- Other essential site infrastructure such as the road access points and drainage systems, including the surface water lagoons.

5.3.4 The Proposed Development is anticipated to become operational approximately nine months prior to the closure of the Power Station. As such, it is necessary to separately consider the effects of the Proposed Development against two baseline scenarios, as follows:

- Firstly, the relatively short period where the Power Station remains operational, and where all the existing structures remain present in the landscape, i.e. the ‘Current Baseline’; and
- Secondly, the period following the closure of the Power Station and the subsequent demolition of many of the existing structures, i.e. the ‘Future Baseline’.

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The Site and its Surroundings

5.3.5 The Site of the Proposed Development would be located within the wider Power Station site (refer to Figure 1.4 for location). The Power Station includes approximately 167 ha of land to the north of the A453, and approximately 106 ha of land to the south of the road. The main built elements of the Power Station and its related infrastructure are located on the northern side of the A453 (the Northern Site). Land to the south of the A453 is used for the handling and storage of by-products, predominantly ash.

5.3.6 The Site of the Proposed Development is located towards the northern edge of the Northern Site, on an open area covering approximately 4 ha. The Site has never previously been built on but has been utilised as a laydown area and car parking for contractors working on the site. As a consequence of this activity, it is surfaced with a mixture of tarmac and compacted stone hardstanding.

5.3.7 The Northern Site is dominated by a wide range of large-scale built development and structures, including:

- A centrally located Turbine Hall and Flue Gas Treatment (FGT) Facility (approximate roof height 63 m) interconnected via a series of large ducts, which ultimately connect to a 199 m high concrete stack;
- A building containing the two gas turbines with a 95 m high concrete stack;
- Eight concrete cooling towers (each 114 m high), which are located on the western part of the Northern Site;
- A range of storage buildings, including for gypsum, some of which are interconnected via high level conveyors;
- Two large substation buildings (400 kV and 132 kV) owned and operated by National Grid;
- A private railway line that runs in a loop through the Northern Site. The line includes sidings, associated unloading infrastructure and conveyor belts;
- Other buildings, including offices, an engineering academy, engineering services and stores; and
- Other infrastructure including roadways, car parking, laydown / storage areas (including stockpiles of coal), lagoons and soft landscaping.

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5.3.8 Figure 1.5 shows oblique aerial photography of the Northern Site. The locations of the Proposed Development and many of the features listed above are annotated on this figure.

5.3.9 As noted above, and as set out in Chapter 1.0, many of these existing structures would be demolished following the closure of the Power Station in 2025.

5.3.10 The extents of the Northern Site are largely defined by the following features:

- A wooded ridge to the north, including Wood Hill and Wright's Hill, which has a maximum elevation of approximately 75 m AOD. The village of Thrumpton and the valley of the River Trent are located on the much lower-lying land north of the ridge;
- The A453 to the east. Beyond the road is a mixture of agricultural land and woodland, including a wooded ridge (Cottagers Hill) with a maximum elevation of approximately 97 m AOD;
- The A453 to the south. Beyond the road is the southern part of the Power Station site, and a mixture of agricultural land and woodland. Pylons and overhead transmission lines running from the Power Station pass through this area; and
- The Midlands Mainline railway and East Midlands Parkway Station (with an associated Park and Ride facility) to the west. Beyond the railway, the River Soar flows through agricultural land.

5.3.11 In the wider context, the Power Station is a very prominent assemblage of structures located at the southern edge of the Greater Nottingham conurbation. Several elements of transport infrastructure, including the recently upgraded A453, the M1, the Midland Main Line railway and East Midlands Airport, are notable influences. Recently built distribution warehouses at the SEGRO Logistics Park on the western side of the motorway are also prominent features. However, land use remains predominately rural, and built development, whilst including very prominent structures, is relatively sparse.

Landscape Designations

5.3.12 The nearest statutory landscape designation to the Proposed Development is the Peak District National Park, located approximately 35 km to the north-west of the

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Site at the closest, and outside of the proposed Study Area. As such, in accordance with the agreed scope of the LVIA, no further consideration is given.

5.3.13 Neither NCC nor RBC currently maintain any non-statutory local level landscape designations.

5.3.14 The Site is located within the Green Belt. Green Belts are not a landscape designation, but effects on the openness of the Green Belt (an important planning consideration) can be influenced by visual effects. As such, the visual effects upon the openness of the Green Belt are considered in the LVIA, in order to inform wider planning decisions.

Tax-exempt Landscapes

5.3.15 In their scoping response, Natural England asked that consideration be given to potential effects upon landscapes that qualify for conditional exemption from capital taxes on the grounds of outstanding scenic, scientific or historic interest. As part of their tax-exempt status, such features must be available for the public to view. Details of all such features can be found on the HMRC website.[4] Review of the website confirmed that there are no such landscapes located within the Study Area for the LVIA.

Landscape Character Assessment and Other Studies

National Character Areas

5.3.16 159 National Character Areas (NCA) have been identified across England by the former Countryside Commission (now Natural England). Their broad geographic reach means that the key characteristics identified as typical of a particular character area may not necessarily apply to a specific location within that character area. The Site is located within NCA74: Leicestershire and Nottinghamshire Wolds [5], adjacent

[4] *HMRC, undated. Land, buildings and their contents – search. Online <http://www.hmrc.gov.uk/gds/heritage/lbsearch.htm> Accessed 06 Apr 2020.*

[5] *Natural England. 2014. National Character Area profile: 74 Leicestershire and Nottinghamshire Wolds. Available at <https://www.gov.uk/government/publications/national-character-area-profiles-data-for-local-decision-making/national-character-area-profiles> [accessed 30 Mar 2020].*

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to the boundary with NCA69: Trent Valley Washlands.[6] The boundaries of the two NCAs are illustrated on Figure 5.1.

5.3.17 The descriptive text for NCA74 notes that: *"…the power station at Ratcliffe-on-Soar is a dominant visual feature…"* [7]

5.3.18 The descriptive text for NCA69 notes that: *"…The immense coal-fired power station at Ratcliffe-on-Soar and redundant cooling towers at Willington dominate the landscape locally as do the huge sheds of commercial and industrial estates, and the rows of giant electricity pylons…"* [8]

Regional Character

5.3.19 The *East Midlands Regional Landscape Character Assessment* [9] (the Regional LCA) identifies a series of Regional Landscape Character Types (RLCT). Urban areas are excluded from the Regional LCA. The Site is located within RLCT8a: Clay Wolds, adjacent to the boundary with RLCT3a: Floodplain Valleys (refer to Figure 5.1 for location). Relevant extracts from the Regional LCA are included in **Appendix 5-3a**.

5.3.20 The text that describes RLCT8a makes no mention of the presence of the Power Station.

5.3.21 However, a key characteristic of RLCT3a is:

- Sewage Treatment Works and power stations common close to larger settlements that fringe the floodplains.

Local Character

5.3.22 The Greater Nottingham Landscape Character Assessment [10] (the GNLCA) covers the area around the Nottingham conurbation. Urban areas are excluded from the

[6] *Natural England. 2013. National Character Area profile: 69 Trent Valley Washlands. Available at <https://www.gov.uk/government/publications/national-character-area-profiles-data-for-local-decision-making/national-character-area-profiles> [accessed 30 Mar 2020]*

[7] Natural England. 2014. National Character Area profile: 74 Leicestershire and Nottinghamshire Wolds. Available at <https://www.gov.uk/government/publications/national-character-area-profiles-data-for-local-decision-making/national-character-area-profiles> [accessed 30 Mar 2020]. Page 8

[8] Natural England. 2013. National Character Area profile: 69 Trent Valley Washlands. Available at <https://www.gov.uk/government/publications/national-character-area-profiles-data-for-local-decision-making/national-character-area-profiles> [accessed 30 Mar 2020]. Page 10

[9] LDA Design, 2009. East Midlands Regional Landscape Character Design.

[10] TEP, 2009. Greater Nottingham Landscape Character Assessment.

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GNLCA. Regional Character Areas are identified in the GNLCA. The boundaries of these Regional Character Areas are similar to the RLCTs identified in the Regional LCA. The Proposed Development would be located within the Nottinghamshire Wolds Regional Character Area (the boundary of which coincides very closely with RLCT8a: Clay Wolds) and within Policy Zone NW02: East Leake Rolling Farmland (adjacent to the boundary with Policy Zone NW01: Gotham and West Leake Hills and Scarps). Relevant extracts are included in **Appendix 5-3b**, and locations are illustrated on Figure 5.1.

5.3.23 Key characteristics of the Nottinghamshire Wolds Regional Character Area include:

- "Industrial influences have a localised effect on the area such as Ratcliffe-on-Soar Power Station, and gypsum works at East Leake and Gotham."

5.3.24 Key characteristics of Policy Zone NW02 include:

- "Rural character present across the area although there are views towards urban elements such as Ratcliffe-on-Soar Power Station visible above hills, a gypsum works and village fringes."

5.3.25 The overall landscape strategy for Policy Area NW02 is to 'conserve and enhance'.

5.3.26 Key characteristics of Policy Zone NW01 include:

- "Rural character although urban elements such as villages, power station, industry and quarrying are frequent in the landscape."

5.3.27 The overall landscape strategy for Policy Zone NW01 is to 'conserve'.

Summary

5.3.28 The landscape character of the Study Area has been classified at national, regional and county levels. A common pattern across the three levels of classification is the transition from the wolds landscape in the south and east of the Study Area, into the river valleys to the north and west. This transition is largely determined by the underlying landform, and the influence this has upon hydrology.

5.3.29 The Power Station is located at the transition point between the two areas of character. Given its extent and the size / scale of the structures present, it is a strong

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influence upon the surrounding landscape character to the south and west in particular. The landform to the east and north reduces how far the influence of the Power Station reaches in these directions.

5.3.30 On the basis that the RLCTs identified in the Regional LCA provide consistent coverage across the Study Area, it is considered that these are a suitable baseline against which to assess the effects of the Proposed Development. The finer grain Policy Zones identified in the GNLCA cover the eastern part of the Study Area only (i.e. the area within the Nottinghamshire county boundary); however, due regard is had to them when undertaking the assessment (refer to Subsection 5.4 for the assessment).

5.3.31 The RLCTs in the Study Area are as follows:

- 3a Floodplain Valleys (GNLCA Regional Character Area Trent and Soar Valley), including:
  - GNLCA Policy Zone NC01 River Meadowlands;
  - GNLCA Policy Zone TSV01 Attenborough Wetlands; and
  - GNLCA Policy Zone TSV02 Soar Valley Farmlands.
- 4a Unwooded Vales (GNLCA Regional Character Area South Nottinghamshire Farmlands), including:
  - GNLCA Policy Zone SN01 Clifton Slopes; and
  - GNLCA Policy Zone SN02 Ruddington Alluvial Farmland.
- 5b: Wooded Farmland Villages;
- 8a: Clay Wolds (GNLCA Regional Character Area Nottinghamshire Wolds), including:
  - GNLCA Policy Zone NW01 Gotham and West Leake Hills and Scarps; and
  - GNLCA Policy Zone NW02 East Leake Rolling Farmland.

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Future Landscape Change

5.3.32 In the absence of the Proposed Development it is considered that the Site would remain in its present condition, i.e. an area of hardstanding within the wider Power Station. As the Power Station would close in 2025, with many structures subsequently demolished, the assemblage of structures present would change irrespective of the presence / absence of the Proposed Development.

5.3.33 The East Midlands Development Corporation (EMDC), which is currently operating in shadow form supported by a range of public and private sector organisations, has identified the Power Station site as one of three strategically important locations for future economic growth in the East Midlands. The vision for the Power Station is to create an employment site based around modern industrial and manufacturing uses, underpinned by a sustainable energy theme. Whilst this vision is in its early stages, the Proposed Development is viewed as the catalyst, and would be the first new build at the redeveloped Power Station site, and would generate low-carbon and partially renewable energy for the future industry and manufacturing uses.

5.3.34 As such, there is likely to be considerable change at the Power Station, which could occur even if the Proposed Development was not granted planning permission. Any other future redevelopment of the Power Station would result in further change.

Visual Baseline

Zone of Theoretical Visibility

5.3.35 The Zone of Theoretical Visibility (ZTV) of the Proposed Development is illustrated on Figure 5.2. The ZTV illustrates the theoretical visibility of both the pair of proposed stacks (at a height of 110 m above the development platform) and the proposed boiler house roof (at a height of 49.5 m above the development). The ZTV also illustrates the theoretical visibility of the gas turbines stack (at a height of 95 m above ground level), which would be retained post-2025, and of the existing 199 m stack, which would be removed post-2025.

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5.3.36 The ZTV was generated using a 2 m digital surface model (DSM) generated from open source Environment Agency LIDAR data.[11] The DSM records the physical surface of the Study Area, including landform, buildings and other structures, and vegetation. This dataset consists of a series of spot levels across the study area at 2 m intervals.

5.3.37 The DSM was then amended to remove those structures that would be removed from the Power Station post-2025. These structures currently provide a degree of screening of the proposed site but will not post-2025. The ZTV therefore illustrates the worst-case, long-term theoretical visibility of the Proposed Development.

5.3.38 Refer to **Appendix 5-2** for further details regarding ZTV production, and for discussions of the limitations of the ZTV.

Viewpoints

5.3.39 The LVIA includes a detailed assessment of visual effects from ten viewpoints. The locations of the viewpoints are shown in overview on Figures 5.1 and 5.2, and in greater detail on Figure 5.3. Locations were agreed via post-scoping consultation with NCC. The precise locations of each viewpoint were determined on site.

5.3.40 Viewpoints can fall into three categories, as set out in the GLVIA:

- Representative viewpoints (which represent the experience of different types of receptors in the vicinity);
- Specific viewpoints (a particular view, for example a well-known beauty spot); and
- Illustrative viewpoints (which illustrate a particular effect / issue, which may include limited / lack of visibility).

5.3.41 It should be noted that the viewpoint itself is not the receptor; rather it is the people that would be experiencing the view from the viewpoint. Receptors in the vicinity of the Site that are likely to experience views of the development include:

- Residents in nearby properties;
- Users of public rights of way and other routes / land with public access;

[11] *2 m DSM data downloaded in January 2020 from https://environment.data.gov.uk/DefraDataDownload/?Mode=survey. The data downloaded was captured in 2017 and does not reflect any subsequent changes to the landscape.*

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- Road users; and
- Rail users.

5.3.42 The viewpoints included in the LVIA are set out in Table 5.1.

Table 5.1: Viewpoint Locations

Viewpoint	British National Grid Co-ordinates	Viewpoint Details
1. Trent Lock	449102, 331128	*Representative* of views available to river users, pub goers and walkers.
2. Footpath near Redhill Lock	449148, 330232	*Representative* of the views available to river users and walkers.
3. Midshires Way, Ratcliffe Lane	448607, 329230	*Representative* of the views available to walkers and road users.
4. New Kingston	451669, 328860	*Representative* of the views available to residents.
5. Kingston on Soar	450008, 327889	*Representative* of the views available to residents and walkers.
6. Kegworth	448981, 327276	*Representative* of the views available to walkers and road users.
7. River Trent, Sawley Cut	447217, 330968	*Representative* of the views available to river users and walkers.
8. Pasture Lane	450457, 331910	*Representative* of the views available to walkers, road users and users of the water park.
9. Footpath, Barton in Fabis	452162, 332931	*Representative* of the views available to residents and footpath users.
10. Bridleway, Cottagers Hill	451886, 330462	*Representative* of the views available to bridleway users.

5.3.43 Figures 5.4a-j include visualisations from each of the Viewpoints. Each figure has been prepared in accordance with current good practice guidance.[12] A detailed methodology describing how the visualisations have been produced is included in **Appendix 5-2**. Baseline photography is provided from each viewpoint, which is annotated where deemed appropriate to highlight key features.

5.3.44 Photomontages have been prepared from Viewpoints 2 and 10, where the Proposed Development would be clearly visible prior to the removal of existing structures at the Power Station.

[12] Landscape Institute, 2019. Visual Representation of Development Proposals. Technical Guidance Note 06/19.

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5.3.45 At the other eight Viewpoints, an outline of the Proposed Development has been superimposed onto the baseline photograph to give an indication of its height and mass. These have been produced to the same degree of accuracy as the photomontages but do not include a rendered image of the new facility.

5.3.46 At each of the Viewpoints, those structures which would be removed in the Future Baseline scenario post-2025 are also indicated.

5.3.47 The approach to visualisations was agreed with NCC as part of post-scoping consultation. In order to produce photomontages reflecting the post-2025 baseline with many existing structures removed, the structures in question would have to be edited out of the baseline photographs, with further editing then required to reflect what might be visible behind them. There is no way to do this with any accuracy – a guess would have to be made as to what the skyline would look like, and what if any vegetation or structures are present behind the removed structures. Any photomontages produced this way would not be of the required degree of quality and accuracy necessary to inform an ES.

Cumulative Baseline

5.3.48 As set out in Chapter 2.0 of this ES, only one cumulative scheme has been identified, namely High Speed 2 Rail (HS2), the route of which would run close to the Power Station. HS2 is, at the time of writing, awaiting formal consent. In the vicinity of the Power Station, HS2 would pass over the Soar valley and the existing Midlands Main Line railway via a viaduct (up to 14 m in height), and would then enter a tunnel, which would carry it beneath the ridge north of the Power Station.

5.3.49 Land north of East Midlands Parkway Station (on the western side of the existing railway line, directly opposite the Power Station) would be used as a temporary construction compound for HS2. A second temporary HS2 compound would be located within the Power Station itself, to the north of existing structures, and immediately west of the Site of the Proposed Development. The indicative construction programme set out in the draft ES document [13] states that these two compounds would be in use between mid-2025 and early 2029. As such, HS2 construction in the vicinity of the Power Station would commence after the Proposed

[13] Hs2.org.uk, October 2018. *High Speed Rail (Crewe to Manchester and West Midlands to Leeds) Working Draft Environmental Statement Volume 2: Community Area report LA05: Ratcliffe-on-Soar to Long Eaton*.

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Development becomes operational, and at around the same time that the closure and subsequent demolition of many of the existing Power Station structures are scheduled to occur.

5.4 Assessment of Effects

Construction Phase

5.4.1 The construction phase is described in Chapter 4.0 of this ES. Construction would be managed in accordance with a Construction Environmental Management Plan (CEMP), setting out how environmental issues would be managed in compliance with any particular limitations imposed by the planning permission, as well as in compliance with relevant legislation, regulations and best practice guidance.

5.4.2 As detailed in Chapter 4.0 of this ES, the temporary construction compound would be located on the hardstanding immediately to the west of the Application Site. No vegetation would need to be removed to accommodate the compound during the anticipated 36 month construction process.

5.4.3 Different activities would take place at different times and locations during this period., As such, the specific construction effects that are apparent would vary across the construction period and would vary in intensity and nature. There would be a sequence of specific effects of shorter duration over the 36 months.

5.4.4 Construction would, by necessity, require the use of specialist vehicles and other plant (notably cranes), some of which would be readily apparent by virtue of their colour, size or movement. Based on knowledge of other similar developments, it is anticipated that cranes (the tallest, and hence most visible item of plant) would be present at the Site. For the purposes of this assessment it has been assumed that the cranes would be on-site for approximately half of the total construction period (approximately 18 months).

5.4.5 Construction activities would be temporary and localised and would take place in the context of existing activity at the Site. Much of the construction plant and equipment (and thus many of the construction activities) would be relatively low in height, and would be not be visually conspicuous over a wide area. An exception would be cranes, but these would be present in the context of the existing tall structures at the

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Power Station. Construction would be a temporary and intermittent activity, having only a limited influence upon the character of the surrounding landscape and upon views, which would not be significant.

5.4.6 Lighting would be required to ensure the health, safety and welfare of those on Site during poor light conditions, and for any activities undertaken during hours of darkness. This may require both fixed lighting columns and mobile task lighting. In some instances, lighting may be required for work on elevated structures, including crane mounted lighting. Some use of low level lighting of compounds for security purposes may also be required.

5.4.7 Night-time construction effects resulting from lighting would be limited and would not be significant. It should be recognised that lighting is already present at the Site. There is also column mounted lighting at the junctions of the A453 located south of the Northern Site, and at East Midlands Parkway Station. Additionally, the tall existing structures at the Power Station, and the landform to the north and east of the Site, would provide considerable screening of any construction lighting. The CEMP would include measures to minimise any effects on amenity attributable to construction lighting.

Operational Phase

Effects on Landscape Fabric

5.4.8 The Proposed Development would be introduced into a Site comprising hard surfaces, with little or no existing vegetation cover present. The existing fabric of the Site is of low sensitivity, and any changes to it would not result in significant effects. As such, further detailed consideration is not given.

5.4.9 The Proposed Development would introduce new buildings and structures, associated new hard surfaces, and associated landscape treatments. The extent of proposed landscaping would in the context of the entire Site be a relatively small proportion, but would nevertheless represent a clear increase in vegetation cover. This would represent a beneficial change.

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5.4.10 As the changes to landscape fabric would occur immediately, once the main facility and all ancillary features are built and landscape proposals implemented, there would be no further change occurring in the Future Baseline scenario.

Effects on Landscape Character

5.4.11 A detailed assessment of the effects of the Proposed Development upon landscape character is set out in **Appendix 5-4**. In summary, such effects would not be significant.

5.4.12 In the Current Baseline scenario, any change in character would be negligible. The Proposed Development would be added to the existing Power Station, and would represent a limited addition to this existing assemblage of prominent large-scale structures. The influence that structures at the Power Station site have upon the surrounding landscape would not materially change.

5.4.13 In the Future Baseline scenario, the removal of the majority of the existing structures would result in an obvious beneficial change in character, reducing the long-standing influence of the Power Station upon its surroundings. Some of the existing structures would be retained, as set out in Chapter 2.0 of this ES and Subsection 5.3, and the industrial character of the Power Station would remain. The presence of the Proposed Development would maintain the established influence of electricity generating infrastructure upon the landscape, albeit that this influence would be reduced from the current baseline. The effects of the Proposed Development would be minor to moderate upon RLCT 3a: Floodplain Valleys and RLCT 8a: Clay Wolds. In RLCT 4: Unwooded Vales, effects would be negligible.

5.4.14 In RLCT 5b: Wooded Village Farmlands, there would be no effect upon character in either baseline scenario. The RLCT is relatively distant from the Site, and is strongly influenced by contemporary development within it (SEGRO Logistics Park and M1 motorway). The presence / absence of the Proposed Development would not change the existing character.

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Visual Effects

ZTV

5.4.15 The ZTV of the Proposed Development is illustrated on Figure 5.2. As discussed in Subsection 5.3, this has been generated to reflect the Future Baseline scenario, in which many of the existing Power Station structures would be removed post-2025.

5.4.16 The ZTV should be read in combination with the Viewpoint visualisations (Figures 5.4a-j), which show the Current Baseline view, and which also illustrate how visible the Proposed Development would be from each Viewpoint.

5.4.17 By reference to Figures 5.4a-j, it can be seen that the ZTV exaggerates the post-2025 visibility of the Proposed Development to some degree, indicating visibility of the boiler house from locations where viewpoint visualisations indicate this would not actually be visible (for example at Viewpoints 5, 8, and 9). It is likely that this is due to the DSM data used to generate the ZTV understating the height of vegetation cover. As such, the ZTV shows a worst-case scenario of visibility.

5.4.18 The ZTV does illustrate relatively widespread visibility across the Study Area, but also illustrates there would be few locations from which the proposed stacks would be visible where the retained gas turbines stack is not already visible. The areas where this additional visibility is indicated are located to the north of the Site, around Thrumpton and along a section of the River Trent, and at the eastern edge of the Study Area, from the countryside south and east of Gotham. There are residential properties and public footpaths located within this area, and as such, they are likely to have views of the proposed stacks post-2025, when other structures remaining at the Power Station are not visible. There would therefore be a limited increase in the extent of visibility of the post-2025 Power Station as a result of the presence of the Proposed Development. It should be noted that the existing Power Station structures would be visible from all these areas and so this would not be a case of introducing views of industry that were without precedent.

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Viewpoints

5.4.19 A detailed assessment of the effects of the Proposed Development at each of the ten Viewpoints included in the LVIA is set out in **Appendix 5-5**. In summary, none of the Viewpoints would experience significant visual effects in either the current or future baseline scenarios.

5.4.20 In the Current Baseline scenario, a moderate adverse effect would be experienced at Viewpoint 10, located on the bridleway that runs up Cottagers Hill, east of the Site. At this Viewpoint, the Proposed Development would be clearly visible, in a context where existing Power Station structures are already very prominent. The spread of visible development would be extended as a result of the Proposed Development. However, the nature of the view, looking west towards a series of large industrial structures, would not change.

5.4.21 At Viewpoints 1, 2, 4, 5, 6, 7, 8 and 9, a minor adverse effect would be experienced in the Current Baseline scenario. At these Viewpoints, the Proposed Development would appear as minor addition in the background of the view, often well screened by intervening vegetation cover and in some instances by the existing structures at the Power Station. The proposed stacks would be visible on the skyline, in a context where other tall structures would remain far more prominent. The upper elevations of the proposed main facility building would also be visible from some Viewpoints.

5.4.22 At Viewpoint 3 in the Current Baseline scenario, visual effects would be negligible. The Proposed Development would be almost entirely screened from view by the existing structures at the Power Station, and its presence would have no appreciable influence upon the views available.

5.4.23 In the Future Baseline scenario, the level of effect that would occur would be similar at most of the Viewpoints, although the nature of the change that would result in visual effects would be different. The removal of the majority of the existing large structures at the Power Station would not typically increase the visibility of the Proposed Development. The Proposed Development would remain visible and its adverse influence upon the view would remain but the context in which it would be seen would change. The gas turbines stack (a bulkier structure than the proposed twin stacks associated within the Proposed Development) would remain widely visible, and from some locations other retained structures (including large

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substations) would also be visible. The Proposed Development would appear significantly smaller in size than the removed structures, occupying a far lesser proportion of the view, both vertically and horizontally, and the overall perceived influence of large scale industry upon the view would notably reduce.[14]

5.4.24 At Viewpoint 2, the Proposed Development would be more clearly visible following the removal of existing structures. The new facility would remain a background structure, with development and activity along the adjacent River Soar remaining more prominent. Effects in the Future Baseline scenario would be minor to moderate adverse.

5.4.25 At Viewpoint 3, on the footpath adjacent to Ratcliffe Lane, south-west of the Site, the removal of the existing structures would open up clear views of the Proposed Development. This would have a moderate adverse effect in the Future Baseline scenario, with the presence of the Proposed Development maintaining the established influence of built development upon the view.

5.4.26 The adverse effects of the presence of the Proposed Development that would occur in the Future Baseline scenario should be considered in the context of the removal of many very prominent existing structures. The assemblage of retained structures at the Power Station would appear significantly smaller in size than the removed structures, occupying a far lesser proportion of the view, both vertically and horizontally, and the *perceived* influence of large scale industry upon the view would reduce irrespective of the presence / absence of the Proposed Development.

Pattern of Visual Effects

5.4.27 In the Current Baseline scenario, in very general terms, the Proposed Development would comprise a limited addition to the very prominent assemblage of structures visible at the Power Station. There are no locations from which the Proposed Development would be visible, and the existing structures would not be. The spread of development across the view would often increase due to the introduction of the Proposed Development, but in all cases, existing structures would remain the most prominent features by virtue of their height and mass.

[14] *The effects of the removal of the existing structures are not the subject of the LVIA. Nevertheless, this removal would have a clear influence upon views towards the Proposed Development.*

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5.4.28 The Proposed Development would often be well screened by other features in the landscape, including the wooded ridges to the north and east of the Site (refer to Viewpoints 1, 7, 8 and 9), and woodland cover within the southern part of the Power Station (refer to Viewpoints 4, 5 and 6). The existing Power Station structures would also provide screening of views, especially from the south-west and west (refer to Viewpoints 2, 3 and 6). From these locations, visibility would typically be limited to the proposed stacks, and the top of the main building.

5.4.29 Locations where clearer views would be available are limited but include approximately 1.25 km stretches of public rights of way running along the ridges to the north and east, where the combination of the orientation of the landform and lack of screening features allows some relatively open views towards the Site (refer to Viewpoint 10).

5.4.30 In the <u>Future Baseline</u> scenario, the removal of the majority of the larger structures at the Power Station would lead to beneficial change in view, which would occur irrespective of the presence / absence of the Proposed Development. The industrial character of views would remain, albeit the prominence of structures at the Power Station would reduce. In this context, the Proposed Development would be the amongst the largest structures visible, and would be one of the principal contributors to the influence of development upon the view (along with the Gas Turbines Stack). The actual visibility of the Proposed Development would only increase in comparison to the current baseline from those locations to the south-west and west where the removed structures had previously provided significant screening (refer to Viewpoints 2 and 3).

Plume Visibility

5.4.31 The combustion process at the Proposed Development would produce an emissions plume, composed primarily of water vapour, which would be emitted via the exhaust flues contained in the stack. The degree to which this plume is visible would be determined by the flowrate of the exhaust gases in combination with their temperature and humidity relative to that of the surrounding air environment.

5.4.32 When visible, emission plumes vary greatly in their visual characteristics in response to weather conditions. Plumes often have characteristics in common with the

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surrounding air environment (i.e. on a cloudy or overcast day they will tend to blend in with the background, as they comprise primarily of water vapour).

5.4.33 Plume visibility has been modelled as part of the Air Quality Assessment (Chapter 8.0). The modelling was based on weather data recorded over the five-year period 2015–2019.

5.4.34 The modelling indicates that a visible plume would be apparent for between 22 % and 27 % of daylight hours (the extent of variation is based upon the variability of weather conditions during the 5 year period included in the model). In other words, there would be no visible plume for more than 73 % of the time. The average visible plume length is predicted to be short, with plume length being less than 50 m for between approximately 85 % and 91 % of daylight hours (including those periods when no plumes are visible). The visible plume would be of a length that exceeds 100 m for between approximately 4 % and 8 % of daylight hours.

5.4.35 Where the emissions plume is visible, this would have potential to draw attention to the presence of the Proposed Development from the surrounding area, thereby increasing the influence of the new structures upon the views available.

5.4.36 Atmospheric conditions that lead to plume formation (low temperature and low humidity) occur more frequently in winter, and consequently both plume length and visibility reduce in the summer months.

5.4.37 Cloud cover is a significant factor in determining the extent to which visible plumes are discernible. In clear or blue sky conditions a plume will contrast strongly with its background. However, in skies with more than one or two oktas [15] of cloud, this contrast becomes progressively less marked. The periods when cloud cover is likely to be at its greatest are across the autumn, winter and early spring seasons, which coincide with when the plumes are most likely to occur, and when hours of daylight are less.

5.4.38 The modelling indicates that a visible plume would not be present for the majority of daylight hours (not visible more than 73 % of the time), and when visible, the plume would tend to be fairly short. As such, in general it is considered that the emissions

[15] *An okta is a unit of measurement describing levels of cloud cover. 0 oktas equates to a clear sky, whilst 8 oktas equates to complete cloud cover.*

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plume would not be prominent. There would be occasional transient adverse visual effects locally (for example where the plume forms in clear skies during a temperature inversion), but it is concluded overall that the presence of the emissions plume would not lead to significant adverse visual effects.

Night-time Effects

5.4.39 The existing Power Station is lit, with further lighting close by along the A453 junctions and at East Midlands Parkway Station. More distant lighting is present in settlements; around commercial development; and along the corridor of the M1 (road lighting at junctions, and head / tail lights of vehicles).

5.4.40 As described in Chapter 4.0, once commissioned, the Proposed Development would be operational on a continuous twenty-four hours per day, seven days per week basis, albeit that fuel deliveries and most staff movements would take place during the normal working day. As such, there would be a need for lighting to ensure a safe working environment for operatives during the hours of darkness. It is likely that low level security lighting would also be required.

5.4.41 The measures that would be incorporated into the lighting design are described in outline in Chapter 4.0. Lighting would be designed and specified to accord with current industry standards and best practice guidance. The aim would be to minimise the generation of obtrusive light beyond the Site. Internal lighting within the proposed new buildings would be designed with the same concerns in mind and would be designed to reduce the spillage of light outside the buildings themselves.

5.4.42 As daylight hours are shorter during the winter months, the proposed lighting would be in use for a greater proportion of the day, and at times when larger numbers of people are likely to be outside to experience views towards the Site (i.e. at the beginning and end of the working day). As such, the night-time effects of the Proposed Development are more likely to be experienced during the winter.

5.4.43 The generation of light would increase locally as a result of the Proposed Development. However, this increase would be minimised by the implementation of a sensitively designed lighting scheme, by elevated landform to the north and east of the Site, and by the presence of existing lighting at the Power Station to the south

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and west. As such, the presence of the Proposed Development would not materially alter the night-time environment, and night-time effects would not be significant.

5.4.44 In the Future Baseline scenario, parts of the Power Station site would continue to be lit post-2025, although the nature of lighting may differ from that which is currently present due to the demolition of many structures. There would therefore be some change in the night-time environment. The presence of the well-designed modern lighting associated with the Proposed Development is unlikely to result in any notable increase in lighting levels in the surrounding area, and effects would not be significant.

Effects on the Openness of the Green Belt

Current Baseline

5.4.45 Much of the area east of the River Soar, including the Power Station, is located within the Nottingham Green Belt. The Green Belt is, as might be anticipated, largely undeveloped. In the vicinity of the Site, it includes the Power Station, which is very prominent. Other development within the Green Belt locally includes East Midlands Parkway Station, marina development along the Rivers Trent and Soar, the A453 corridor and several small villages.

5.4.46 As noted above, Proposed Development would be largely screened from view by the wooded ridges to the north and east. These ridges very clearly define the extent of open views from land within the Green Belt further to the north and east. The visible structures at the Power Station (whether existing or proposed) are very obviously located behind these landforms and do not prevent or otherwise intrude upon foreground or middle ground views. As such, the presence of the Proposed Development would not have any material effect upon the degree to which views across the Green Belt would remain open, i.e. the perception of openness would be unaffected.

5.4.47 From the south and from the west (in views looking into the Green Belt from west of the River Soar), the Proposed Development would be located beyond the existing Power Station structures, including the cooling towers, the 199 m high concrete stack, and the existing boiler house, turbine hall and flue gas treatment zone. It would be seen as part of this existing assemblage of structures associated with the Power

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Station and would often be wholly or partly screened from view. The introduction of the Proposed Development would therefore not result in any appreciable change to the degree to which views across the Green Belt would remain open, i.e. the perception of openness would be unaffected.

Future Baseline

5.4.48 Post-2025, when many of the tall structures at the Power Station have been removed, the Power Station site as a whole (including the Proposed Development), would, whilst remaining a prominent feature within the Green Belt, nevertheless be less prominent than it is currently. The removal of the bulky cooling towers, the 199 m concrete stack, and the existing turbine hall and boiler house in particular would reduce the overall height and mass of the assemblage of structures present. This would result in a notable improvement of the perceived openness of the Green Belt, due to the reduction in the number of prominent structures at the Power Station, and an associated reduction in the horizontal field of view occupied by development as seen from the surrounding area.

5.4.49 The presence of the Proposed Development (which would at this point be an existing feature) would have little bearing upon this improvement in the perceived openness of the Green Belt, due to its location within the Power Station in relation to other retained structures (when seen from the south and west) and to the surrounding landform (when seen from the north and east). The Proposed Development would make a contribution to the influence of the assemblage of structures at the Power Station upon views from the Green Belt, and this limited visual change would not be sufficient to materially affect openness.

5.5 Cumulative Effects

Current Baseline

5.5.1 As noted in Subsection 5.3, construction of HS2 is scheduled to commence after the Proposed Development becomes operational, at about the same time that the removal of the existing Power Station structures would take place. There would therefore be no cumulative landscape and visual effects occurring in the current baseline scenario.

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Future Baseline

5.5.2 In the future baseline scenario, the removal of the Power Station structures would, as noted in Subsection 5.4, lead to appreciable beneficial change in landscape character and upon views, which would occur irrespective of the presence / absence of the Proposed Development. The introduction of HS2 (including construction) would occur in this context.

5.5.3 The route of HS2 would pass close to Viewpoints 2 and 3 and would intrude upon views toward the Proposed Development from these locations, and from the surrounding rights of way network. As the new railway would pass over the Soar valley on a viaduct up to 14 m high, it is likely that the majority of views towards the Proposed Development from the area west of the river would be at least partially screened.

5.5.4 The construction of HS2 would result in short-term change in character, and its presence once operational would change character on a permanent basis. The combined presence of the Proposed Development and HS2, together with the removal of the existing Power Station structures, would reflect a transition from older forms of infrastructure to contemporary 21st century infrastructure. Cumulatively, this would reinforce the trends in the landscape identified in Subsection 5.4.

5.5.5 It is emphasised that it is not the effects of HS2 that are being assessed, but rather the landscape and visual effects of the Proposed Development in a cumulative baseline where HS2 is also present. In such a scenario, the effects of the Proposed Development would be similar to but incrementally less than those identified in Subsection 5.4, due to the influence of HS2 upon areas west of the Site. Cumulative landscape and visual effects would not be significant.

5.6 Mitigation

5.6.1 No further mitigation measures are proposed.

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5.7 Residual Effects and Conclusions

5.7.1 The Proposed Development would be introduced into the existing Power Station, which includes a series of very large and very prominent structures, and which exerts a strong influence upon the surrounding area. The Proposed Development would be located in an area of existing hardstanding close to the north-eastern edge of the Power Station, with wooded ridges enclosing the Power Station to the north and east.

5.7.2 Initially, the Proposed Development would have little or no appreciable influence upon its surroundings, due to the landform to the north and east and the existing structures to the south and west. These features would largely screen the Proposed Development from view, and would also limit any influence upon the character of the surrounding landscape to negligible levels.

5.7.3 Approximately nine months after the Proposed Development becomes operational, the existing Power Station is scheduled to close, and many of the existing structures would be subsequently removed. This closure would occur regardless of the presence of the Proposed Development and would lead to a clear change in landscape character and similar change in views from the surrounding area, with the influence of the Power Station reducing notably. The Proposed Development would be one of the largest structures remaining, and its presence would maintain the long-established influence of electricity generating infrastructure upon the surrounding area, and hence would have an adverse effect. This should, however, be considered in the context of the removal of many very prominent existing structures, the benefits of which would far outweigh any limited adverse effects resulting from the continued presence of the Proposed Development. The medium- and long-term landscape and visual effects of the Proposed Development would not be significant.

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CHAPTER 6.0 ECOLOGY AND NATURE CONSERVATION

APPENDICES (Volume 3 bound separately)

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6.0 ECOLOGY AND NATURE CONSERVATION

6.1 Introduction

6.1.1 This Chapter considers the impacts of the Proposed Development on flora and fauna, in accordance with the requirements of the Town and Country Planning (Environmental Impact Assessment) Regulations 2017.

6.1.2 The legislative background, scope and methodology of the study are described below; this is followed by a description of habitats and fauna, including the occurrence of legally protected species, and invasive alien species. The nature conservation interest of the Site and its surroundings is then evaluated; any significant impacts upon interest features are assessed, including indirect impacts on designated sites in the wider vicinity of the Proposed Development. Proposed mitigation and ecological enhancement measures are outlined, with a summary of residual impacts following the implementation of mitigation measures.

6.1.3 The Chapter is informed by the following ecological surveys and reports, which are presented as Technical Appendices to this Chapter:

- Preliminary Ecological Appraisal (PEA) (**Appendix 6-1**), incorporating a data search and supported by the calculation of baseline ecological value in accordance with Biodiversity Metric 2.0 (**Appendix 6-4**);
- Extended Phase 1 Habitat Survey and PEA for wider area undertaken by EMEC Ecology (**Appendix 6-2**); and
- Ecological Interpretation of Emissions Modelling Assessment (**Appendix 6-3**).

Competence

6.1.4 This Chapter has been compiled by the Director of Argus Ecology Ltd., with over 27 years' experience of ecological impact assessment; this includes extensive experience of the assessment of energy recovery and related facilities, including the ecological assessment of air quality effects.

6.1.5 Argus Ecology Ltd. is a specialist ecological consultancy, established in 1991. Employee expertise includes protected species survey and mitigation, habitat and

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ornithological surveys. All ecological staff are members of the Chartered Institute of Ecology and Environmental Management (CIEEM).

6.2 Methodology and Scope of Assessment

Legislation and Guidance

European Conservation Legislation

6.2.1 The Habitats Directive (92/43/EEC) provides for strict protection of species of Community interest listed in Annex IV(a) of the Directive ('European Protected Species').

6.2.2 Article 12 of the Habitats Directive sets out the system of strict protection which Member States are required to adopt for animal species listed on Annex IV(a). Article 12(1)(b) prohibits: *"deliberate disturbance of these species, particularly during the period of breeding, rearing, hibernation and migration"*; Article 12(1)(d) prohibits: *"deterioration or destruction of breeding sites or resting places."*

6.2.3 Council Directive 2009/147/EC on the conservation of wild birds (the 'Birds Directive') provides for the conservation and management of all wild bird species naturally occurring in the European Union, their nests, eggs and habitats.

6.2.4 Article 2 of the Birds Directive provides for the maintenance of populations of wild birds: *"at a level which corresponds in particular to ecological, scientific and cultural requirements, while taking account of economic and recreational requirements, or to adapt the population of these species to that level."* Article 4(4) requires that (outside of protected sites) member states: *"should strive to avoid pollution or deterioration of habitats."*

6.2.5 The Habitats and Birds Directives are implemented in England and Wales by the Conservation of Habitats and Species Regulations 2017 (the 'Habitats Regulations'). Regulation 10 implements provisions in Article 4 of the Birds Directive, requiring competent authorities to: *"use all reasonable endeavours to avoid any pollution or deterioration of habitats of wild birds."* Regulation 42 implements the system of strict protection applied to European Protected Species.

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National Conservation Legislation

6.2.6 The Wildlife and Countryside Act 1981 (as amended) provides the principal legislation for designation of nationally important conservation sites and the protection of species. Section 28 provides powers for designation of Sites of Special Scientific Interest (SSSI), while subsequent amendments, including those enacted by the Countryside and Rights of Way Act 2000 and the Natural Environment and Rural Communities Act 2006, strengthen the protection of SSSI.

6.2.7 Section 40 of the Natural Environment and Rural Communities Act 2006 ('NERC Act') sets out the duty of public authorities to conserve biodiversity in the exercise of their functions, through: *"having regard, so far as is consistent with the proper exercise of their duties, to the purpose of conserving biodiversity."* Biodiversity conservation is further defined as including the restoration or enhancement of a population or habitat. Section 41 of the NERC Act requires the Secretary of State to publish a list of species and habitats which are of principal importance for the conservation of biodiversity in England (i.e. 'priority species and habitats'), and to take and promote the taking of *'reasonably practicable'* steps to further their conservation.

6.2.8 The National Planning Policy Framework (NPPF) for England sets out a number of policies for conserving and enhancing the natural environment in Section 15 (paragraphs 170–183). Of particular relevance in the present context are the following policies:

- 170: includes reference to the need to minimise risks to biodiversity and promote net gains for biodiversity where possible, including establishing coherent ecological networks (170 (d));
- 171: site protection should be commensurate with their status, and take a strategic approach to maintaining and enhancing habitat networks;
- 175: addresses the conservation and enhancement of biodiversity in planning applications;
- 177: the presumption in favour of sustainable development does not apply when an Appropriate Assessment under the Habitats Regulations has determined there will be an adverse effect on the integrity of a habitats site; and
- 180: includes policies to consider effects of pollution, including light pollution, on the natural environment.

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6.2.9 At the time of writing the Environment Bill is currently passing through Parliament. Amongst its most relevant provisions includes a strengthening of the duties under Section 40 of the NERC Act to require public authorities to enhance as well as conserve biodiversity. It will also introduce a mandatory requirement for biodiversity net gain into the planning system.

Assessment Methodology

6.2.10 Impact assessment methodology follows current Chartered Institute of Ecology and Environmental Management guidelines (CIEEM, 2016).[1] This is based on:

- The identification of valued ecological resources;
- The characterisation of potential impacts as a consequence of the development;
- An assessment of the likelihood of occurrence, duration, extent, magnitude, frequency and reversibility; and
- An assessment of impact significance.

6.2.11 In order to assess the effects of the development on flora and fauna, it is first necessary to identify the nature and geographical extent of likely impacts, and identify the component ecological interest features of the receiving environment. This process identifies important ecological features which should be subject to further assessment. These are features which are sufficiently important and potentially affected by the project; CIEEM guidelines state: *"it is not necessary to carry out detailed assessment of features that are sufficiently widespread, unthreatened and resilient to project impacts and will remain viable and sustainable."*

6.2.12 The identification of ecological effects also takes incorporated mitigation measures into account. These comprise already committed measures, which the decision maker can be confident would be included as part of the Proposed Development; they are described at the start of Subsection 6.4 below.

[1] *CIEEM (2016). Guidelines for Ecological Impact Assessment in the UK and Ireland. Terrestrial, Freshwater and Coastal. Second Edition, January 2016.*

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6.2.13 The valuation of habitats and quantification of gains and losses as a consequence of the Proposed Development has been undertaken in accordance with the guidance set out in Biodiversity Metric 2.0 Calculation (**Appendix 6-4**).[2]

Scope of Assessment

Ecological Scoping Process

6.2.14 A Preliminary Ecological Appraisal (PEA) was commissioned by Uniper from EMEC Ecology, Nottinghamshire Wildlife Trust's consultancy.[3] Fieldwork was undertaken in June 2019, and included an Extended Phase 1 Habitat Survey, evaluation of habitat quality, and recommendations for mitigation. No data searches were undertaken.

6.2.15 A data search based on an area which encompassed a 2 km buffer around the Site boundary was requested from the three local environmental records centres within this area (Nottinghamshire, Leicestershire and Derbyshire). The search area was derived using a 2 km buffer around the Site boundary, smoothed to 100 points on its circumference.

6.2.16 The Nottinghamshire data search included locally designated conservation sites, protected and notable species records, as the Site is located within this area. Derbyshire and Leicestershire data searches were confined to locally designated sites, including information on habitats and reasons for designation, in order to identify sensitive ecological receptors for consideration of possible air quality effects.

6.2.17 Information on statutory designated sites and ancient woodlands was obtained from the Multi-Agency Geographic Information for the Countryside (MAGIC) database. The area of search included a 10 km radius for European and internationally designated sites, and a 2 km radius for UK statutory designated sites and ancient woodlands.

[2] Crosher, I.A., Gold, S.B., Heaver, M.D., Heydon, M.A., Moore, L.D., Panks, S.A., Scott, S.C., Stone, D.A. & White, N.A. (2019). The Biodiversity Metric 2.0: auditing and accounting for biodiversity value. User guide (Beta Version, July 2019). Natural England Joint Publication JP029.

[3] EMEC Ecology (2019). Potential Energy Project at Ratcliffe Power Station Ratcliffe on Soar, Nottinghamshire. Preliminary Ecological Appraisal (PEA). Report to Uniper Technologies Ltd.

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6.2.18 Information obtained from the data searches and field survey results were summarised in the ecology section of the Environmental Impact Assessment (EIA) Scoping Report submitted to Nottinghamshire County Council (NCC) (**Appendix 2-1**). Table 6.1 sets out the comments on the scope of ecological assessment which were received from NCC and statutory consultees, and explains how they have been taken into account in the EIA.

Table 6.1: Scoping Response – Ecological Matters

Scoping Opinion Issue	Response
County Ecologist Comments	
In agreement with the scope of the ecological survey and assessment as proposed by the applicant. It appears that potential indirect impacts are likely to be a primary consideration, and I note that the assessment of noise, lighting, air quality and water quality impacts will be cross-referenced with relevant assessments from these other disciplines. Ecological interpretation of the Air Quality Assessment will be provided in a separate technical appendix, which is welcomed.	Noted – noise impacts on sensitive ecological receptors are set out in **Appendix 7-8** and interpreted below. Air quality modelling is set out in **Appendix 8-1** and ecological effects interpreted in **Appendix 6-3**.
Particular consideration should be given to impacts on the adjacent Thrumpton Park Local Wildlife Site (LWS), which lies less than 200 m to the north. In that context, noise contour plans and lux diagrams would be particularly useful. With regards to noise, it may be necessary to extend the survey area to include the LWS to ensure that noise-sensitive receptors such as breeding birds are sufficiently covered.	Thrumpton Park has been identified as a sensitive receptor with respect to the noise assessment (Chapter 7.0), baseline measurements taken, and noise levels predicted with respect to the highest potential impacts (construction phase piling noise; **Appendix 7-8**). Results are interpreted in Chapter 6.0 below in terms of effects on breeding birds and other noise-sensitive receptors. Measures which will be taken to reduce light spillage are set out in Chapter 4.0; a lighting plan with lux diagrams will be produced as part of a pre-commencement condition.
As well as Thrumpton Park LWS, the noise assessment should identify other sensitive ecological receptors to include in the assessment.	The location of other noise-sensitive receptors was considered in the ecological interpretation of noise data.
An assessment of cumulative impacts should take into account the development of High Speed 2 (HS2), the line of which passes a short distance to the west and will directly impact upon Thrumpton Park LWS.	The HS2 development is considered in the assessment of cumulative ecological effects, and published ecological and other information on the HS2 project has been consulted in the preparation of this ES Chapter.
Reference to using the Defra Biodiversity Metric to assess mitigation / compensation is welcomed; the development should have the aim of delivering Biodiversity Net Gain.	The landscape design has been developed with ecological input in order to achieve Net Gain in accordance with the emerging requirements of the Environment Bill.

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Scoping Opinion Issue	Response
Natural England comments (summarised)	
The Ecological Impact Assessment (EcIA) should be undertaken in accordance with CIEEM guidance and taking account of paragraphs 174–177 of the NPPF.	EcIA has been carried out in accordance with these guidelines, and is assessed against the policies set out in paragraphs 174–177 of the NPPF.
ES should fully adopt the Biodiversity Net Gain (BNG) approach for this development, in accordance with the NPPF and the emerging Environment Bill.	Biodiversity Metric 2.0 has been applied to the valuation of baseline habitats, and Net Gain calculated from the landscape design.
Site is within the Impact Risk Zone (IRZ) for Lockington Marshes SSSI. ES should include a full assessment of the direct and indirect effects of the development on the features of special interest within these sites and should identify such mitigation measures as may be required in order to avoid, minimise or reduce any adverse significant effects.	Site has been identified as a sensitive receptor with respect to air quality and other effects of the Proposed Development. The EcIA includes an assessment of direct and indirect impacts on its notified features.
Assessment will need to consider effects on local wildlife sites, include proposals for mitigation of any impacts and if appropriate, compensation measures	Assessment considers potential effects on all local wildlife sites within 2 km of the Proposed Development
The Environmental Statement (ES) should assess the impact of all phases of the proposal on protected species, with surveys carried out at optimal times.	ES includes assessment of risk to protected species based on Extended Phase 1 Habitat Survey and data search, and considers direct and indirect effects of Proposed Development at construction and operational phases.
Nottingham Wildlife Trust (summarised)	
The application should be supported by an ecological impact assessment and informed by information and assessments.	The ecological impact assessment is supported by a biological record centre data search. Alongside an extended Phase 1 Habitat Survey and PEA (undertaken by EMEC Ecology) which covered a greater area than the Application Site (**Appendix 6-2**). Further consideration is also provided in paragraphs 6.2.22 and 6.2.23.
Details of site restoration and habitat creation in and around the development to secure biodiversity net gain.	The NCC scoping letter confirmed that in terms of site restoration, the EMERGE Centre is a permanent development and therefore details of site restoration would not appear to be appropriate in this instance. In terms of biodiversity net gain, it has been demonstrated that there would be over a 50 % net gain.

Assessment of Significance / Assessment Criteria

6.2.19 In the CIEEM (2016) guidelines a significant effect in ecological terms is defined as an effect that: *"either supports or undermines biodiversity conservation objectives for important ecological features or for biodiversity in general."* In EIA terms, this is an effect that is sufficiently important to require assessment and reporting so that the

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decision maker is adequately informed of the environmental consequences of permitting a project.

6.2.20 In common with the approach taken elsewhere in this ES, CIEEM guidance does not define particular levels of significance. However, a geographic scale at which the effect is significant is applied, where appropriate, in order to determine a proportionate response in developing mitigation measures, and help inform the decision-making response to any residual effects.

6.2.21 Any significant ecological effects are subject, wherever feasible, to additional mitigation measures, with the aim of avoidance, reduction or compensation. The significance of residual effects is then re-assessed.

Limitations

6.2.22 The surveys described in **Appendix 6-2** were undertaken at appropriate seasons for the relevant taxa, and did not report any constraints which may have affected the validity of the results. As with any ecological surveys, the use of a site by fauna and the development of vegetation may change over time, sometimes over short timescales. However, given the extremely limited range of wildlife habitats within the Site, this is unlikely to be a significant factor in the case of the Proposed Development.

6.2.23 A further walkover verification survey by the ES authors was planned for spring 2020, but was not possible due to the access restrictions to the Power Station imposed due to the Covid-19 outbreak. CIEEM guidance published in March 2020 stated reduced survey effort caused by virus-related access restrictions should be taken account of by regulatory authorities, while the ecological assessment takes a precautionary approach in cases where any doubt exists about the status of important ecological features. However, in this case the assessment is supported by an ‘in date’ survey undertaken in 2019, taking in a wider survey area than the Proposed Development boundary, and which did not recommend any further survey work.

6.3 Baseline

Baseline Ecological Data

6.3.1 The following section summarises baseline ecological data relating to the Site and its surroundings, which are set out in more detail in the Technical Appendices. See **Appendix 6-1** for more details of the data search, habitats present on Site, protected species risk assessment, and valuation of baseline habitats in accordance with Biodiversity Metric 2.0, the latter contained in **Appendix 6-4**. **Appendix 6-2** provides more details of the Extended Phase 1 Habitat Survey, while **Appendix 6-3** addresses sensitivity of statutory and locally designated sites and priority habitats to air quality impacts in greater detail.

Site Context

Statutory Designated Sites

6.3.2 There are no Natura 2000 (European designated sites) sites within a 10 km radius of the Proposed Development. This is the maximum zone of influence (ZoI) normally used for consideration of indirect effects of a development of this scale and nature, and accords with Environment Agency (EA) screening distances for consideration of air quality effects.

UK Statutory Designated Sites

6.3.3 There is one Site of Special Scientific Interest (SSSI) and one Local Nature Reserve (LNR) within 2 km of the Proposed Development:

- Lockington Marshes SSSI; and
- Forbes Hole LNR.

6.3.4 Lockington Marshes SSSI is around 1.2 km west of the Site within the County of Leicestershire, with its nearest point located at OS grid reference 449120, 330260. Forbes Hole LNR is around 1.8 km north-north-west of the Site within the County of Derbyshire, with its nearest point located at OS grid reference 449575, 332300; see **Appendix 6-1** for details of location and extent of each site. Further details of ecological interest features of the sites are given in **Appendix 6-3**.

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Non-statutory Designated Sites

6.3.5 Information on non-statutory designated sites (Local Wildlife Sites (LWSs)) within 2 km of the Proposed Development has been obtained from local biological records centres, comprising Nottinghamshire Biological and Geological Records Centre (NBGRC), Derbyshire Wildlife Trust (DWT), and Leicestershire Environmental Records Centre (LERC). Information provided through pre-application dialogue with the Environment Agency in relation to the Environmental Permit for the EMERGE Centre was also incorporated into this process.

6.3.6 The data search returned details of locations of a total of 40 LWSs. Locations are set out in **Appendix 6-1**, with details of component habitats and potential sensitivity to air quality effects set out in **Appendix 6-3**.

6.3.7 Two LWSs are located within 1 km of the Site boundary, and therefore may require consideration as sensitive receptors with respect to proximal disturbance effects; both are within the Nottinghamshire County area:

- Thrumpton Park LWS, located around 0.19 km north-north-west at its closest point to the Site boundary; and
- Red Hill, Ratcliffe on Soar LWS, located around 0.74 km west-north-west at its closest point to the Site boundary.

Ancient Woodlands

6.3.8 There are no ancient woodland sites within the 2 km area of search, based on Natural England's Ancient Woodland Inventory v.3.7 data. Gotham Wood, located at OS grid reference 452196, 329312 on its nearest boundary, and an unnamed wood to the south-west, located at 451936, 329040, are on the edge of the 2 km buffer.

Protected Species Records

6.3.9 Records of European protected species (Habitats Directive Annex IV) obtained from NBGRC included a number of bat records from the Ratcliffe-on-Soar and Thrumpton Park areas. These comprised four relatively widespread species, including common and soprano pipistrelles (*Pipistrellus pipistrellus; P. pygmaeus*), noctule (*Nyctalus noctula*) and brown long-eared bats (*Plecotus auritus*).

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6.3.10 There are no records of great crested newt (*Triturus cristatus*; GCN) within 500 m of the Site.

6.3.11 There was an otter (*Lutra lutra*) record from Thrumpton Park, which appeared to be located on the River Trent, on the northern boundary of the LWS.

6.3.12 With respect to UK protected species, protected under Schedule 5 of the Wildlife and Countryside Act 1981, there are old (1999) records of water vole (*Arvicola amphibius*) from the Ratcliffe-on-Soar area. This species has suffered a significant range contraction in recent decades, and the lack of recent records may indicate it no longer occurs within the search area.

6.3.13 Records obtained from biological records centres cannot be considered as comprehensive, and were not relied upon to determine the scope of the survey programme, without careful consideration of the likely risk of occurrence on or near the Site.

Habitats and Vegetation

Local Ecological Context

6.3.14 The Site is located to the north-east of the currently operational Ratcliffe-on-Soar Power Station, within the curtilage of the Power Station's perimeter security fence. Rail lines with coal unloading infrastructure and coal stocking areas are located to the south of the Site, with built structures, hard standing and a hedgerow to the west.

6.3.15 Areas of immature woodland and an arable field are located to the north of the Site, outside the perimeter security fence; beyond this is Thrumpton Park LWS, which includes grassland, woodland, and scattered parkland trees extending north to the River Trent.

6.3.16 The Site's wider context includes two major linear infrastructure features: the Loughborough to Nottingham rail line, running on a north-south axis around 710 m west of the Site boundary, and the A453 dual carriageway road, running on as south-west – north-east axis to the south and east of the Site, around 450 m from the nearest boundary at its closest point.

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6.3.17 The River Trent is located to the north-west and north of the Site, a minimum 640 m from the nearest Site boundary. The River Soar (a tributary of the Trent) is located a minimum of 1.14 km to the west of the Site, beyond the rail line.

Habitats within Site

6.3.18 Habitats within the Site are described and mapped in **Appendix 6-1**, while an Extended Phase 1 Habitat Survey of a wider survey area including the Site is provided in **Appendix 6-2**.

6.3.19 Almost 95 % of the Site area is unvegetated, including some industrial buildings, and hard standing comprising sealed and unsealed surfaces. Ephemeral – short perennial vegetation is starting to establish in part of the Site, consisting of sparse ruderal (disturbed ground) on an aggregate substrate. There is also a narrow strip of amenity grassland alongside the Site access road.

6.3.20 The northern and eastern boundaries of the Site are formed by a tall, fine-mesh, electrified security fence set in concrete foundations, with other boundaries contiguous with the adjoining Power Station. There are no boundary hedgerows, although a species-rich hedgerow extends eastwards perpendicular to the Site boundary, within the Power Station. The Site adjoins vegetated habitats to the north of the security fence, including grassland and scrub / young plantations.

Fauna

Protected Species

6.3.21 The potential of the Site to support protected species was assessed in the Extended Phase 1 Habitat Survey (**Appendix 6-2**).

6.3.22 None of the buildings within the Site were assessed to have more than a negligible risk of supporting bat roosts.

6.3.23 The electrified security fence was assessed as forming an effective barrier to ingress of terrestrial fauna, and none of the habitats within the perimeter were assessed as having any potential to support protected species.

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6.3.24 The hedgerow to the east of the Site was assessed as providing a suitable habitat for breeding birds, although this is outside of the footprint of the Proposed Development. It is likely that there is some bat foraging around the margins of the Site, although this is likely to be limited to vegetated habitats outside the perimeter fence, and to species tolerant of a higher light environment due to the existing lighting of the Power Station.

6.3.25 The data search undertaken since completion of the Extended Phase 1 Habitat Survey has not revealed any additional risks of occurrence of protected species on Site.

Invasive Species

6.3.26 No non-native invasive species listed on Schedule 9 of the Wildlife and Countryside Act 1981 were recorded within the Site.

Future Baseline

Do-nothing Scenario

6.3.27 In the absence of the Proposed Development or any other disturbance within the Site, ruderal species may be expected to continue to colonise exposed aggregate surfaces. With time this may improve the nature conservation value of this habitat, particularly if a mosaic of different habitats develops.

6.3.28 The capacity of the Site to support terrestrial fauna will continue to be limited while the electrified perimeter fence remains operational. In the absence of electric power, the fine mesh and continuous concrete base would continue to make ingress difficult, even for small bodied and / or burrowing species such as reptiles or amphibians.

Closure of the Power Station

6.3.29 Coal-fired power stations are major point sources for a range of atmospheric pollutants. The principal effects of closure in ecological terms will therefore be a reduction in background pollution levels; for example, source attribution charts on the Air Pollution Information Service (APIS) website for Lockington Marshes SSSI give the Power Station's contribution to sulphur deposition as 0.05 keq H^+/ha/yr, or

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12 % of total sulphur sources.[4] This creates 'headroom', offsetting the effects of the Proposed Development, although it should be noted that the Power Station annual running hours are now considerably lower than in 2012, the year on which the source attribution data is based.

6.3.30 There would also be more local effects in terms of reduced noise and vehicle / train movements in the vicinity of the Proposed Development. In common with the approach taken elsewhere in the EIA, effects of any future development of the Power Station site have not been considered in assessing the ecological effects of the future baseline.

Important Ecological Features

Designated Sites

6.3.31 Lockington Marshes SSSI can be considered as an ecological feature of national importance for the purposes of the impact assessment.

6.3.32 The LWSs listed in Table 6.3 can be considered as ecological features of County-level importance, designated in the context of quality standards set within Nottinghamshire, Derbyshire and Leicestershire. The nearest site (Thrumpton Park LWS) is relevant for consideration of near-site effects such as noise or human disturbance.

Protected Species

6.3.33 In order to assess the level of value of protected species as important ecological features, it is necessary to consider the following:

- The extent to which the Site contributes to the maintenance of their conservation status in the wider area; and
- Their level of legal protection, in order to address whether and how the Proposed Development could proceed in accordance with current legislation, and assess whether any operations may require a Natural England (NE) disturbance licence.

[4] http://www.apis.ac.uk/srcl/source-attribution?submit=Source+Attribution&sitetype=SSSI&sitecode=1000882&sitename=Lockington+Marshes

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6.3.34 In the case of the Proposed Development, the Site does not provide any opportunities for protected species, due to the lack of suitable habitat on Site, proximity to the operational Power Station, and presence of an effective perimeter barrier preventing access by terrestrial fauna.

Priority Species

6.3.35 No Priority Species, defined as those listed on Section 41 of the NERC Act, were recorded on or adjacent to the Site.

Priority Habitats

6.3.36 No Priority Habitats occur within the Site. The area of ephemeral – short perennial vegetation within the Site was assessed to determine if it fitted the criteria for Open Mosaic Habitat on Previously Developed Land Priority Habitat. As explained in **Appendix 6-1**, it did not meet all of the necessary qualifying criteria.

6.3.37 A hedgerow within the curtilage of the Power Station site and located perpendicular to the eastern boundary of the Site can be regarded as an example of Hedgerows Priority Habitat.

Biodiversity Metric 2.0 value

6.3.38 The baseline value of the Site in biodiversity units has been calculated using the Biodiversity Metric 2.0 spreadsheet (**Appendix 6-4**), and is summarised in **Appendix 6-1**. The value, subject to peer review by the local planning authority's ecologist, is **0.84 units**.

Summary of Important Ecological Features

6.3.39 Table 6.2 summarises important ecological features which should be considered in the assessment of ecological effects.

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Table 6.2: Summary of Important Ecological Features

Feature	Legal and Policy Status	Level of Importance
Lockington Marshes SSSI	Wildlife and Countryside Act 1981 (as amended); NPPF paragraphs 170–71	National
Forbes Hole LNR	National Parks and Access to the Countryside Act 1949	County level
LWS (previously SINC) sites (see **Appendix 6-1**, Table 3.1)	NPPF p. 171	County level
Hedgerows Priority Habitat	S41, NERC Act 2006	Local

6.4 Assessment of Effects

Incorporated Mitigation

Scheme Design

6.4.1 Mitigation measures incorporated into the design of the Proposed Development are set out in Chapter 4.0 Scheme Description of this ES.

Measures to Avoid Effects on the Water Environment

6.4.2 Measures will be incorporated into the construction and operational phase of the Proposed Development to avoid effects on the water environment. These include measures to address both water quantity (i.e. changes in run-off characteristics) and water quality (i.e. avoidance of pollution). No aquatic habitats of high sensitivity have been identified in the vicinity of the Site, but such measures will serve to protect habitats in the wider (River Trent) catchment.

Measures to Reduce Noise Disturbance

6.4.3 Measures to reduce noise generation during the construction and operational phases of the Proposed Development are outlined in Chapter 7.0 Noise, paragraph 7.4.1 of this ES.

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Measures to Maintain / Enhance Habitats on Site

6.4.4 Figures 5.5a-b (Illustrative Landscape Design) illustrate how the landscape design of the Proposed Development will create habitats of nature conservation interest. These include an area of birch woodland and wildflower meadow in an area located in the south-eastern part of the Site; native woodland planting near the northern boundary with species-rich grassland; and new hedgerow / species-rich grassland within the northern / eastern boundary fence.

Construction Phase

Potential Impacts

6.4.5 Key potential impacts during the construction phase of the Proposed Development include:

- Land-take for construction, with consequent loss of habitats and component species in those parts of the Site which lie within the development footprint or construction laydown area;
- Potentially increased risk to water environment from loss of vegetation / increase in run-off from bare surfaces, leakage of hydrocarbons from plant and vehicles, and / or contamination from stored fuel or other materials; and
- Increased noise, lighting, vehicle movements and human activity as a consequence of construction works, with potential disturbance of species using proximal habitats.

Effects of Land-take

6.4.6 The area of vegetated habitats within the Proposed Development footprint is very small, and no features of nature conservation importance have been identified within its boundaries. No effects on protected species or breeding birds are predicted, due to the lack of suitable habitats or structures within the Site.

6.4.7 As noted in Subsection 6.3 above, a calculation has been made of the value of habitats lost in biodiversity units using Biodiversity Metric 2.0. The basis of the calculations is set out in **Appendix 6-1**; taking the conservative assumption that all habitats within the Site will be lost, this equates to a total of **0.84 habitat units** and

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0.00 hedge units. This provides the basis for assessing the value of restored habitats within the Site, and the value of off-site mitigation.

Risks to Water Environment

6.4.8 There is an increased potential for effects on the water environment during the construction phase. The Proposed Development does not involve working in close proximity to existing watercourses, so this risk is of low magnitude.

6.4.9 Incorporated mitigation measures would help avoid risks of inadvertent pollution of watercourses during the construction phase, coupled with the additional mitigation measures which will be set out in a Construction Environmental Management Plan (CEMP). It is intended that this would require approval as a planning condition prior to the commencement of development.

Increased Disturbance during Construction

6.4.10 The construction phase of the Proposed Development has the risk of causing more intensive disturbance of wildlife than its subsequent operational phase, although individual disturbance events will generally be relative short in duration. Examples include site clearance and earthmoving, and construction operations involving the use of heavy equipment. Increased human activity, noise and the use of temporary security lighting all have the potential to cause temporary disturbance of wildlife.

6.4.11 The potential for construction-related disturbance to have a significant ecological effect is limited by the generally low sensitivity of proximal receptors. It also needs to be seen in the context of existing baseline disturbance levels from the operational Power Station. The nearest habitats which could be considered as sensitive receptors to construction phase disturbance is Thrumpton Park LWS, located a minimum of 190 m from the nearest Site boundary. Given the fact that sightlines are interrupted by intervening vegetation, and the LWS is itself composed of relatively enclosed, wooded habitats (including woodland on the southern edge of the LWS), the risks of human activity causing direct disturbance of species using Thrumpton Park can be assessed as negligible.

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Construction Noise Disturbance

6.4.12 The EIA Scoping response requested that noise contour plots should be provided for the Proposed Development, with particular reference to Thrumpton Park; these are set out in **Appendix 7-8**. They are based on worst-case assumptions, derived from piling noise at the Site centre with a sound power level of 117 dB_{LWA} derived from the operation of a piling rig and associated activities (see **Appendix 7-5**).

6.4.13 When interpreting the effects of noise on sensitive receptors such as birds, there is no generally applicable guidance on what constitutes an ecologically significant effect. University of Hull Institute of Estuarine and Coastal Studies (IECS) has produced guidance on both noise and visual disturbance on birds of estuarine habitats to assist in the mitigation of construction and other development activities. The Waterbird Disturbance Mitigation Toolkit [5] guidance is underpinned by a number of scientific studies, including those which controlled for the interaction between noise and visual stimuli.

6.4.14 The Toolkit defines a 'high noise level effect' as a sudden noise of over 60 dB at the bird, or a more prolonged noise of over 72 dB. For species regarded as highly sensitive to noise disturbance, the Toolkit advises caution for noises over 55 dB, although levels up to 70 dB at the bird may be acceptable. For all species, a level of 55 dB(A) for sudden noises is likely to represent a minimum disturbance threshold (note the A-weighting used for human hearing frequency response is acceptable to apply to birds, which have a similar although slightly narrower range), and can therefore be used as a screening threshold to consider potential effects.

6.4.15 The IECS guidance indicates that the likelihood of disturbance effects depends on background noise levels, due to habituation of birds to noisier environments. Monitoring results for the edge of Thrumpton Park LWS are given in **Appendix 7-8**, Figure 21. Although undertaken at a time of unusually low levels of human activity due to the Covid-19 virus, the time series shows numerous L_{Amax} peaks in excess of 60 dB, with a 90th percentile value given in Figure 22 of 63.1 dB.

6.4.16 There is no similar guidance applicable to other habitats, but there is no evidence that birds of more enclosed habitats such as woodland are more sensitive to sudden

[5] *Cutts, N., Hemingway, K., & Spencer, J. (2013). Waterbird Disturbance Mitigation Toolkit. Version 2.3. Institute of Estuarine and Coastal Studies, University of Hull.*

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impulsive noise, and as such do not warrant application of a more precautionary screening threshold. Research on species of more enclosed habitats such as woodland has tended to focus on effects of elevated background levels, including responses such as changes in sound pressure levels and frequency of songs, and effects such as reduced breeding success. The potential for such effects is more appropriately considered in terms of predicted operational phase noise.

6.4.17 With respect to construction phase piling noise, **Appendix 7-8**, Figures 23 and 24 provide contour plots of sound pressure levels at Thrumpton Park LWS and the adjoining Redhills LWS, using two different calculation methods. Figure 23, using BS5228 methodology, shows the area over 55 dB L_{Aeq} to be confined to the southern woodland edge. Figure 24 uses ISO9613/2 methodology, which takes the attenuating effect of topography into account. This gives a more complex prediction within the LWS, but no areas are predicted to experience > 55 dB(A) sound pressure levels. However, it should be noted that construction activities are not temporally steady and transient increases in noise levels can arise. The magnitude of sound pressure levels during these peaks is uncertain, but levels 10 dB above the L_{Aeq} "energy-average" would not be uncommon. On this basis, since no areas are predicted to exceed 55 dB L_{Aeq}, the transient increases in sound pressure levels would not be expected to exceed 65 dB(A), or, if they did, they would be confined to the nearest part of the LWS. Levels of transient / sudden noise levels of this magnitude are potentially indicative of a moderate disturbance to birds; however, they are comparable in magnitude to those already occurring at the edge of the Thrumpton LWS (Figure 22 in **Appendix 7-8**). Overall, it is considered that whilst transient increases in noise level during construction are predicted to occur, the area affected is limited in extent. The baseline monitoring suggests that similar magnitude levels of sudden noise are already occurring at the edge of the LWS and likely to have been habituated and, as such, there should not be any widespread effect of construction noise on the LWS sites.

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Operational Phase

Potential Impacts

6.4.18 Key potential impacts during the operational phase of the Proposed Development include:

- Potential air quality effects of emissions on sensitive ecological receptors, including statutory designated sites;
- Potential near-site effects of noise, human disturbance and lighting; and
- Positive effects of habitat creation measures incorporated into the Site's landscape design.

Air Quality Effects

6.4.19 Atmospheric dispersion modelling was carried out and reported in the Air Quality Assessment (AQA) (**Appendix 8-1**). This predicted a number of exceedances of EA or IAQM screening thresholds[6] in cases where the predicted environmental concentration (PEC) exceeds the relevant Environmental Quality Standard (EQS). These are set out in the AQA, and interpreted in terms of their likely ecological effects in **Appendix 6-3**.

6.4.20 Effect magnitude and significance is set out in summary Table 6.3; however, for a fuller explanation of the rationale for these conclusions, **Appendix 6-3** should be consulted.

Potential Effects of Human Disturbance and Lighting

6.4.21 As noted in the context of the construction phase, there are few important ecological features around the Site which could be regarded as particularly disturbance-sensitive, with the possible exception of Thrumpton Park LWS to the north. However, the potential of habitats around the Site to support wildlife, including within-site habitats developed as part of landscape enhancements, would be greater if operational noise levels are controlled, and light spillage is minimised.

[6] *Holman et al (2019). A guide to the assessment of air quality impacts on designated nature conservation sites – version 1.0, Institute of Air Quality Management, London.* www.iaqm.co.uk/text/guidance/airquality-impacts-on-nature-sites-2019.pdf

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6.4.22 The increase in operational phase traffic movements within and around the Site relative to the current baseline is low (see Chapter 11.0 of this ES), and does not significantly alter the likelihood of disturbance of adjoining habitats. Vehicle movements are generally less disturbing than pedestrians, and a degree of habituation is already likely amongst species of adjoining habitats due to the operation of the Power Station.

6.4.23 There are few receptors of high sensitivity to increased light levels in the vicinity of the Proposed Development, given the Proposed Development's location adjoining the currently illuminated Power Station. Any additional lighting would therefore be incremental in extent, rather than introducing lighting into a previously dark natural environment.

6.4.24 The Lighting Assessment to be produced prior to the commencement of development would indicate the luminance and extent of lateral light spillage levels from the Proposed Development. Given the distance from the Site boundary, it is anticipated that levels of 1.0 lux or less can be achieved before the boundary with Thrumpton Park LWS ensuring that there would be no effect on potentially more valuable bat foraging habitats within this site. The 1.0 lux threshold is recognised as a 'no effect' level for the most light-sensitive species, with other species tolerant of significantly higher lighting levels. These more tolerant species include most of the species recorded in the data search – the common and soprano pipistrelle, and noctule.

Predicted Operational Phase Noise Effects

6.4.25 **Appendix 7-8**, Figure 25 illustrates that no part of Thrumpton Park LWS or Redhill LWS are predicted to experience noise levels in excess of 50 dB L_{Aeq} as a consequence of the operation of the Proposed Development, and areas in excess of 45 dB L_{Aeq} confined to a narrow fringe along part of the LWSs southern boundary. Such levels are well below any thresholds of effect of background noise on breeding birds, reported in studies on roads and industrial noise sources. It can therefore be concluded that there would be no effect on breeding birds from operational noise arising from the Proposed Development.

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Effect Significance

6.4.26 Table 6.3 combines the identification of important ecological features, including their geographic scale of importance, with the potential impacts and their predicted effects set out above. It uses these to assess the effect on the conservation status of species, and the integrity of any sites or component habitats thereof, in order to identify whether any ecological effects can be considered to be significant in EIA terms.

Table 6.3: Effect Significance

Interest feature	Scale of importance	Effects	Effect significance / effect on site integrity or conservation status
Lockington Marshes SSSI	National	No increase above IAQM or EA air quality screening thresholds	No significant harm to notified features (see Ecological Interpretation of AQA, **Appendix 6-3**)
Forbes Hole LNR	County level	Acid deposition rates just below IAQM screening threshold	No significant harm to ecological interest features
Gotham Hill Wood LNR	County level	Small magnitude (< 5 %) increase in nitrogen deposition rates	No significant harm to ecological interest features
Thrumpton Park LWS	County level	Small magnitude (< 5 %) increase in nitrogen deposition rates. Small magnitude increase in noise levels remaining below disturbance thresholds for operation. Localised irregular construction noise levels above disturbance threshold, comparable to current baseline noise	No significant harm to ecological interest features
Red Hill, Ratcliffe on Soar LWS	County level	Negligible increase in noise levels, remaining below disturbance thresholds	No predicted effects
River Soar, Loughborough Meadows to Trent LWS	County level	No increase above IAQM screening thresholds	No significant harm to ecological interest features
Lockington Fen	County level	No increase above IAQM screening thresholds	No significant harm to ecological interest features
Lockington Shooting Ground Marsh, Grassland	County level	Outside 2 km radius from emission source (within 2 km buffer around site boundary)	No effect on ecological interest features
Rare Plant Register Mousetail Pasture	County level	No increase above IAQM screening thresholds	No significant harm to ecological interest features
Redhill Marina Backwater	County level	No increase above IAQM screening thresholds	No significant harm to ecological interest features
Lockington, swamp by SSSI	County level	No increase above IAQM screening thresholds	No significant harm to ecological interest features

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Interest feature	Scale of importance	Effects	Effect significance / effect on site integrity or conservation status
Lockington Confluence Backwater	County level	No increase above IAQM screening thresholds	No significant harm to ecological interest features
Ratcliffe Lane Pasture and Stream	County level	No increase above IAQM screening thresholds	No significant harm to ecological interest features
Soar Meadow near Ratcliffe Lock	County level	No increase above IAQM screening thresholds	No significant harm to ecological interest features
River Soar West Bank south of A453	County level	No increase above IAQM screening thresholds	No significant harm to ecological interest features
Trent Floodplain Wetland - Lock m07	County level	No increase above IAQM screening thresholds	No significant harm to ecological interest features
River Trent North Bank	County level	No increase above IAQM screening thresholds	No significant harm to ecological interest features
Attenborough West Gravel Pits	County level	No increase above IAQM screening thresholds	No significant harm to ecological interest features
Trent Lock Marsh	County level	No increase above IAQM screening thresholds	No significant harm to ecological interest features
Narrow Bridge Fish Pond	County level	No increase above IAQM screening thresholds	No significant harm to ecological interest features
Sheetstores Junction Pond	County level	No increase above IAQM screening thresholds	No significant harm to ecological interest features
Poplars Fish Pond	County level	No increase above IAQM screening thresholds	No significant harm to ecological interest features
South Junction Pond	County level	No increase above IAQM screening thresholds	No significant harm to ecological interest features
Meadow Lane Carr	County level	Small magnitude (just over 1 %) increase in acid deposition rates	No significant harm to ecological interest features
Erewash Canal	County level	No increase above IAQM screening thresholds	No significant harm to ecological interest features
Hedgerow to west of Site	Local	No effects predicted	Not significant

6.4.27 The assessment of effects on Lockington Marsh SSSI takes into account the low sensitivity of alder woodlands to nutrient nitrogen and acid deposition; this is discussed further in **Appendix 6-3**, but essentially means that critical loads are not exceeded for this habitat.

6.4.28 The assessment of effects on relevant LWS sites takes into account the very low magnitude of exceedance of IAQM screening thresholds at a small number of sites, and the lower level of policy protection afforded to locally designated sites, again in accordance with IAQM guidance. Although not necessary to conclude no significant effect in EIA terms, the future baseline scenario of closure of the existing coal-fired

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Power Station will serve to create 'headroom', which will only be partially taken up by the impacts of the Proposed Development. These conclusions are explained in greater detail in **Appendix 6-3**.

6.5 Cumulative Effects

6.5.1 As set out in Chapter 2.0 of this ES, only one cumulative scheme has been identified, namely High Speed 2 Rail (HS2), the route of which would run close to the Power Station. In terms of potential ecological effects, this project will involve rail construction works to the west of the Proposed Development, around 600 m from the Site boundary at its closest point. The construction timetable does not overlap with the intended construction programme for the Proposed Development, so any in-combination construction phase ecological effects would be sequential in nature.

6.5.2 The main potential for cumulative effects is as an additional pressure on sites which have been identified as being impacted by the Proposed Development. From north to south, these include the following:

- Soar Meadow by Ratcliffe Lock LWS (direct effect – on HS2 route);
- Thrumpton Park LWS (direct effect – on HS2 route); and
- Meadow Lane Carr LWS (potential effect – HS2 route in close proximity).

6.5.3 None of these sites are predicted to be subject to significant ecological effects as a consequence of the Proposed Development alone.

6.5.4 Soar Meadow by Ratcliffe Lock LWS is not predicted to experience any impacts in excess of IAQM screening thresholds with respect to atmospheric pollutants, taking into account the sensitivities of the lowland meadow habitat at that site (see **Appendix 6-3**). Impacts of the Proposed Development can therefore be regarded as *de minimis*, and there is no mechanism whereby effects could operate in combination with HS2. Furthermore, HS2 is likely to have a high magnitude effect on this site; the LWS will be crossed by a rail viaduct, leading to potentially significant construction phase effects and permanent effects of the overlying rail bridge.

6.5.5 The western section of Thrumpton Park LWS will be affected by a construction of a tunnel by cut and cover methods. This will lead to the loss of habitat within this construction corridor, but with the potential for partial recovery of vegetation over the

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tunnel. The key area considered for proximal effects of noise of the Proposed Development is to the east of the proposed HS2 construction corridor, while air quality effects are also of higher magnitude to the north-east of the Proposed Development, and east of the HS2 route.

6.6 Mitigation

6.6.1 Although habitats within the Site have been assessed as having very little potential for nesting birds, a further check should be made prior to the commencement of development, including for the presence of ground-nesting species on open, partly-vegetated habitats. If nesting birds are present, then site clearance operations should be timed to occur outside the bird breeding season, which for most species which may occur on Site runs from early April until mid to late August. This may be extended into September for some species which may nest in structures (e.g. barn swallow, *Hirundo rustica*).

6.6.2 No additional mitigation measures are proposed.

6.7 Residual Effects and Conclusions

6.7.1 With the implementation of the Illustrative Landscape Design, the residual effect of the Proposed Development will result in a biodiversity net gain of 52.46 % when measured using Biodiversity Metric 2.0 (**Appendix 6-4**). This significantly exceeds the anticipated future requirements under the Environment Bill of a 10 % net biodiversity gain.

6.7.2 No effects on legally protected species are predicted as a consequence of the Proposed Development, and it will not be necessary to obtain a protected species disturbance licence in order to undertake works on site. Although current potential has been assessed as low, there is a risk that habitats within the Site could be utilised by breeding birds. A nesting bird survey is therefore recommended prior to the commencement of development, with timing of site clearance works scheduled to commence outside the bird breeding season.

6.7.3 Off-site effects of noise and air quality on sensitive ecological receptors have been assessed for the Proposed Development. Predicted noise levels during construction and operational phases are below thresholds likely to have any effect on birds. The

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AQA predicted a number of exceedances of screening thresholds with respect to ammonia levels, nitrogen and acid deposition. These have been assessed in detail in **Appendix 6-3**. Taking into account the sensitivity of the receiving environment, and interpreting predictions in accordance with IAQM guidance, it can be safely concluded that none of the modelled impacts are significant in EIA terms. This conclusion is not reliant on the future baseline of closure of the Power Station, although this would lead to a net reduction in current baseline pollutant levels and deposition rates.

6.7.4 In conclusion, the Proposed Development will not result in any significant environmental effects in EIA terms.

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CHAPTER 7.0 NOISE

FIGURES (Volume 2 bound separately)

APPENDICES (Volume 3 bound separately)

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7.0 NOISE

7.1 Introduction

7.1.1 This Chapter assesses the likely significant environmental effects of the Proposed Development in relation to noise. It describes the methods used to assess the effects, the existing sound climate and the assessment of future baseline sound levels in the vicinity of the Site. In addition, potentially affected Noise Sensitive Receptors (NSRs) are identified. The Chapter sets out the likely significant effects arising from the construction and operation of the Proposed Development and provides details of mitigation measures to minimise noise effects.

7.1.2 The assessment includes:

- A description of the existing sound environment;
- An outline of the likely evolution of the future baseline sound levels;
- The identification of construction and operational activities that may cause noise effects;
- Predictions of noise levels during the construction and operation at the nearest NSRs;
- Details of potential cumulative effects where noise from other potential developments may also affect the same NSRs; and
- The identification of likely residual significant effects taking into account additional mitigation.

7.1.3 Potential noise effects are considered in the context of the current and predicted future background sound levels at the nearest NSRs, which in the area surrounding the Site are predominantly influenced by local and distant road traffic.

7.1.4 A sound survey has been carried out at the nearest NSRs in the vicinity of the Proposed Development to determine existing representative background baseline and residual sound levels. The aim of the sound survey was to:

- Identify the existing baseline sound levels for use as a reference for background and residual sound levels in the assessment of impacts related to the construction and operation of the Proposed Development;
- Enable the assessment baseline to be established and understand the effects of existing developments on the future baseline; and

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- Characterise the nearest NSRs.

7.1.5 The methodology and approach to the sound survey and assessment included the following:

- Establishing the nearest NSRs;
- Identification of levels that are representative of present and future background / residual sound levels;
- Evaluation of noise sources from the Proposed Development in terms of typical construction and operating noise levels;
- Assessment of specific noise sources in relation to appropriate guidance and standards; and
- Identification of any additional noise mitigation measures (over and above incorporated mitigation) where noise generated from the Proposed Development has been identified in this assessment as exceeding noise limits or would have the potential to cause a significant increase in noise levels compared to the assessment baseline.

7.1.6 The noise assessment has been undertaken in accordance with the methodology identified in the Scoping Report and subsequently confirmed as appropriate in the Scoping Opinion by Nottinghamshire County Council (NCC).

7.1.7 **Appendix 7-1** provides details of technical terms used within the chapter, together with a chart showing typical everyday noise levels to assist in understanding the subjective level of noise in terms of decibels (dB), which is the unit used tomeasure sound intensity.

7.1.8 Perception of ground borne vibration during construction and operation is not anticipated beyond separation distances greater than around 50 m. On the basis that sensitive receptors are at distances much greater than this, vibration impacts can be assumed to be negligible and have not been considered further.

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Proposed Development

7.1.9 A full description of the Proposed Development is provided in Chapter 4.0 of this Environmental Statement (ES) and the location of the Application Site is shown on Figure 1.1.

7.1.10 Of particular relevance to the noise assessment are the operating hours of the various components of the Proposed Development, which are repeated below for ease of reference.

7.1.11 The Proposed Development would operate 24 hours a day, seven days a week. With planned and routine periods of shutdown, each of the two lines of the Proposed Development would typically be operational for 90 % of the year. Non-hazardous residual waste would predominantly be delivered to the Site by road between the hours of 06:00 and 18:00 (Monday to Friday inclusive) with substantially fewer HGV movements during weekend daytimes.

7.1.12 Utilisation of the existing rail infrastructure at the Ratcliffe-on-Soar Power Station (hereafter referred to as 'the Power Station') is a possible alternative route by which residual waste fuel could be transported to the Proposed Development in the future.

Competence

7.1.13 The author of this assessment has over 20 years' experience in the field of industrial and environmental acoustics with a MSc Degree in Acoustics and is a Member of the Institute of Acoustics.

7.2 Methodology and Scope of Assessment

General

7.2.1 To establish the impact of noise on existing or proposed residential receptors, it is necessary to consider the relevant noise guidance, standards and policy for the Proposed Development which for the purposes of this assessment is an industrial development. This section examines the guidance and establishes the methodology adopted for assessing noise impacts.

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7.2.2 Information used in this assessment has been obtained from the following sources:

- Ordnance Survey maps of the local area;
- General layout of the Proposed Development;
- National Planning Policy Framework – February 2019;[1]
- Noise Policy Statement for England (NPSE) – March 2010;[2]
- Planning Practice Guidance – March 2014 Department for Communities and Local Government (Ref ID: 30-001-20140306);[3]
- IPPC – Technical Guidance Note IPPC H3 Part 2 – Noise Assessment & Control;[4]
- World Health Organisation: 'Guidelines for Community Noise' – April 1999;[5]
- World Health Organisation 'Night Noise Guidelines for Europe' – 2009;
- British Standards BS4142:2014+A1:2019, BS7445:2003 and BS8233:2014;
- Design Manual for Roads and Bridges, LA 111 Noise and Vibration – November 2019;[6]
- World Health Organisation 'Environmental Noise Guidelines for the European Region' – 2018;[7]
- Department of Transport 'Calculation of Road Traffic Noise' – 1988;
- ISO 9613-2:1996 Acoustics – Attenuation of Sound During Propagation Outdoors;[8] and
- Published and library data.

National Planning Policy

National Planning Policy Framework (NPPF)

7.2.3 Chapter 15 of the National Planning Policy Framework (NPPF) is concerned with the conservation and enhancement of the natural environment. It indicates at paragraph 170 that: *"Planning policies and decisions should contribute to and enhance the natural and local environment by* (amongst others)*: preventing new and existing development from contributing to, being put at unacceptable risk from, or being*

[1] National Planning Policy Framework – February 2019.
[2] Noise Policy Statement for England (NPSE) – March 2010.
[3] Planning Practice Guidance – 6 March 2014 Department for Communities and Local Government (Ref ID: 30-001-20140306).
[4] IPPC - Technical Guidance Note IPPC H3 Part 2 – Noise Assessment & Control.
[5] Guidelines for Community Noise – World Health Organisation: April 1999 WHO 'Night Noise Guidelines for Europe' – 2009.
[6] Design Manual for Roads and Bridges, LA 111 Noise and vibration.
[7] World Health Organisation 'Environmental Noise Guidelines for the European Region': 2018.
[8] ISO 9613-2: 1996 Acoustics – Attenuation of Sound During Propagation Outdoors.

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adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability…"

7.2.4 Paragraph 180 refers directly to the issue of noise and states: *"Planning policies and decisions should also ensure that new 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, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:*

- *mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;*
- *identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason."*

Noise Policy Statement for England

7.2.5 The Noise Policy Statement for England (NPSE) was published in March 2010. It specifies the following long-term vision and aims: *"Noise Policy Vision: Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development."*

7.2.6 This long-term vision is supported by the following aims: *"Noise Policy Aims: Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:*

- *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."*

7.2.7 The NPSE introduced three concepts to the assessment of noise, as follows:

- NOEL – No Observed Effect Level: This is the level below which no effect can be detected and below which there is no detectable effect on health and quality of life due to noise;
- LOAEL – Lowest Observable Adverse Effect Level: This is the level above which adverse effects on health and quality of life can be detected; and

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- SOAEL – Significant Observed Adverse Effect Level: This is the level above which significant adverse effects on health and quality of life occur.

7.2.8 The above categories are undefined in terms of noise levels. In addition, for the SOAEL the NPSE indicates that the noise level will vary depending upon the noise source, the receptor and the time of day / day of the week, etc. The need for more research is therefore required to establish what may represent a SOAEL. It is acknowledged in the NPSE that not stating specific SOAEL levels provides policy flexibility until there is further evidence and guidance.

7.2.9 The NPSE indicates how the LOAEL and SOAEL relate to the three aims listed above. The first aim of NPSE requires that: *"significant adverse effects on health and quality of life should be avoided while also taking into account the guiding principles of sustainable development."*

7.2.10 The second aim of the NPSE (mitigating and minimising adverse impacts on health and quality of life) refers to the situation where the impact lies somewhere between LOAEL and SOAEL. It requires that all reasonable steps should be taken to mitigate adverse effects on health and quality of life whilst also taking into account the guiding principles of sustainable development. This does not mean that such adverse effects cannot occur.

7.2.11 The third aim envisages proactive management of noise to improve health and quality of life, again taking into account the guiding principles of sustainable development.

Planning Practice Guidance

7.2.12 On 6 March 2014, the Government published the National Planning Practice Guidance (NPPG) on noise, which provides further information in respect of new developments which may be sensitive to the prevailing noise environment.

7.2.13 The NPPG refers to the NPPF and NPSE documents and under the heading *'How to determine the noise impact?'* it states: *"Local planning authorities' plan-making and decision taking should take account of the acoustic environment and in doing so consider:*

- *whether or not a significant adverse effect is occurring or likely to occur;*

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- *whether or not an adverse effect is occurring or likely to occur; and*
- *whether or not a good standard of amenity can be achieved."*

7.2.14 The NPPG includes a table summarising the noise exposure hierarchy, based on the likely average response. Under the heading of *'Response'*, the *'Present and not intrusive'* assessment of noise is defined as: *"noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but not such there is a perceived change in the quality of life."* The increasing effect level under these conditions is deemed to be 'no observed adverse effect' and 'no specific measures required'.

7.2.15 The NPPG explains this by stating:

"At the lowest extreme, when noise is not noticeable, there is by definition no effect. As the noise exposure increases, it will cross the 'no observed effect' level as it becomes noticeable. However, the noise has no adverse effect so long as the exposure is such that it does not cause any change in behaviour, attitude or other physiological responses of those affected by it. The noise may slightly affect the acoustic character of an area but not to the extent there is a change in quality of life. If the noise exposure is at this level no specific measures are required to manage the acoustic environment.

As the exposure increases further, it crosses the 'lowest observed adverse effect' level boundary above which the noise starts to cause small changes in behaviour and attitude, for example, having to turn up the volume on the television or needing to speak more loudly to be heard. The noise therefore starts to have an adverse effect and consideration needs to be given to mitigating and minimising those effects (taking account of the economic and social benefits being derived from the activity causing the noise)."

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Standards and Guidance

BS4142: 2014+A1:2019 'Methods for rating and assessing industrial and commercial sound'

7.2.16 BS4142: 2014+A1:2019 'Methods for rating and assessing industrial and commercial sound'[9] is based on the measurement of background sound using L_{A90} noise measurements and comparing to source noise levels measured in L_{Aeq} units, i.e. the noise generated by a proposed development. Once any appropriate corrections have been applied for source noise tonality, distinct impulses, etc., the difference between these two measurements (known as the 'rating' level) determines the impact magnitude:

- Typically, the greater the difference, the greater the magnitude of the impact;
- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact (although this can be dependent on the context);
- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context; and
- The lower the rating level is, relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact (although this can be dependent on the context).

7.2.17 In order to establish the rating level, corrections for the noise character need to be taken into consideration. BS4142:2014+A1:2019 states that when considering perceptibility: *"Consider the subjective prominence of the character of the specific sound at the noise-sensitive locations and the extent to which such acoustically distinguishing characteristics will attract attention."*

7.2.18 This approach is required to ensure that where particular noise characteristics occur which could make a noise more noticeable to a NSR, that these are adequately recognised in the assessment. The subjective method adopted includes the character corrections listed in Table 7.1.

[9] *BS4142: 2014+A1:2019 'Methods for rating and assessing industrial and commercial sound'.*

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Table 7.1: BS4142: 2014+A1:2019 Character Corrections

Level of Perceptibility	Correction for Tonal Character dB	Correction for Impulsivity dB	Correction for Intermittency dB	Correction for 'Other Character' dB
Not perceptible	0	0	0	0
Just perceptible	+2	+3	0	0
Clearly perceptible	+4	+6	+3*	+3*
Highly perceptible	+6	+9	+3*	+3*

**Standard defines this should be readily distinctive against the residual acoustic environment, it is interpreted therefore to be either clearly or highly perceptible as a character.*
If characteristics likely to affect perception and response are present in the specific sound, within the same reference period, then the applicable corrections ought normally to be added arithmetically. However, if any single feature is dominant to the exclusion of the others then it might be appropriate to apply a reduced or even zero correction for the minor characteristics

BS8233: 2014 'Guidance on sound insulation and noise reduction for buildings'

7.2.19 The British Standard BS8233 [10] provides additional guidance on noise levels within buildings. These are based on the World Health Organisation (WHO) recommendations and the criteria given in BS8233 for unoccupied spaces within residential properties.

7.2.20 The guidance provided in Section 7.7 of BS8233 provides recommended internal ambient noise levels for resting, dining and sleeping within residential dwellings. Table 7.2 provides detail of the levels given in the standard.

Table 7.2: BS8233: 2014 Indoor Ambient Noise Levels for Dwellings

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting Dining Sleeping (daytime resting)	Living Room Dining Room/area Bedroom	35 dB L_{Aeq} 40 dB L_{Aeq} 35 dB L_{Aeq}	30 dB L_{Aeq}
Study and work requiring concentration	Staff/Meeting Room Training Room/ Executive Office	35–45 dB L_{Aeq} 35–45 dB L_{Aeq}	

7.2.21 This standard would be appropriate to apply to existing or proposed residential developments. The noise contribution from any development should be within the internal noise levels of BS8233:2014, which would include the following noise limits:

- Living room areas: ≤ 35 dB $L_{Aeq,16\ hours}$ (07:00–23:00) (equivalent to an external level of approximately 65 dB $L_{Aeq,16\ hours}$ based on typical standard double-glazed units in the closed position and approximately 50 dB $L_{Aeq,16\ hours}$ in the open position).

[10] *BS8233: 2014 'Guidance on sound insulation and noise reduction for buildings'.*

- Bedrooms: ≤ 30 dB $L_{Aeq,8\ hours}$ (23:00–07:00) (equivalent to an external level of approximately 60 dB $L_{Aeq,8\ hours}$ based on typical standard double-glazed units in the closed position and approximately 45 dB $L_{Aeq,8\ hours}$ in the open position).
- Offices: 35 dB to 45 dB $L_{Aeq,8\ hours}$ (equivalent to an external level of approximately 65 dB to 75 dB $L_{Aeq,8\ hours}$ based on typical standard double-glazed units in the closed position or 50 dB to 60 dB $L_{Aeq,\ 8\ hours}$ based on an open window).

7.2.22 The above internal bedroom limits would comply with sleep disturbance criteria defined by WHO guidelines. The WHO night noise guidelines for Europe refer to a sleep disturbance limit of 42 dB to 45 dB L_{Amax} for regular peak events within bedrooms (which is approximately 57 dB to 60 dB L_{Amax} external to the bedroom window in the open position).

World Health Organisation Guidelines for Community Noise: April 1999

7.2.23 This document provides further updated information on noise and its effects on the community. Within the document for noise *'In Dwellings'* it states that: *"To enable casual conversation indoors during daytime, the sound level of interfering noise should not exceed 35 dB L_{Aeq}. To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55 dB L_{Aeq} on balconies, terraces and in outdoor living areas. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level should not exceed 50 dB L_{Aeq}. Where it is practical and feasible, the lower outdoor sound level should be considered the maximum desirable sound level for new development."*

World Health Organisation (2009) – Night Noise Guidelines for Europe

7.2.24 The WHO Regional Office for Europe set up a working group of experts to provide scientific advice to the Member States for the development of future legislation and policy action in the area of assessment and control of night noise exposure. Considering the scientific evidence on the thresholds of night noise exposure indicated by $L_{night,outside}$ as defined in the Environmental Noise Directive (2002/49/EC), an $L_{night,outside}$ of 40 dB should be the target of the night noise guidance (NNG) to protect the public, including the most vulnerable groups such as children, the

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chronically ill and the elderly. $L_{night,outside}$ value of 55 dB is recommended as an interim target for the countries where the NNG cannot be achieved in the short term for various reasons, and where policy-makers choose to adopt a stepwise approach in moving towards the limit recommended by the WHO.

IPPC – Technical Guidance Note IPPC H3 Part 2 – Noise Assessment and Control

7.2.25 Integrated Pollution Prevention and Control (IPPC) is a regulatory system that employs an integrated approach to control the environmental impacts of certain industrial activities. It involves determining the appropriate controls for industry to protect the environment through a single permitting process. To gain a permit, operators have to show that they have systematically developed proposals to apply the Best Available Techniques (BAT) and meet certain other requirements, taking account of relevant local factors.

7.2.26 In terms of noise specifically, the use of BAT has to be considered and balanced within the wider context of other releases to different media (air, land and water) and taking issues such as usage of energy and raw materials into account. Noise cannot therefore be considered in isolation from other impacts on the environment.

7.2.27 The definition of pollution includes: *"emissions which may be harmful to human health or the quality of the environment, cause offence to human senses or impair or interfere with amenities and other legitimate uses of the environment."* BAT is therefore likely to be similar, in practice, to the requirements of the Statutory Nuisance legislation which requires the use of 'best practicable means' to prevent or minimise noise nuisance. In the case of noise, 'offence to human senses' may be judged by the likelihood of complaints. However, the lack of complaint should not necessarily imply the absence of a noise problem. In some cases, it may be possible, and desirable, to reduce noise emissions still further at reasonable costs and this may therefore be BAT for noise emissions.

7.2.28 Consequently, the aim of BAT should be to ensure that there is no reasonable cause for annoyance to persons beyond the installation boundary.

7.2.29 In summary, the aim of BAT should be to achieve the following:

- Underpinning of good practice, a basic level of which the operator should employ for the control of noise including adequate maintenance of any parts of

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plant or equipment whose deterioration may give rise to increases in noise. For example, this would include bearings, air handling plant, the building fabric as well as specific noise attenuation measures associated with plant, equipment or machinery;

- Noise levels should not be loud enough to give reasonable cause for annoyance for persons in the vicinity, which is a more appropriate environmental standard than that of Statutory Nuisance and is normally the aim of most planning or other conditions applied by Local Authorities; and
- Prevention of 'creeping background' (creeping ambient L_{Aeq}), which is the gradual increase in sound levels as industry expands and areas develop.

7.2.30 The indicative requirements apply to both new and existing activities, but it is more difficult to justify departures from them in the case of new activities. Indeed, because the requirements for noise are likely to be strongly influenced by the local environmental conditions, new installations are expected to meet BAT from the outset and to demonstrate that noise reduction or prevention has been built into the process design. For most existing plant, especially where there are no existing noise limits, the focus is on good practice (BAT) and the need to ensure that there is no reasonable cause for annoyance. In assessing any noise impact, it is more normal to monitor existing levels and apply corrections and calculations, rather than rely on predictions.

7.2.31 The guidance refers to BS4142:1997, BS8233:1999 and WHO guidance for absolute levels for protection of community annoyance. The two British Standards have been updated since the guidance was published, and the latest versions have been considered in this assessment.

Road Traffic Noise

7.2.32 No guidance exists to assess increased traffic noise on existing roads from new developments. However, any change in noise levels along affected roads would be relevant to subsequent planning applications.

7.2.33 The standard index used in the UK for describing road traffic noise is L_{A10}, which is the 'A' weighted sound level in dB exceeded for 10 % of the 18 hour assessment period (ref. Design Manual for Roads and Bridges (DMRB) LA 111 Terms and Definitions). Daytime noise is assessed using the 18-hour L_{A10}, following the

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methodology given in the Department of Transport's Calculation of Road Traffic Noise (CRTN).

7.2.34 For road traffic noise, the CRTN calculation method can be used to predict noise levels from the movement of traffic along adjacent roads. Construction and operation predicted noise levels at sensitive receptors can be compared with predicted noise without the Proposed Development, to establish any likely significant increase in overall traffic noise. Traffic data for the CRTN assessment presented in this Chapter is based on the figures contained within the Transport Assessment (TA), provided as a standalone document in support of the planning application. The TA sets out existing and predicted traffic data for the assessment year based on established growth factors and known committed developments. In this regard the impact of road traffic noise is inherently a cumulative assessment.

7.2.35 According to CRTN where the traffic flow volumes are very low (i.e. where traffic flows below 50 vehicles per hour or 1000 vehicles per 18 hours) then the CRTN methodology is unreliable (ref. paragraph 30 of CRTN). For the assessment of noise arising from HGV movements whilst on Site these have been included within the operational noise modelling, **Appendices 7-6** and **7-7**.

Guidance on Construction Noise

BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites

7.2.36 BS5228 refers to: *"the need for the protection against noise and vibration of persons living and working in the vicinity of, and those working on, construction and open sites. It recommends procedures for noise and vibration control in respect of construction operations and aims to assist architects, contractors and site operatives, designers, developers, engineers, local authority environmental health officers and planners."*

7.2.37 Part 1 deals with noise in terms of background legislation and gives recommendations for basic methods of noise control relating to construction and open sites where significant noise levels may be generated. The guidance is aimed at giving advice on achieving 'best practice' in controlling noise and vibration from construction and open sites. There is an example of noise limits given in Annex E of

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the guidance, which sets out cut-off limits between 65 dB(A) and 75 dB(A) or 5 dB(A) above the ambient noise, whichever is the greater. Part 2 of BS5228 deals specifically with vibration control and provides the legislative background to the control of vibration and recommendations for controlling vibration at source and management controls (e.g. liaison with communities, supervision, preparation and choice of plant, etc).

Consultation

7.2.38 The Scoping Report submitted to Nottinghamshire County Council (NCC) in February 2020 set out the proposed scope and approach to the assessment. NCC issued a Scoping Opinion on 6 April 2020 confirming that the scope and methodology was appropriate. This assessment follows the scope and methodology presented within the Scoping Report, contained at **Appendix 2-1**. As set out in the Scoping Report, potential vibration effects have been scoped out as being unlikely to result in significant environmental effects.

7.2.39 The NCC Scoping Opinion (**Appendix 2-2**) included a comment regarding noise effects on nearby Local Wildlife Sites, and the scope has been extended to include this within the assessment.

Assessment Methodology

Level and Significance of Effect

7.2.40 The level of an effect is a function of the sensitivity or importance of the receiver, or receptor, and the scale or magnitude of the effect. In the case of this assessment the level of the effect has been determined by reference to existing guidance and standards that are explained below.

7.2.41 Four types of receptors have been identified:

- Residents of existing and proposed houses adjacent to the Site who could experience site construction noise during daytime periods;
- Residents of existing and proposed houses adjacent to the Site who could experience site operational noise during daytime and night-time periods;

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- Residents of existing and proposed houses who could experience additional road noise from the construction and operation of the Proposed Development; and
- Local Wildlife Sites could experience additional noise from construction and operation of the Proposed Development.

Magnitude of Effect

Construction Noise

7.2.42 For residents of houses that could be exposed to temporary construction noise, BS5228:2009+A1:2014 is considered to be the appropriate standard. This standard does not prescribe limits, but requires 'best practicable means' (BPM) to be employed to control noise generation. The criterion therefore is that BPM should be employed and conditions implemented, for example to restrict construction noise to non-sensitive hours.

7.2.43 The construction noise impact semantic scale, set out in Table 7.3, is based on the ABC method of assessment described in Annex E of BS5228, which sets out threshold values depending upon the ambient noise at receptors, which have been defined from the baseline sound survey.

7.2.44 According to the guidance found within the DMRB LA 111, the lowest observable adverse effect level (LOAEL) and significant observable adverse effect level (SOAEL) for noise sensitive receptors during construction are shown in Table 7.3.

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Table 7.3: Impact Magnitude Category – Construction Noise

Time period	LOAEL	SOAEL	Threshold Value L_{Aeq1hr} dB
Day (07:00–19:00 Weekday and 07:00–12:00 Saturdays)	Baseline noise levels $L_{Aeq,T}$	Threshold level determined as per BS5228-1:2009+A1:2014 Section E3.2 and Table E.1 BS 5228-1:2009+A1:2014	65
Night (23:00–07:00)	Baseline noise levels $L_{Aeq,T}$	Threshold level determined as per BS5228-1:2009+A1:2014 Section E3.2 and Table E.1 BS 5228-1:2009+A1:2014	45–55*
Evening and weekends (time periods not covered above)	Baseline noise levels $L_{Aeq,T}$	Threshold level determined as per BS5228-1:2009+A1:2014 Section E3.2 and Table E.1 BS 5228-1:2009+A1:2014	55–60

**Note: Based on measured residual levels at NSRs the threshold value according to BS5228-1:2009+A1:2014 will vary (e.g. at all receptors except R4 (Thrumpton Village) the night-time threshold value would be 55 dB L_{Aeq1hr} and at receptors 5 & 6 during evening periods the evening threshold value would be 60 dB $L_{Aeq,1hr}$ otherwise 55 dB $L_{Aeq,1hr}$).*

7.2.45 The magnitude of impact for construction noise is outlined in Table 7.4 (as defined in DMRB LA 111).

Table 7.4: Magnitude of Impact for Construction Noise

Magnitude of impact	Construction noise level
Negligible	Below LOAEL
Minor (Slight)	Above or equal to LOAEL and below SOAEL
Moderate	Above or equal to SOAEL and below SOAEL + 5 dB
Major (Substantial/Severe)	Above or equal to SOAEL + 5 dB

Construction Road Traffic Noise

7.2.46 According the LA 111 guidelines, the magnitude of impact at noise sensitive receptors from construction traffic is set out in Table 7.5.

Table 7.5: Magnitude of Impact for Construction Road Traffic Noise

Magnitude of impact	Increase in basic noise level of closest public road used for construction traffic (dB)
Negligible	Less than 1.0
Minor (Slight)	Greater than or equal to 1.0 and less than 3.0
Moderate	Greater than or equal to 3.0 and less than 5.0
Major (Substantial/Severe)	Greater than or equal to 5.0

Note: Construction noise and construction traffic noise shall constitute a significant effect where it is determined that a major or moderate magnitude of impact will occur for a duration exceeding:

1) *10 or more days or nights in any 15 consecutive days or nights;*
2) *a total number of days exceeding 40 in any 6 consecutive months.*

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Operational Noise

7.2.47 Table 7.6 shows the proposed impact magnitude methodology considering the guidance contained within BS4142: 2014+A1:2019 for fixed and mobile plant noise (e.g. fans, noise breakout and Site HGV movements, etc.).

Table 7.6: Impact Magnitude Scale – Future Noise against Existing in accordance with BS4142: 2014+A1:2019 (Operational Phase)

Rating level above background noise dB(A) as BS4142: 2014+A1:2019	Description of Effect	Impact Magnitude	Adverse Effect Level
-10 to 0	No discernible effect on the receptor.	Negligible	NOEL
+0.1 to +4.4	Non-intrusive – Noise impact can be heard but does not cause any change in behaviour or attitude. Can slightly affect the character of the area but not such that there is a perceived change in the quality of life.	Slight	LOAEL
+4.5 to +9.4	Intrusive – Noise impact can be heard and causes small changes in behaviour and/or attitude. Affects the character of the area such that there is a perceived change in the quality of life. Potential for non-awakening sleep disturbance.	Moderate	–
+9.5 to +14.4	Disruptive – Causes a material change in behaviour and/or attitude e.g. avoiding certain activities during periods of intrusion. Potential for sleep disturbance resulting in difficulty getting to sleep. Quality of life diminished due to change in character of the area.	Substantial	SOAEL
+14.5 and above	Physically Harmful – Significant changes in behaviour and/or inability to mitigate effect of noise leading to psychological stress or physiological effects e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm.	Severe	SOAEL

Note: The ‘rating’ level is the difference between the noise contribution from site and the existing background sound level allowing for any adjustments required for noise characteristics (i.e. tonal, impulsive or intermittent noise character). The Standard advises that rounding of numbers to one decimal place should relate to levels of 0.5 dB or above, which is reflected in the table limits.

7.2.48 The Institute of Environmental Management and Assessment (IEMA) has provided ‘Guidelines for Environmental Noise Impact Assessment’.[11] The guidelines set out an example of how changes in noise level may be assessed in terms of residual L_{Aeq}. This assists in determining the impact of Site operational noise relative to the context of the noise climate, which is detailed in Table 7.7.

[11] *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, Association of Noise Consultants [ANC] and the Institute of Acoustics [IOA], Version 2, 24 March 2020.*

Table 7.7: Impact Magnitude Scale – General Site Noise Change in Sound Levels LAeq dB

Change in sound levels L_{Aeq} dB	Description of Effect	Impact Magnitude
< +2.9	No discernible effect on the receptor.	Negligible
+3.0 to +4.9 (some receptor sensitivity)	Non-intrusive – Noise impact can be heard but does not cause any change in behaviour or attitude. Can slightly affect the character of the area but not such that there is a perceived change in the quality of life.	Slight
+3.0 to +4.9 (high receptor sensitivity) +5.0 to +9.9 (some receptor sensitivity)	Intrusive – Noise impact can be heard and causes small changes in behaviour and/or attitude. Affects the character of the area such that there is a perceived change in the quality of life. Potential for non-awakening sleep disturbance.	Moderate
+5 to +9.9 (high receptor sensitivity)	Disruptive – Causes a material change in behaviour and/or attitude e.g. avoiding certain activities during periods of intrusion. Potential for sleep disturbance resulting in difficulty getting to sleep. Quality of life diminished due to change in character of the area.	Substantial
+10 and above (high receptor sensitivity)	Physically Harmful – Significant changes in behaviour and/or inability to mitigate effect of noise leading to psychological stress or physiological effects e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm.	Severe

Road Traffic Noise

7.2.49 To assess the likely impact on noise sensitive receptors from any traffic noise generated as a result of the Proposed Development using the local road network, noise calculations have been undertaken using CRTN methodology and traffic flow information for the Proposed Development from the Transport Assessment, which accompanies the planning application.

7.2.50 DMRB LA 111 provides guidance on the magnitude of change in terms of road traffic noise. The procedure for assessing noise impacts advises the use of a L_{A10} measurement index based on an 18-hour time period (i.e. 06:00 to 24:00). Further assessment of the impact would be required where changes of 1 dB(A) or more are expected in the short-term and changes of 3 dB(A) in the long term.

7.2.51 DMRB LA 111 defines the short term and long-term scenarios are considered to represent the situation when a new road opens (short term) and 15 years after a road opens (long term). The magnitude of change criteria are set out in Table 7.8 for the short term and Table 7.9 for the long term.

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Table 7.8: Magnitude of Change – Road Traffic Noise- Short Term

Short term magnitude	Short term noise change (dB $L_{A10,18hr}$ or L_{night})	Adverse Effect Level
Negligible	Less than 1.0	NOAEL
Minor (Slight)	1.0 to 2.9	LOAEL
Moderate	3.0 to 4.9	SOAEL
Major (Substantial/Severe)	Greater than or equal to 5.0	UOAEL

Note: UOAEL is defined as Unacceptable Observed Adverse Effect Level

Table 7.9: Magnitude of Change – Road Traffic Noise- Long Term

Long term magnitude	Long term noise change (dB $L_{A10,18hr}$ or L_{night})	Adverse Effect Level
Negligible	Less than 3.0	NOAEL
Minor (Slight)	3.0 to 4.9	LOAEL
Moderate	5.0 to 9.9	SOAEL
Major (Substantial/Severe)	Greater than or equal to 10.0	UOAEL

7.2.52 The impact magnitude categories can then be correlated with the receptor sensitivity category, which we have assumed to be high for residential receptors, to establish the significance of effect as defined in Table 7.10.

Table 7.10: Receptor Sensitivity

Receptor Sensitivity	Type of Receptor
High	Dwellings / residential properties including houses, flats, old people's homes, hospitals, schools, churches, caravans and open spaces / conservation areas.
Moderate	Commercial premises including retails and offices etc.
Low	Industrial premises including warehouses and distribution etc.

7.2.53 Based upon the assessment of impact magnitude and the sensitivity of individual receptors, the matrix shown in Table 7.11 has been developed in order to provide an indication of the possible level of effect for each predicted noise impact. Given that there are many factors which may affect the level of the effect of an impact, not least the character of the noise and timescales over which the noise operates, the overall level of effect must be assessed on an individual basis using professional judgement and experience. Therefore, whilst the matrix provides a useful indication of the likely significance, it cannot be applied in all situations.

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Table 7.11: Level of Effect Matrix

		Receptor Sensitivity		
		High	**Medium**	**Low**
Impact Magnitude	Severe	Major	Major/Moderate	Moderate/Minor
	Substantial	Major/Moderate	Moderate	Minor
	Moderate	Moderate	Moderate/Minor	Minor/Neutral
	Slight	Minor	Minor/Neutral	Neutral
	No Significant Impact (Negligible)	Neutral	Neutral	Neutral

7.2.54 Where a level of effect is defined as Major or Major / Moderate then the effect is likely to be considered significant, i.e. an impact that is likely to be a key material factor in the decision-making process.

Existing Planning Conditions

7.2.55 Currently no planning conditions relating to noise exist for the Power Station site.

Limitations

7.2.56 No specific limitations were encountered in the preparation of this noise assessment. However, it should be noted that some of the baseline noise level data was collected during the Covid-19 outbreak when there was suppressed transport activity and background / residual levels are likely to have been less than would ordinarily occur. Further details can be found in **Appendix 7-2**.

7.3 Baseline

Identification of Noise Sensitive Receptors

Existing or Proposed Residential NSRs

7.3.1 Based on distance relative to the nominal plant centre of the Proposed Development, the nearest residential NSRs are shown in Figure 7.1 and include:

- Receptor 1 (Redhill Marina) located approximately 1,270 m to the west;
- Receptor 2 (Redhill Farm) located approximately 1,180 m to the west;
- Receptor 3 (Middle Gate Cottage) located approximately 1,190 m to the south-west;

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- Receptor 4 (Thrumpton Village) nearest properties located approximately 810 m to the north-east;
- Receptor 5 (Winking Hill Farm) located approximately 890 m to the south-east; and
- Receptor 6 (Ratcliffe on Soar Village) nearest properties located approximately 1,700 m to the south.

Commercial and Future NSRs

7.3.2 There are no local commercial offices in the vicinity of the Proposed Development that would represent sensitive receptors requiring consideration.

Ecological NSRs

7.3.3 There are no high tier designated ecological conservation areas within 1,200 m of the Site or in the potential noise impact area of the Proposed Development. However, the nearest part of the Thrumpton Park Local Wildlife Site (LWS) is within approximately 350 m of the centre of the Site. The LWS covers an area of approximately 76 hectares and at its furthest extends to approximately 1,150 m west of the Proposed Development.

Baseline Background Sound Survey

Residential Receptors

7.3.4 A detailed baseline sound survey has been undertaken at six monitoring positions around the Site in appropriate weather conditions in accordance with the advice given in BS4142: 2014+A1:2019. The continuous monitoring exercise took place between 3 March and 25 March 2020 and allowed representative background sound levels to be established.

7.3.5 The NSR locations chosen for the survey are shown in Figure 7.1 (described in more detail below). They were chosen to be representative of the nearest residential receptors to the Proposed Development. The baseline survey monitoring provides broadband data of the existing sound climate at these receptors. Details of the instrumentation used for the survey and photos of the monitoring locations are provided in **Appendix 7-2**.

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7.3.6 The monitoring positions were as follows:

- A (Redhill Marina and Redhill Farm Areas) located approximately 1,270 m to the west;
- B (Middle Gate Cottage) located approximately 1,190 m to the south-west;
- C (Thrumpton Village) located approximately 810 m to the north-east;
- D (Winking Hill Farm) located approximately 890 m to the south-east; and
- E (Ratcliffe on Soar Village) located approximately 1,700 m to the south.

Position A (Redhill Marina and Farm) – West of Site

7.3.7 Position A is representative of the NSRs in the general Redhill Marina (1) and Farm (2) area. Noise levels at this location are generally affected by local and distant road traffic noise. The monitoring position chosen was adjacent to the banks of the River Soar near the Redhill Marina Café and with relatively unobscured sight of the distant roads and Power Station buildings. Supplementary attended measurements and observations were made near to the canal bridge, approximately 100 m north of the continuous monitoring position.

Position B (Middle Gate Cottage) – West of Site

7.3.8 Position B was located in the rear garden of the Middle Gate Cottage, which is a direct quantification of the noise climate experienced by this NSR. Noise levels at this location are dominated by distant road traffic noise and broadband noise from the nearby cooling towers. Supplementary attended measurements and observations were made on the edge of a field approximately 20 m south of the property.

Position C (Thrumpton) – North-East of Site

7.3.9 Position C is representative of the Thrumpton village to the north-east of the Proposed Development site and noise levels at this location are generally affected by distant A453 and M1 road traffic noise. Any contributions from fixed / mobile plant and transport activities across the Power Station site are attenuated by presence of the intervening hill. The continuous monitoring position was chosen to be on the edge of the cricket ground near the Church Farm cluster of residential properties.

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Supplementary attended measurements and observations were made on the edge of the field adjoining the residential Church Farm Properties.

Position D (Winking Hill Farm) – South-East of Site

7.3.10 Position D was located on a grassed area in front of the Winking Hill Farm residential buildings with line of sight to the Power Station site and nearby A453 dual carriageway. This serves as a direct quantification of the noise climate experienced by this NSR. Noise levels at this location are generally affected by traffic using the nearby dual carriageway; however, during lowest traffic flows there is a discernible steady contribution from activities on the Power Station site. Supplementary attended monitoring was undertaken alongside the access road to the farm buildings, approximately 100 m east of the residential buildings.

Position E (Ratcliffe on Soar) – South of Site

7.3.11 Position E used for the attended monitoring survey was on the grass verge near the bench / stone monument at the minor road junction of Main Street in the middle of the village. This position is less susceptible to contributions from traffic on Kegworth Road and the results represents a general quantification of the noise affecting the properties surrounding this area. Noise at this location was dominated by road traffic on the nearby A453 dual carriageway and intermittently by vehicles on Kegworth Road.

7.3.12 Although ambient noise levels can vary depending on weather conditions, the purpose of the baseline survey is to monitor sound levels under suitable weather conditions. This then provides a typical and representative indication of ambient conditions. The effect of wind on noise levels can be significant, as an example, BS8233: 2014 (Ref. Paragraph 6.8) states: *"Whether noise levels are measured or predicted, wind gradients, temperature gradients and turbulence affect the level of received sound and audibility over short periods. The magnitude of these effects, i.e. variations in noise level and audibility, increases with increasing distance between source and receptor. The effects are asymmetrical and, for distances of 500 m to 1000 m, typically range from increasing the level by typically 2 dB downwind to reducing it by typically 10 dB upwind. It is not usually practicable to use these factors in design, but the prevailing wind direction should be considered when planning*

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building orientation. Noise from wind and precipitation, including the wind-generated noise from trees, can also affect noise measurements."

7.3.13 The attended monitoring was specifically timed to coincide with weather conditions that would commonly occur in the East Midlands Region, i.e. low wind speeds from a west / south-west direction. The continuous noise monitoring took place over several days that experienced a variety of weather conditions; consequently, the monitoring can be considered to cover a representative set of propagation conditions. For the purpose of the noise assessment, long-term downwind noise propagation conditions are assumed for the noise model. Meteorological measurements and weather conditions from a nearby observation site have been used to characterise the weather throughout the period of monitoring. Any monitoring periods where rainfall was noted, where values suggested wind speeds local to the monitoring in excess of 5 m/s or where temperatures were below 0 ˚C, were excluded from the analysis dataset (see **Appendix 7-2**).

Ecological Receptors

7.3.14 Continuous noise monitoring was undertaken on the edge of the Thrumpton LWS. This allows the current noise climate to be characterised and will allow any future noise from the Proposed Development to be put into context.

Baseline Background Sound Survey Results

Residential Receptors

7.3.15 The results of the continuous monitoring and attended spot baseline background noise survey are presented in Table 7.12, with further detail provided in **Appendix 7-3**. For the majority of the baseline survey period the Power Station was not generating electricity, but there were 5 periods when Unit 1 was exporting power to the grid during the day and evening. The baseline results have been categorised and analysed on the basis of the Power Station being "On-load" (generating electricity) or "Off-load" (not generating electricity) during the measurements.

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Table 7.12: Summary of Baseline L_{Aeq} and L_{A90} levels (Power Station off-load)

Position	Period	L_{Aeq} dB	L_{A90} dB			
		Mean	Median	Mean	Most Common	Representative [1]
[A] Redhill Marina/ Farm	Day (06:00-18:00)	51	47	46	46	**46**
	Day (07:00-19:00)	51	47	46	46	**46**
	Evening (19:00-23:00)	49	48	47	48	**47**
	Night (23:00-06:00)	47	45	45	46	**45**
	Night (23:00-07:00)	48	46	45	46	**45**
[B] Middle Gate Cottage	Day (06:00-18:00)	50	48	47	49	**47**
	Day (07:00-19:00)	50	47	46	48	**46**
	Evening (19:00-23:00)	50	49	48	49	**48**
	Night (23:00-06:00)	48	48	46	49	**46**
	Night (23:00-07:00)	49	48	47	49	**47**
[C] Thrumpton	Day (06:00-18:00)	45	41	41	39	**39**
	Day (07:00-19:00)	44	40	41	39	**39**
	Evening (19:00-23:00)	43	40	40	42	**40**
	Night (23:00-06:00)	41	38	37	42	**37**
	Night (23:00-07:00)	42	39	38	42	**38**
[D] Winking Hill Farm	Day (06:00-18:00)	60	56	56	56	**56**
	Day (07:00-19:00)	59	55	55	54	**54**
	Evening (19:00-23:00)	54	48	48	46	**46**
	Night (23:00-06:00)	52	42	42	41	**41**
	Night (23:00-07:00)	53	42	43	41	**41**
[E] Ratcliffe on Soar Village	Day (07:00-19:00)	59	-	56	-	**56**
	Evening (19:00-23:00)	53	-	49	-	**49**
	Night (23:00-07:00)	50	-	44	-	**44**

Note1: Takes into account the median, mean and most commonplace L_{A90} based on statistical analysis, whichever is lowest.

7.3.16 The Proposed Development will operate continuously 24 hours a day and the delivery of waste fuel to the Site will predominantly occur during weekday daytime periods. From an environmental noise emission perspective there are two basic operational states for the Proposed Development: (1) during the evening and night-time periods there will be noise generated by the operational process only; and (2) during the day there will be operational process noise plus additional contributions from HGV movements around the Site. It is appropriate to consider these two basic operational states in the context of the diurnal noise climate.

7.3.17 Across all monitoring positions the representative L_{A90} noise levels during the evening period (19:00–23:00) are either higher than daytime levels or higher than night-time levels. As evening operational noise emissions from the Site will be comparable to night-time levels, it is appropriate to focus on quantifying the operational noise impact of the plant during day and night-time periods. Due to the lower number of waste delivery and staff vehicle movements, any impact during the

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evening period is assured to be lower than either of the day or night periods since less noise will be generated from the Proposed Development in the evening than during the day and the evening baseline L_{A90} and L_{Aeq} levels are higher than at night.

7.3.18 Table 7.12 shows that when the Power Station is off-load, the representative baseline background noise levels at all monitoring positions vary between 39 dB and 56 dB L_{A90} during the daytime (07:00–23:00) and 38 dB and 47 dB L_{A90} during the night-time (23:00–07:00). Even when all units are off-load, there are auxiliary plant operational at the Power Station that generate noise. During the attended surveys, the baseline levels were mainly due to road noise; however, overnight during breaks in the traffic flows, the steady noise from these auxiliary activities was discernible.

7.3.19 The amount of noise emitted from the Power Station site increases further when one or more of the units is on-load and generating electricity. The Current Baseline for the ES assumes the continued operation of the Power Station during the construction and initial operation of the Proposed Development. It is feasible that the Proposed Development will operate during a period when the baseline noise level in the community is experiencing an additional contribution due to one or more units at the Power Station also being on-load.

7.3.20 **Appendix 7-4** contains an analysis of the potential increase in baseline noise levels arising from future on-load operation of the Power Station units based on results from the recent surveys and historic monitoring. Steady operational noise emissions from the Power Station are highest during on-load operation of the generating units with a ‘worst-case’ of all four units being on-load simultaneously. For the majority of the recent surveys all units were in off-load states and only Unit 1 was intermittently on-load during day and evening periods. The baseline noise levels across the NSRs did not show any particular sensitivity to this on-load operation and this was primarily due to the prominence of road noise during the day and evening periods across the community. Only limited noise monitoring has taken place near NSR locations in the past; therefore, it is not possible to quantify a typical specific noise level at community locations during simultaneous on-load operation of all four units. However, some site perimeter noise monitoring has taken place in the past which provides a basic indication of how much more noise is generated during on-load operation. Relative to levels that occur during off-load operation of the plant, noise levels at the north-east perimeter of the Power Station site have historically been 4 dB higher during

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on-load operation of one to three units than typically occurred during off-load operation.

7.3.21 The current baseline assessment is based around noise level data collected in the surrounding community whilst all the Power Station units were off-load. Higher noise contributions from the Power Station have occurred in the past and may occur in the future if on-load operation coincides with construction and initial operational phases of the Proposed Development. The value of the increase will vary with receptor location, but the historic monitoring provides an indication of the magnitude of past and future noise emissions from the Power Station during on-load operation, i.e. 4 dB to the north of the site. In the event that one or more units is on-load concurrently with operation of the Proposed Development, then the relative impact arising from the additional noise by the Proposed Development will be less than indicated by the adopted baseline. Consequently, basing the assessment on noise levels measured a NSRs whilst all the Power Station units were off-load is considered to be a conservative approach.

Ecological Receptors

7.3.22 The monitoring results indicate a mean L_{Aeq} of approximately 43 dB and 5 % of the 5-minute interval periods contained L_{Amax} levels in excess of 68 dB. Details are provided in **Appendix 7-8**.

Future Baseline

Future Baseline Resulting from Natural Changes

7.3.23 The EIA Regulations 2017 require: *"A description of the relevant aspects of the current state of the environment (baseline scenario) and an outline of the likely evolution thereof without implementation of the development as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge."*

7.3.24 For the purposes of noise assessment there is unlikely to be any material change in the baseline noise situation at NSRs as a result of natural changes.

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Future Baseline (Baseline 2) after Decommissioning and Demolition of Ratcliffe-on-Soar Power Station

7.3.25 The planned decommissioning of the Power Station and removal of the majority of operational plant buildings will have an impact on the future baseline. The decommissioning of the plant will remove its specific contribution to the noise baseline and the magnitude of the change is considered in **Appendix 7-4**.

7.3.26 During periods of low traffic flows, noise from the off-load operation of the Power Station is currently discernible at some of the more noise sensitive receptors. Future baseline levels at each of the residential receptors with this contribution removed are shown in **Appendix 7-4** and used as the basis for the Future Baseline assessment.

7.3.27 There will be noise associated with the future decommissioning of the Power Station plant and demolition/clearing of the site buildings. Details of the environmental noise associated with these activities is not considered here, but would be subject to detailed assessment in any future decommissioning EIA to ensure that their impact and effects are suitably managed and controlled.

7.4 Assessment of Effects

Incorporated Mitigation

7.4.1 Predicted noise levels from the Proposed Development have been calculated using the noise levels set out within **Appendix 7-6**. The noise levels are based on a library of data of similar plant operating in the UK and include the following assumed incorporated mitigation measures:

- Buildings constructed from composite cladding (R'w=26 dB) (Steam Turbine Building R'w=38 dB);
- Air cooled condenser (ACC) fans operating at an overall sound power level LWA of 103 dB(A) e.g. 8 fans of 94 dB LWA each fan). Top of ACC fitted with a solid wind shield extending above the fans by approximately 10 m;
- Emissions fan stack designed to a sound power level of 95 dB LWA at flue exit point of each stack;
- Turbine air cooler fans – overall sound power level of all fans operating designed to a level of 95 dB LWA;

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- Ventilation louvres to be attenuated with a minimum sound reduction index of 25 dB(A);
- Doors closed except for access to and egress from the waste reception tipping hall unless for maintenance or emergency. Doors to be fast acting automatic opening / closure action with a minimum R'w 18 dB. Steam Turbine Building minimum R'w 29 dB, all other doors R'w 18 dB;
- Boiler roof and turbine roof vents silenced to 95 dB LWA sound power level;
- Design to ensure no noise character is perceptible at NSRs in accordance with BS4142: 2014+A1:2019;
- Sound power levels of other plant as detailed in **Appendix 7-6**; and
- Mobile plant vehicles fitted with non-tonal reversing alarms (i.e. broadband type noise alarms).

Construction Phase Noise Effects – Mobile Plant Noise

7.4.2 Construction works would involve the movement of soils, piling and the construction of new buildings and infrastructure. Excavators, haulage lorries, piling rigs, cranes, dumpers, concrete plant, diggers and paving machines would all, at some time during the construction programme, be operating at the Site. In addition, ancillary equipment such as small generators, pumps and compressors may also be operating on occasions.

7.4.3 The above noise sources and their associated activities would vary from day to day and may be in use at different stages of the construction period for relatively short durations. The noisiest activities are expected during soil movement and piling work during the initial stages of construction when excavators, piling rigs, dozers or similar may be in use.

7.4.4 The actual noise level produced by construction work would vary at the nearest property boundary at any time depending upon a number of factors including the plant location, duration of operation, hours of operation, intervening topography and type of plant being used. Refer to **Appendix 7-5** for the construction plant inventory that has been taken into account in this assessment.

7.4.5 Daytime construction works (between 07:00 and 19:00 Monday to Saturday) and associated noise levels are provided in Table 7.13, which is based on the ABC

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method of assessment within BS5228: 2009 (Annex E.3.2.) +A1:2014. The noise predictions are based on the construction plant specified in **Appendix 7-5** and assumed to be operating at the nominal centre of the site. The levels are estimated based on the range of possible distances from the whole extent of the site to the NSR.

Table 7.13: Noise Predictions for Highest Likely Construction Noise at NSRs (daytime activities)

NSR Location	Approx. Distance to Receptors /m	Construction Activity	Predicted Construction Noise $L_{Aeq,1hr}$			Daytime Residual Sound Level L_{Aeq}	Total Ambient Noise (Residual + Construction) L_{Aeq} dB			Increase Above Threshold	BS 5228 Threshold Value (Daytime)
			Min	Max	Range	Mean	Min	Max	Range	L_{Aeq} dB	L_{Aeq} dB
[1] Redhill Marina	1200-1410	Earthworks	40	41	40-41	51	51	52	51-52	-13	65
	1200-1410	Piling	46	47	46-47	51	52	53	52-53	-12	65
	1200-1410	General Site Work	39	40	39-40	51	51	52	51-52	-13	65
	1200-1410	Infrastructure	40	41	40-41	51	51	52	51-52	-13	65
	1200-1410	Building Construction	43	44	43-44	51	52	52	52-52	-13	65
[2] Redhill Farm	1100-1300	Earthworks	40	42	40-42	51	51	52	51-52	-13	65
	1100-1300	Piling	46	48	46-48	51	52	54	52-54	-11	65
	1100-1300	General Site Work	39	41	39-41	51	51	52	51-52	-13	65
	1100-1300	Infrastructure	40	42	40-42	51	51	52	51-52	-13	65
	1100-1300	Building Construction	43	45	43-45	51	52	52	52-52	-13	65
[3] Middle Gate Farm	1110-1280	Earthworks	41	42	41-42	50	51	51	51-51	-14	65
	1110-1280	Piling	47	48	47-48	50	52	53	52-53	-12	65
	1110-1280	General Site Work	40	41	40-41	50	50	51	50-51	-14	65
	1110-1280	Infrastructure	41	42	41-42	50	51	51	51-51	-14	65
	1110-1280	Building Construction	44	45	44-45	50	51	52	51-52	-13	65
[4] Thrumpton	720-910	Earthworks	44	46	44-46	44	47	50	47-50	-15	65
	720-910	Piling	50	52	50-52	44	51	55	51-55	-10	65
	720-910	General Site Work	43	45	43-45	44	47	49	47-49	-16	65
	720-910	Infrastructure	44	46	44-46	44	47	50	47-50	-15	65
	720-910	Building Construction	47	49	47-49	44	49	52	49-52	-13	65
[5] Winking Hill Farm	770-1010	Earthworks	43	45	43-45	59	59	59	59-59	-6	65
	770-1010	Piling	49	51	49-51	59	59	60	59-60	-5	65
	770-1010	General Site Work	42	44	42-44	59	59	59	59-59	-6	65
	770-1010	Infrastructure	43	45	43-45	59	59	59	59-59	-6	65
	770-1010	Building Construction	46	48	46-48	59	59	60	59-60	-5	65
[6] Ratcliffe on Soar Village	1630-1840	Earthworks	37	39	37-39	59	59	59	59-59	-6	65
	1630-1840	Piling	43	45	43-45	59	59	59	59-59	-6	65
	1630-1840	General Site Work	36	38	36-38	59	59	59	59-59	-6	65
	1630-1840	Infrastructure	37	39	37-39	59	59	59	59-59	-6	65
	1630-1840	Building Construction	40	42	40-42	59	59	59	59-59	-6	65

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7.4.6 On the basis of the predictions in Table 7.13, the increase in noise as a result of construction is likely to result in an impact magnitude classification of negligible resulting in a neutral level of effect at all residential receptors (i.e. as defined in Table 7.10 with receptors of a high sensitivity). The results show that there are no significant effects in EIA terms.

7.4.7 The application of best practice in accordance with BS5228-1:2009+A1:2014 [12] will assist in minimising impacts from construction noise. This is discussed further in Paragraph 7.6.1.

Ecological Receptors

7.4.8 An assessment of the impact and significance of construction noise on the Thrumpton LWS is provided in Chapter 6.0 Ecology and Nature Conservation. It is concluded that, although the construction activity will give rise to irregular noise levels above the disturbance threshold for birds, it would be localised and broadly comparable in magnitude to that already occurring on the edge of the LWS, and presumably habituated by birds.

Construction Phase Noise Effects – Road Traffic Noise

7.4.9 The construction period would last approximately 36 months and the majority of construction operations would occur to 07:00 to 19:00 Monday to Saturday with no noisy construction work on Sundays or Bank Holidays. Outside the core working hours, some less intense construction activities would continue to take place 24 hours a day and over weekends, but would be restricted to only those low noise activities whose impact would not exceed the construction threshold value levels identified in Table 7.3.

7.4.10 The TA outlines the potential construction phase activities, levels of staff and HGV traffic that could arise for the Proposed Development. These estimates indicate that at the peak of construction traffic (Month 21) there will be 436 staff movements (car / van) and 106 HGV movements per day (i.e. 53 in and 53 out) during typical weekday 06:00 to 24:00 periods.

[12] *BS5228-1:2009+A1:2014 'Code of Practice for noise and vibration control on construction and open sites'.*

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7.4.11 The TA shows that all vehicles accessing the Site will use the A453 dual carriageway to access the unnamed public road that leads to the site entrance. A CRTN sensitivity study has been undertaken to quantify relative contributions from the main three road segments that are used by vehicles associated with the construction activity (A453 westbound, A453 eastbound and the unnamed road leading from the A453 to the Site), see **Appendix 7-9**. The average movements of 30 vehicles per hour on the road accessing the Site is below the 50 per hour lower limit for a CRTN calculation. Assuming an increased average flow of 50 vehicles per hour (20 % HGVs) it is found that at all six NSRs the contribution to the $L_{A10,1hr}$ from traffic on the A453 is 21 dB higher (or substantially more) than the noise contribution from vehicles passing along the unnamed road to access the Site. As there are no residential properties within 400 m of the short section of public road that leads to the Site, it is considered that any increase in noise from this short section will be insignificant in the context of the surrounding road network.

7.4.12 Due to the relative remoteness of the residential receptors from the roads used by the construction traffic, it is appropriate to consider the relative change in L_{A10} level that will arise as a result of the additional vehicle movements on the A453 road only.

7.4.13 As the propagation conditions remain unchanged, any change in L_{A10} level will arise solely from the increased traffic flows and HGV percentage. Table 7.14 shows estimates of change to the noise level arising from the construction traffic travelling along the A453 to and from the site in terms of the $L_{A10,18hr}$ (06:00–24:00) and $L_{A10,6hr}$ (00:00–06:00).

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Table 7.14: Transport Noise -2023 Construction – Increase in $L_{A10,18h}$ (06:00–24:00) and $L_{A10,6h}$ (00:00–06:00) due to extra vehicle movements on A453

Case		**Daytime 18 h period (06:00–24:00)**		**Night-time 6 h period (00:00–06:00)**	
		A453 East of site access	**A453 west of site access**	**A453 East of site access**	**A453 west of site access**
2023 Baseline+ Committed Development	Total vehicles	33508	37226	1897	2086
	HGV	3290	3616	210	226
	% HGV	9.8 %	9.7 %	11.1 %	10.8 %
Proposed Development Construction Vehicles	Total vehicles	54	488	18	162
	HGV	10	96	4	32
	% HGV	19 %	20 %	20 %	20 %
2023 Baseline+ Committed Development +Construction	Total vehicles	33562	37714	1915	2248
	HGV	3300	3712	214	258
	% HGV	9.8 %	9.8 %	11.2 %	11.5 %
% increase in vehicles due to Proposed Development	Total Vehicles	0.2 %	1.3 %	1 %	8 %
	HGVs	0.3 %	2.7 %	2 %	14 %
$L_{A10,18h}$ Change		**0.0**	**0.1**	**0.0**	**0.4**

Change in L_{A10} arising from additional movements on A453 formula (CRTN 42.2)

$$\Delta L_F = 10\,\mathrm{Log}_{10}(Q'/Q) + 33\,\mathrm{Log}_{10}\left[\frac{V' + 40 + \frac{500}{V'}}{V + 40 + \frac{500}{V}}\right] + 10\,\mathrm{Log}_{10}\left[\frac{1 + \frac{5p'}{V'}}{1 + \frac{5p}{V}}\right]$$

Q is flow, V is speed and p is HGV percentage for 2023 baseline.
Q' is flow, V' is speed and p' is HGV percentage for 2023 baseline including Proposed Development construction vehicles.
V' and V assumed to be 97 km/h.

7.4.14 Based on this scenario for the construction period, the above results show no significant increase in noise levels alongside roads during daytime and night-time periods. According to the DMRB short-term impact methodology, there would be no change to negligible impact from road traffic associated with construction.

7.4.15 Assuming the receptors to be of high sensitivity, Table 7.5 criteria suggests a neutral effect for daytime and night-time construction vehicle movements on public roads and hence the impact is not significant in EIA terms.

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Operational Phase Noise Effects

Noise Characteristics

7.4.16 In terms of the potential noise characteristics of the Proposed Development during operation, the following provides the details of the appropriate noise criteria applied in this assessment in accordance with BS4142: 2014+A1:2019:

Tonality

7.4.17 In terms of tonality, the results of noise surveys from a number of energy recovery facilities show no tonal characteristics associated with operational noise. Plant emitting any significant tonal character at source would be controlled by design or mitigation measures, e.g. use of bespoke cladding / enclosures. HGVs would follow a one way system and any reversing alarms would be confined to within the tipping hall building and hence be attenuated by that building's cladding treatment, and therefore impacts are unlikely to be perceptible at NSRs. It is therefore considered that no tonal noise character penalty is required for the operational plant noise or vehicle noise.

Impulsivity

7.4.18 In terms of impulsivity (e.g. noise from pressure relief valves and impacts) empirical on-site noise monitoring of similar sites indicates no audible impulse noise where pressure relief valves and offloading of waste are enclosed within buildings. The design of the plant means that all waste loading and unloading will take place within dedicated buildings, i.e. waste tipping buildings. If any pressure relief valves are mounted external to the building they would be fitted with appropriate silencers. There are safety valves for venting of steam, which are externally mounted on the roof of the boiler house, but these would only operate during an emergency (or statutory testing) and hence are not normally in operation. For the proposed design, it is therefore considered that an impulsive noise character penalty is not required.

Intermittency

7.4.19 In terms of intermittency, the plant would normally operate continuously during daytime and night-time. Any HGV movements around the site roads would typically

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occur during the daytime and would not be readily distinctive at NSRs due to the relative separation distance and proximity of the A453 dual carriageway.

7.4.20 In conclusion, with the proposed noise mitigation strategy and controls of specific plant selection and design, it is considered that no character penalty is required.

Operational Noise

7.4.21 Noise predictions arising from operational activities at the Site have been undertaken based on the inherent noise control measures outlined at Paragraph 7.4.1 and detailed in **Appendix 7-6**. Separate assessments are made for daytime and night-time periods and for Baseline 1 (current) and Baseline 2 (future). Details of the estimation of Power Station's current contribution are provided in **Appendix 7-4** and noise contour maps for the Proposed Development are given in **Appendix 7-7**.

Daytime Operations – Baseline 1 (Current Baseline)

7.4.22 Table 7.15 provides information on the predicted noise levels during daytime operations at the Proposed Development and compares this with the baseline sound levels at the NSRs. The daytime assessment period is taken as 06:00–18:00 to align with the HGV waste fuel deliveries and ash removals movements.

Table 7.15: Predicted Noise Contribution during Day-time Operations (with Incorporated Noise Mitigation)

Receptor	Predicted Rating[1] Noise Level $L_{A,r}$ dB	Assessment Baseline Sound Level[2]		Difference between Rating Level $L_{A,r}$ and Background L_{A90} dB	Noise Change in L_{Aeq} dB
		L_{A90} dB	L_{Aeq} dB		
1 Redhill Marina	31.2	46	51.0	-15	0.0
2 Redhill Farm	31.3	46	51.0	-15	0.0
3 Middle Gate Cottage	29.0	47	49.9	-18	0.0
4 Thrumpton	33.2	39	44.5	-6	0.3
5 Winking Hill Farm	37.9	56	59.5	-18	0.0
6 Ratcliffe on Soar Village	29.9	56	58.8	-26	0.0

Note 1: Noise characteristics at receptor locations do not include a penalty. This would be controlled by design.
Note 2: Baseline 1 (Current) Levels are L_{Aeq} and L_{A90} values from survey results excluding periods of high winds, precipitation and on-load operation of the Power Station.

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7.4.23 The last column in Table 7.15 shows the difference between the predicted rating noise level and the baseline sound level at the NSRs location in accordance with the methodology detailed within BS 4142: 2014+A1:2019.

7.4.24 An assessment using BS4142: 2014+A1:2019 would indicate that the impact would be low as the rating level is significantly less than the background L_{A90} level.

7.4.25 According to the magnitude scale in Table 7.6, this is a negligible impact and a neutral level of effect significance (as defined in Table 7.11).

Night-time Operations Baseline 1 (Current Baseline)

7.4.26 Table 7.16 provides information on the predicted noise levels during night-time (taken to be 23:00–06:00 to align with daytime operational deliveries typically occurring between 06:00 and 18:00).

Table 7.16: Predicted Noise Contribution during Night-time Operations (with Incorporated Noise Mitigation)

Receptor	Predicted Rating Noise Level[1] $L_{A,r}$ dB	Assessment Baseline Sound Level[2]		Difference between Rating Level $L_{A,r}$ and Background L_{A90} dB	Noise Change in L_{Aeq} dB
		L_{A90} dB	L_{Aeq} dB		
1 Redhill Marina	30.7	45	47	-14	0.1
2 Redhill Farm	31.0	45	47	-14	0.1
3 Middle Gate Cottage	28.9	46	48	-17	0.1
4 Thrumpton	32.9	37	41	-4	0.6
5 Winking Hill Farm	35.6	41	52	-5	0.1
6 Ratcliffe on Soar	29.2	44	50	-15	0.0

Note 1: Noise characteristics at receptor locations do not include a penalty. This would be controlled by design.
Note 2: Baseline 1 (Current) Levels are L_{Aeq} and L_{A90} values from survey results excluding periods of high winds, precipitation and on-load operation of the Power Station.

7.4.27 An assessment using BS4142: 2014+A1:2019 would indicate that the impact would be low as the rating level is significantly less than the background L_{A90} level.

7.4.28 According to magnitude scale in Table 7.6, this is a negligible impact and a neutral level of effect significance (as defined in Table 7.11).

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Daytime Operations – Baseline 2 (Future Baseline)

7.4.29 Table 7.17 provides information on the predicted noise levels during daytime operations at the Proposed Development and compares this with the future baseline sound levels at the NSRs. The daytime assessment period is taken to be 06:00–18:00 to align with the HGV waste fuel deliveries and ash removal movements.

7.4.30 It is suggested that the following subjective changes in background noise level are likely to arise once the Power Station is decommissioned and when the level mainly depends upon traffic noise:

- 1 Redhill Marina and 2 Redhill Farm – Due to its proximity to the Power Station site, a reduction in baseline noise level is anticipated under the Baseline 2 (Future) scenario. However, during the circumstances that prevailed during the attended survey on 15–16 March 2020, distant road traffic noise predominated and noise from the Power Station was not discernible at the monitoring position;
- 3 Middle Gate Cottage – Due to its proximity to continuously operating cooling towers, a reduction in baseline noise level is anticipated at this position;
- 4 Thrumpton – A general industrial noise from the direction of the Power Station was discernible during both the attended measurement surveys and overnight and was the main source of steady noise. It is anticipated that under the future baseline scenario the background noise level will be lower than currently occurs;
- 5 Winking Hill Farm – During both of the attended measurement surveys, noise from the Power Station was discernible during lulls in the traffic flow. It is anticipated that under the future baseline scenario the background noise level will be lower than currently occurs; and
- 6 Ratcliffe on Soar Village – No significant decrease in baseline noise level is anticipated at this position due to the proximity to the M1 and A453 and its relative separation from the operational parts of the Power Station site.

7.4.31 Removing the majority of Power Station buildings will mean that there are fewer structures to act as barriers to noise propagation from the Proposed Development. The specific noise level at the affected receptors will therefore increase relative to the current baseline (see **Appendix 7-4** for further details).

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Table 7.17: Predicted Noise Contribution during Day-time Operations (with Incorporated Noise Mitigation)

Receptors	Predicted Rating[1] Noise Level $L_{A,r}$ dB	Assessment Baseline Sound Level[2]		Difference between Rating Level $L_{A,r}$ and Background L_{A90} dB	Noise Change in L_{Aeq} dB
		L_{A90} dB	L_{Aeq} dB		
1 Redhill Marina	31.7	44	50.4	-12	0.1
2 Redhill Farm	33.6	44	50.4	-10	0.1
3 Middle Gate Cottage	33.3	44	50.4	-11	0.1
4 Thrumpton	33.2	37	44.0	-4	0.3
5 Winking Hill Farm	37.9	56	59.5	-18	0.0
6 Ratcliffe on Soar	30.3	56	58.8	-26	0.0

Note 1: Noise characteristics at receptor locations do not include a penalty. This would be controlled by design.
Note 2: Baseline 2 (Future) Levels are L_{Aeq} and L_{A90} values derived by subtraction of estimated steady noise contributions due to the off-load operation of the Power Station.

7.4.32 The last column in Table 7.17 shows the difference between the predicted rating noise level and the baseline sound level at the NSRs location in accordance with the methodology detailed within BS 4142: 2014.

7.4.33 An assessment using BS4142: 2014+A1:2019 would indicate that the impact would be low as the rating level is significantly less than the background L_{A90} level.

7.4.34 According to magnitude scale in Table 7.6, this is a negligible impact and a neutral level of effect significance (as defined in Table 7.11).

Night-time Operations Future Baseline

7.4.35 Table 7.18 provides information on the predicted noise levels during night-time (taken to be 23:00–06:00 to align with daytime operational deliveries typically occurring between 06:00 and 18:00).

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Table 7.18: Predicted Noise Contribution during Night-time Operations (with Incorporated Noise Mitigation)

Nearest Sensitive Receptors	Predicted Rating Noise Level[1] $L_{A,r}$ dB	Assessment Baseline Sound Level[2]		Difference between Rating Level $L_{A,r}$ and Background L_{A90} dB	Noise Change in L_{Aeq} dB
		L_{A90} dB	L_{Aeq} dB		
1 Redhill Marina	30.9	42	45	-11	0.2
2 Redhill Farm	32.6	42	45	-9	0.2
3 Middle Gate Cottage	32.3	42	45	-10	0.2
4 Thrumpton	32.9	33	40	0	0.8
5 Winking Hill Farm	35.6	38	52	-2	0.1
6 Ratcliffe on Soar	29.7	44	50	-15	0.0

Note 1: Noise characteristics at receptor locations do not include a penalty. This would be controlled by design.
Note 2: Baseline 2 (Future) Levels are L_{Aeq} and L_{A90} values derived by subtraction of estimated steady noise contributions due to the off-load operation of the Power Station.

7.4.36 An assessment using BS4142: 2014+A1:2019 would indicate that the impact would be low as the rating level is significantly less than the background L_{A90} level.

7.4.37 According to magnitude scale in Table 7.6, this is a negligible impact and a neutral level of effect significance (as defined in Table 7.11).

Ecological Receptors

7.4.38 An assessment of the impact and significance of operational noise on the Thrumpton LWS is provided in Chapter 6.0 Ecology and Nature Conservation. Noise levels are predicted to be below any thresholds of effect of regular / steady noise on breeding birds. It is concluded that there would be no effect on breeding birds from operational noise arising from the Proposed Development.

Operational Road Traffic Noise Weekday Flows

7.4.39 An assessment of the noise effects from the weekday traffic flows from the Proposed Development has been undertaken. The assessment uses traffic generation figures detailed in the TA (provided as a standalone document in support of the planning application) and predicts changes in noise levels arising from the additional road traffic using the CRTN methodology.

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7.4.40 The TA outlines the levels of staff and HGV traffic that could arise during operation of the Proposed Development. These estimates indicate that there will be 310 HGV movements per day (i.e. 155 in and 155 out) and 100 staff movements (car / van) during typical weekday periods. Deliveries to the Site would be reduced on a Saturday to approximately 48 HGV movements (24 in and 24 out).

Weekday Period

7.4.41 Table 7.19 and Table 7.20 provide details of predicted average weekday impacts arising from vehicles travelling to and from site during the operational phase of the Proposed Development. The TA shows that all HGV vehicles accessing the site will use the A453 dual carriage way to access the unnamed public road that leads to the site entrance.

7.4.42 As there are no residential properties within 400 m of the short section of public road that leads to the site entrance, it is considered that any increase in noise from this short section will be insignificant in the context of the surrounding road network. Due to the relative remoteness of the residential receptors from the roads used by the construction traffic, it is appropriate to consider the change in L_{A10} level from the A453 that will arise as a result of the additional movement.

7.4.43 As the propagation conditions remain unchanged, any change in L_{A10} level will arise solely from the increased traffic flows and percentage of HGVs. [Note: Noise from HGV movements associated with the waste fuel delivery and IBA removal whilst within the boundary of the Proposed Development are considered within the operational noise impact section (see **Appendix 7-6**)]

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Table 7.19: Transport Noise 2025 Operation (Baseline 1) – Increase in $L_{A10,14h}$ due to extra vehicles (weekdays 06:00–20:00)

Case		A453 East of site access	A453 West of site access
2025 Baseline+ Committed Development, AAWT14	Total vehicles	33,754	37,505
	HGV	3,289	3,617
	% HGV	9.7 %	9.6 %
Proposed Development Construction Vehicles AAWT14	Total vehicles	99	294
	HGV	58	252
	% HGV	59 %	86 %
2025 Baseline+ Committed Development +Construction	Total vehicles	33,853	37,799
	HGV	3,347	3,869
	% HGV	9.9 %	10.2 %
% increase in vehicles due to Proposed Development	Total Vehicles	0 %	1 %
	HGVs	2 %	7 %
$L_{A10,14h}$ Change		**0.0**	**0.1**

Change in L_{A10} arising from additional movements on A453 formula (CRTN 42.2)

$$\Delta L_F = 10\,\mathrm{Log}_{10}(Q'/Q) + 33\,\mathrm{Log}_{10}\left[\frac{V' + 40 + \frac{500}{V'}}{V + 40 + \frac{500}{V}}\right] + 10\,\mathrm{Log}_{10}\left[\frac{1 + \frac{5p'}{V'}}{1 + \frac{5p}{V}}\right]$$

Q is flow, V is speed and p is HGV percentage for 2023 baseline.
Q' is flow, V' is speed and p' is HGV percentage for 2023 baseline including Proposed Development construction vehicles.
V' and V assumed to be 97 km/h.

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Table 7.20: Transport Noise 2030 Operation (Baseline 2) – Increase in $L_{A10,14h}$ due to HGV and Car vehicles (weekdays 06:00–20:00)

Case		A453 east of site access	A453 west of site access
2030 Baseline+ Committed Development, AAWT13	Total vehicles	34,800	38,687
	HGV	3,400	3,740
	% HGV	9.8 %	9.7 %
Proposed Development Construction Vehicles AAWT13	Total vehicles	99	294
	HGV	58	252
	% HGV	59 %	86 %
2030 Baseline+ Committed Development +Construction	Total vehicles	34,899	38,981
	HGV	3,458	3,992
	% HGV	9.9 %	10.2 %
% increase in vehicles due to Proposed Development	Total Vehicles	0 %	1 %
	HGVs	2 %	7 %
$L_{A10,14h}$ Change		**0.0**	**0.1**

Change in L_{A10} arising from additional movements on A453 formula (CRTN 42.2)

$$\Delta L_F = 10\,\mathrm{Log}_{10}(Q'/Q) + 33\,\mathrm{Log}_{10}\left[\frac{V' + 40 + \frac{500}{V'}}{V + 40 + \frac{500}{V}}\right] + 10\,\mathrm{Log}_{10}\left[\frac{1 + \frac{5p'}{V'}}{1 + \frac{5p}{V}}\right]$$

Q is flow, V is speed and p is HGV percentage for 2023 baseline.
Q' is flow, V' is speed and p' is HGV percentage for 2023 baseline including Proposed Development construction vehicles.
V' and V assumed to be 97 km/h.

7.4.44 Table 7.19 for the 2025 Baseline 1 scenario shows negligible magnitude and neutral effect level of significance, based on the receptors being high sensitivity.

7.4.45 Table 7.20 for the 2030 Baseline 2 scenario negligible impact magnitude and neutral effect of significance, based on the receptors being high sensitivity.

7.4.46 For both Baseline 1 and 2 scenario increases in noise from operational traffic is considered to not be significant in EIA terms.

Saturday Period

7.4.47 Around 97 % of the fuel deliveries to site are expected to occur during weekday (Monday to Friday 06:00–18:00). The number of HGV movements to the site on Saturday will be considerably lower than on weekdays. It is estimated there would be in the region of 48 HGV movements to the Site (24 in, 24 out), which equates to approximately 14 % of assumed weekday flows.

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7.4.48 As weekend traffic on the A453 remains at approximately 67 % of weekday flows, the substantial reduction in HGV movements means that the noise impact from them is less than occurs during weekdays and not significant in EIA terms.

Rail Delivery of Waste

7.4.49 Chapter 4.0 Scheme Description of this ES provides details of future option of utilising the existing rail infrastructure on the Power Station site for fuel (waste) delivery to the Site. Instead of fuel arriving by HGVs, containers of compacted waste would arrive at the Power Station site by rail. The containers would be removed from the train by lift trucks and then transferred to the Proposed Development by slave flat-bed units for handling within the enclosed waste tipping hall.

7.4.50 In the past, when the Power Station had a higher generation profile, all available rail delivery slots were utilised for coal deliveries (up to 79 train deliveries over a week). In the event that rail delivery of fuel was utilised as a future alternative to the HGV road deliveries for the Proposed Development, it is estimated that 3–4 rail deliveries per day would be required (15–20 per week over the anticipated weekday daytime period).

7.4.51 A detailed assessment of the noise arising from the change of fuel handling activity on the Power Station site has not been undertaken. On account of the significant reduction in train deliveries required to transport fuel to the Proposed Development, it is to be expected that repurposing the rail unloading area at the Power Station would result in a decrease in overall noise relative to the previous fuel handling activities.

7.4.52 For the default scenario of waste being delivered to the Proposed Development by road, it is assumed within the noise model that there would be two HGVs present on the Site roads at all times during the day. In the event that fuel was being brought onto the Site from the rail unloading facility, the number of vehicle movements around the Site roads is unlikely to change significantly from that currently assumed in the noise model. Therefore, in the event that waste was to arrive via rail, the predicted noise level arising from daytime operation activities at the Site is unlikely to differ significantly from that predicted for road HGV delivery.

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7.5 Cumulative Effects

High-Speed Rail Phase 2b (HS2b)

7.5.1 The proposed High-Speed Rail Phase 2b (HS2b) is identified as a future development in the area that requires consideration for cumulative effects. Noise information for HS2b has been taken from High Speed Rail (Crewe to Manchester and West Midlands to Leeds) Working Draft Environmental Statement for the West Midlands LA05. The planned HS2b route passes to the west of Power Station and through a new tunnel in the Redhill area.

7.5.2 The HS2b assessment states: *"potential for noise effects that are considered significant on a community basis in areas between the 50 dB and 65 dB daytime noise contours, or 40 dB and 55 dB night-time contours, is dependent on the baseline in that area and the change in level brought about by the Proposed Scheme."* Maps SV-01-365 and SV-01-366 of the LA05 Map book [13] show rail noise L_{Aeq} contours for day (07:00–23:00) and night-time periods (23:00–07:00). Observations regarding the potential noise impact arising from future HS2b trains at the six human NSR and Thrumpton LWS areas considered for the Proposed Development are as follows:

- 1 Redhill Marina and 2 Redhill Farm areas – lie within the predicted 45–50 dB L_{Aeq} night and 55–60 dB L_{Aeq} day L_{Aeq} zones;
- 3 Middle Gate Cottage – due to its proximity to the proposed HS2b route, this property is close to the 65 dB Day and 55 dB Night L_{Aeq} contour lines and identified for consideration for noise insulation due to having a likely significant noise effect;
- 4 Thrumpton – the overwhelming majority of the village falls outside the HS2b airborne noise study area and considerably beyond the 50 dB day and 40 dB L_{Aeq} contour where the HS2b assessment identifies that generally no adverse effect is expected;
- 5 Winking Hill Farm – this dwelling lies outside the HS2b airborne noise study area and considerably beyond the 50 dB day and 40 dB night L_{Aeq} contour where the HS2b assessment identifies that generally no adverse effect is expected; and

[13] *High Speed Rail (Crewe to Manchester and West Midlands to Leeds) Working Draft Environmental Statement for the West Midlands LA05 (and Map Book), October 2018.*

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- 6 Ratcliffe on Soar Village – the residences are outside the 50 dB L_{Aeq} day and 40 dB L_{Aeq} night contour, the level at which the HS2b assessment identifies that generally no adverse effect is expected.
- Thrumpton LWS – according to the HS2b Draft Environmental Statement: *"Habitat losses would be a permanent adverse effect on the integrity of the Thrumpton Park LWS that would be significant at the county/metropolitan level."* The remainder of the LWS would be subject to noise from the HS2b train movements and the estimated 50 dB L_{Aeq} daytime contour extends approximately 400 m each side of the tunnel. The noise contours from the operation of the Proposed Development (**Appendix 7.8**) indicate L_{Aeq} levels of approximately 40 dB in this area of the LWS. As this is 10 dB below the specific noise level estimate for HS2b no cumulative impacts from the simultaneous operation of the Proposed Development are anticipated.

7.5.3 No quantitative noise assessment has been undertaken for the construction of HS2b. Three construction compounds are proposed: the River Soar main compound to the north of East Midlands Parkway; Redhill compound to the west of the Proposed Development; and Long Eaton Satellite compound to the north-west of the Proposed Development, on the north side of the River Trent. These compounds and associated construction activities are not due to become active until 2025 Q3. As this is after the planned completion of the Proposed Development, no cumulative effects associated with construction noise are anticipated.

7.5.4 The current timetable for the two projects means that cumulative effects of operational noise from the Proposed Development and HS2b construction/operation are feasible. Table 7.21 shows the cumulative L_{Aeq} arising from the Proposed Development operating concurrently with HS2b.

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Table 7.21: Cumulative impact of proposed development and HS2b

	Committed Development (HS2b) L_{Aeq} dB		Proposed Development (Baseline 2/Future) L_{Aeq} dB		Committed HS2b + Proposed Development L_{Aeq} dB		Increase due to HS2b + Proposed Development L_{Aeq} dB	
Position	**Daytime**	**Night-time**	**Daytime**	**Night-time**	**Daytime**	**Night-time**	**Daytime**	**Night-time**
1 Redhill Marina	55	45	31.7	30.9	55.0	45.2	0.0	0.2
2 Redhill Farm	55	45	33.6	32.6	55.0	45.2	0.0	0.2
3 Middle Gate Cottage	60	50	33.3	32.3	60.0	50.1	0.0	0.1
4 Thrumpton	47	37	33.2	32.9	47.2	38.4	0.2	1.4
5 Winking Hill Farm	No HS2b data available as outside HS2b study zone							
6 Ratcliffe on Soar	45	35	30.3	29.7	45.1	36.1	0.1	1.1

7.5.5 Table 7.21 shows that HS2b dominates the overall L_{Aeq} noise level. The Proposed Development shows a resultant increase in cumulative noise levels in the range 0.0 dB to +0.2 dB during daytime and in the range +0.1 dB to +1.4 dB during night-time across the six NSRs – considered to be negligible impacts (see Table 7.7). Based on an assumed high sensitivity of the receptors these magnitudes are assessed as being neutral during the daytime and night-time (see Table 7.11).

7.5.6 Overall, the cumulative impact associated with the Proposed Development being operational alongside HS2b is considered to not be significant in EIA terms.

7.6 Mitigation

Construction Noise

7.6.1 In accordance with BS5228, best practical means would be employed to control the noise generation (e.g. using equipment that is regularly maintained, where practicable use equipment fitted with silencers or acoustic hoods). The Construction Environmental Management Plan (CEMP) would stipulate the use of best practice measures to mitigate and minimise construction noise levels. This would include:

- Restriction of construction hours;
- Careful choice of piling rigs to minimise noise;
- Avoiding unnecessary plant operation and revving of plant or vehicles;

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- Locating plant away from nearest sensitive receptors or in locations that provide good screening in the direction of sensitive receptors;
- Use of broadband noise reverse alarms (where practicable) on mobile plant;
- Careful handling of materials used in construction processes to avoid unnecessary noise;
- Use of appropriate noise silencing / noise reducing equipment for noisy elements of plant; and
- Ensuring plant and machinery are serviced and well maintained.

Operation Road Traffic Noise

7.6.2 The increase road traffic noise arising from the operation of the Proposed Development would be negligible and have neutral effect and hence is not significant; therefore, no additional mitigation measures are considered necessary.

Operational Noise

7.6.3 The incorporated mitigation measures described previously in Paragraph 7.4.1 adequately address the need to further avoid, reduce and compensate for the potential operational noise effects of the Proposed Development for Baselines 1 (Current) and 2 (Future). No additional mitigation is considered necessary.

7.6.4 The plant noise emission limits, building construction and general noise control measures and techniques suggested in **Appendix 7-6** may be subject to change during the detailed design phase of the plant. Overall, the final adopted noise control measures will be consistent with the application BAT and will achieve the same noise criteria during daytime and night-time periods.

7.7 Residual Effects and Conclusions

Construction Phase

7.7.1 During the construction period, there would be a variety of noise sources in use at different stages and their associated activities would vary from day to day. The highest noise levels relative to nearest receptors are likely to occur during piling and infrastructure activities. The peak noise activities do not normally occur over long

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periods of time and best practical means would be employed to control the noise being generated. It is concluded that the increase in construction noise with the implementation of mitigation measures, using best practice, is likely to result in an impact magnitude classification of negligible at receptors and a neutral level of effect. This would not be significant in EIA terms.

7.7.2 The change in road traffic noise would be negligible and have neutral effect and hence is not significant; therefore, no additional mitigation measures are considered necessary.

Operational Phase

7.7.3 The noise associated with the Proposed Development would be negligible and neutral effect and hence is not significant; therefore, no additional mitigation measures are considered necessary. An assessment using BS4142: 2014+A1:2019 would indicate that the impact of operation of the Proposed Development would have a low impact under both Baseline 1 (Current) and 2 (Future) Scenarios.

7.7.4 The increase road traffic noise arising from the operation of the Proposed Development would be negligible and have a neutral effect and hence is not significant.

Cumulative Impacts

7.7.5 The assessment of the cumulative impact arising from the operation of the Proposed Development occurring concurrently with construction / operation of the proposed HS2b rail line indicates a neutral effect and hence no additional mitigation is considered necessary.

Residual Impact Summary

7.7.6 In summary, no significant noise effects have been identified by the assessment in relation to construction or operation of the Proposed Development. Table 7.22 summarises the predicted noise effects during construction and operation of the Proposed Development.

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Table 7.22: Residual Impact at Nearest Residential NSRs

Source	Nature of Effect	Time Period	Impact Magnitude	Level of Significance
Construction noise	Temporary	Daytime	Negligible	Neutral
Road traffic noise (construction)	Temporary	Daytime Night-time	Negligible Negligible	Neutral Neutral
Road traffic noise (operation)	Permanent	Daytime weekday Daytime weekend	Negligible Negligible	Neutral Neutral
Industrial noise (Site operation) (Baseline 1)	Temporary	Daytime Night-time	Negligible Negligible	Neutral Neutral
Industrial noise (Site operation) (Baseline 2)	Permanent	Daytime Night-time	Negligible Negligible	Neutral Neutral

Conclusions

7.7.7 Noise levels have been considered and assessed during the construction and operational phases of the Proposed Development. Relevant and appropriate noise guidance and standards have been used to determine the impact. The assessment has been undertaken to inform and guide the initial design of the Proposed Development, such that any likely noise impact on existing and potential NSRs is minimised.

7.7.8 To establish a robust basis for the assessment, baseline sound levels have been monitored near the NSRs for the Proposed Development using a combination of fixed continuous and attended measurements. The continuous monitoring extended over several days to allow representative background sound levels to be established.

7.7.9 The assessment methodology follows the approach proposed in the Scoping Report and incorporates additional measurements and modelling in response to the NCC Scoping Opinion.

7.7.10 In accordance with appropriate standards, best practical means would be employed to control noise generation during the construction period. Measures will include restricting hours when noisy activities can occur and suitable selection of piling rigs to minimise noise. Appropriate construction plant and techniques would be defined within the CEMP.

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7.7.11 For the operational phase, initial noise control measures for the plant and building have formed the basis of the noise predictions and subsequent assessment of impact and significance. Future detailed design of the plant will be undertaken on the basis of optimally achieving rating levels for operation of the Proposed Development which are less than or equal to current or estimated future daytime and night-time background levels.

7.7.12 In respect of any vibration impacts and effects, due to the extent of the separation distance between the Proposed Development and NSRs, any generated vibration during construction or operation would be imperceptible; therefore, no significant impacts or effects would occur.

7.7.13 The assessment shows that there would be no significant noise impacts during the construction and operation of the Proposed Development by implementing the proposed mitigation.

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CHAPTER 8.0 AIR QUALITY AND HUMAN HEALTH

FIGURES (Volume 2 bound separately)

APPENDICES (Volume 3 bound separately)

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8.0 AIR QUALITY AND HUMAN HEALTH

8.1 Introduction

8.1.1 This Chapter considers the potential impacts of the Proposed Development on local air quality, odour and plume visibility. The assessment includes the potential impacts on human health arising through exposure via inhalation and, for the relevant species, ingestion together with impacts on local ecological sites. The main focus of the Chapter is the emissions from the flue stacks associated with the Proposed Development. However, impacts from vehicle emissions and fugitive dust during the construction phase and vehicle emissions and fugitive emissions of dust and odour during the operational phase have also been assessed.

8.1.2 This Chapter is supported by an Air Quality Assessment (**Appendix 8-1**), which provides technical details of the dispersion modelling of process emissions undertaken and a detailed analysis of the existing air quality in the area. The results of the dispersion modelling are presented in this Chapter and an assessment of the significance of the effect made. In addition, a Human Health Risk Assessment is contained within **Appendix 8-2** which has been undertaken based on the results of the dispersion model to assess the impact of persistent pollutants released from the Proposed Development. A Plume Visibility Assessment has also been undertaken and is detailed in **Appendix 8-3** and summarised in this Chapter. **Appendix 8-4** includes the results of the carbon assessment (summarised in this Chapter) and sets out the road map to reducing CO_2 emissions from the Proposed Development to net zero by 2050 (summarised in Chapter 4.0). Finally, **Appendix 8-5** provides technical details relevant to the Vehicle Emissions Dispersion Modelling.

8.1.3 Where data is available, cumulative impacts from existing sources of pollution in the area have been accounted for in the adoption of site-specific background pollutant concentrations from air quality monitoring networks in the vicinity of the Proposed Development. Additional modelling, including the cumulative impact of the Proposed Development with operation of the open cycle gas turbines (hereinafter the OCGTs) and / or the coal-fired Ratcliffe-on-Soar Power Station (hereinafter the Power Station), has been included in the assessment. These modelling assessments will include some double accounting for emissions from the OCGTs and the Power Station as the impact of the two existing installations on ground level concentrations will be included in the local monitoring data.

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Competence

8.1.4 This Chapter has been written by two environmental specialists from Uniper Technologies Ltd. One is a chartered physicist and a member of the Institute of Physics. She has produced air quality assessments for a wide range of developments and has over 15 years of experience of environmental assessment in the power sector. The other is the Technical Head for Environmental Sciences and Climate Change at Uniper Technologies. He has over 20 years of experience in environmental compliance, specialising in impacts on air quality, habitats and human health. He has worked on a wide range of planning applications and Environmental Permit (EP) applications for power generation facilities including gas, coal, oil, carbon capture and storage, biomass and energy from waste plants.

8.2 Methodology and Scope of Assessment

Legislation and Guidance

Ambient Air Quality

8.2.1 European air quality legislation is consolidated under the Ambient Air Quality Directive (Directive 2008/50/EC) [1], which came into force on 11 June 2008. This Directive consolidates previous legislation which was designed to deal with specific pollutants in a consistent manner and provides Ambient Air Directive (AAD) Limit Values for sulphur dioxide, nitrogen dioxide, benzene, carbon monoxide, lead and particulate matter with a diameter of less than 10 µm (PM_{10}) and a new AAD Target Value and Limit Value for fine particulates (those with a diameter of less than 2.5 µm ($PM_{2.5}$).

8.2.2 The fourth daughter Directive – 2004/107/EC [2] – was not included within the consolidation. It sets health-based Target Values for polycyclic aromatic hydrocarbons (PAHs), cadmium, arsenic, nickel and mercury, for which there is a requirement to reduce exposure to as low as reasonably achievable. Directives 2008/50/EC and 2004/107/EC are transposed into UK law into the Air Quality Standards Regulations, 2010 [3] and subsequent amendments.

[1] *Council of European Communities. (2008). Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe.*
[2] *Council of European Communities. (2004). Fourth Daughter Directive on Measures, 2004/107/EC.*
[3] HMSO. (2010). The Air Quality Standards Regulations 2010, UK Statutory Instruments 2010 No. 1001 http://www.legislation.gov.uk/uksi/2010/1001/contents/made

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8.2.3 The UK Government and the devolved administrations are required under the Environment Act 1995 [4] to produce a national air quality strategy. This was last reviewed and published in 2007.[5] The Air Quality Strategy (AQS) sets out the UK's air quality objectives and recognises that action at national, regional and local level may be needed, depending on the scale and nature of the air quality problem. This includes additional targets and limits for 15-minute sulphur dioxide and 1,3-butadiene and more stringent requirements for benzene and PAHs, known as AQS Objectives.

8.2.4 Environmental Assessment Levels (EALs) for other pollutants are presented on the gov.uk website as part of the Environment Agency's (EA) guidance on air emissions risk assessment for environmental permits [6] which was last updated on 2 August 2016 (AER Guidance 2016). AAD Target and Limit Values, AQS Objectives, and EALs are set at levels well below those at which significant adverse health effects have been observed in the general population and sensitive groups. For the remainder of this assessment these are collectively referred to as Air Quality Assessment Levels (AQALs).

8.2.5 Local Air Quality Management Technical Guidance, 2016 [7], referred to as LAQM.TG(16), outlines that the AQALs apply in the following locations:

- Annual mean – all locations where members of the public might be regularly exposed – i.e. building facades of residential properties, schools, hospitals, care homes, etc;
- 24-hour mean and 8-hour mean – all locations where the annual mean objective would apply together with hotels and gardens of residential properties;
- 1-hour mean – all locations where the annual mean, 24-hour and 8-hour mean apply together with kerbside sites and any areas where members of the public might be reasonably expected to spend one hour or more; and
- 15-minute mean – all locations where members of the public might reasonably be exposed for a period of 15 minutes or more.

8.2.6 Table 8.1 and Table 8.2 show the AQALs used in this assessment. There are no AQALs for thallium or cobalt; therefore, these pollutants have not been considered further in this assessment. There are also no AQALs for dioxins and furans and

[4] HMSO. (1995). Environment Act 1995. http://www.legislation.gov.uk/ukpga/1995/25/contents
[5] DEFRA and the Devolved Administrations. (2007). The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. Cm 7169 NIA 61/06-07
[6] Environment Agency. (2016a). Air Emissions Risk Assessment for your Environmental Permit, Updated 2 August 2016 https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit
[7] DEFRA. (2016). Local Air Quality Management Technical Guidance, LAQM.TG(16)

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hence they are not considered further in relation to air quality; however, these pollutants are considered in the Human Health Risk Assessment due to their potential to accumulate in the environment.

Table 8.1: Air Quality Assessment Levels

Pollutant	AQAL ($\mu g/m^3$)	Averaging Period	Frequency of exceedance	Source
Nitrogen dioxide	200	1 hour	18 times per year (99.79th percentile)	AAD Limit Value
	40	Annual	-	AAD Limit Value
Sulphur dioxide	266	15 minutes	35 times per year (99.9th percentile)	AQS Objective
	350	1 hour	24 times per year (99.73rd percentile)	AAD Limit Value
	125	24 hours	3 times per year (99.18th percentile)	AAD Limit Value
	50	Annual	-	WHO guideline
Carbon monoxide	30,000	1 hour	-	EA (2016)
	10,000	8 hour rolling	-	AAD Limit Value
Particulate matter (PM_{10})	50	24 hours	35 times per year (90.41st percentile)	AAD Limit Value
	40	Annual	-	AAD Limit Value
Particulate matter ($PM_{2.5}$)	25	Annual	-	AAD Limit Value
Hydrogen chloride	750	1 hour	-	EA (2016)
Hydrogen fluoride	160	1 hour	-	EA (2016)
	16	Annual	-	EA (2016)
Ammonia	2,500	1 hour	-	EA (2016)
	180	Annual	-	EA (2016)
Benzene	195	1 hour	-	EA (2016)
	5	Annual	-	AQS Objective
1,3-butadiene	2.25	Annual rolling	-	AQS Objective
PAHs – benzo[a]pyrene	0.00025	Annual	-	AQS Objective
PCBs	6	1 hour	-	EA (2016)
	0.2	Annual	-	EA (2016)

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Table 8.2: Air Quality Assessment Levels for Metals

Pollutant	AQAL ($\mu g/m^3$)	Averaging Period	Frequency of exceedance	Source
Cadmium	0.005	Annual	-	EA (2016)
Thallium	-	-	-	No objective
Mercury	7.5	1 hour	-	EA (2016)
	0.25	Annual	-	EA (2016)
Antimony	150	1 hour	-	EA (2016)
	5	Annual	-	EA (2016)
Arsenic	0.003	Annual	-	EA (2016)
Chromium (II & III)	150	1 hour	-	EA (2016)
	5	Annual	-	EA (2016)
Chromium (VI)	0.0002	Annual	-	EA (2016)
Cobalt	-	-	-	No objective
Copper	200	1 hour	-	EA (2016)
	10	Annual	-	EA (2016)
Lead	0.25	Annual	-	EA (2016)
Manganese	1,500	1 hour	-	EA (2016)
	0.15	Annual	-	EA (2016)
Nickel	0.02	Annual	-	EA (2016)
Vanadium	1	1 hour	-	EA (2016)
	5	Annual	-	EA (2016)

8.2.7 Critical Levels for the protection of sensitive ecosystems and habitats are also outlined within the Air Quality Standards Regulations for oxides of nitrogen and sulphur dioxide. Limits for ammonia and hydrogen fluoride are set out in the EA's AER Guidance 2016. The Critical Levels relevant to this project are presented in Table 8.3.

8.2.8 Critical Loads to assess the impacts of nitrogen and acid deposition were obtained from the Air Pollution Information System (APIS). The full details of the habitats specific critical loads can be found in **Appendix 8-1**.

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Table 8.3: Critical Levels for the Protection of Ecosystems

Pollutant	Critical Level (µg/m^3)	Averaging Period	Source
Ammonia	1 µg/m^3 where lichens or bryophytes (including mosses, landworts and hornwarts) are present	Annual	EA (2016)
	3 µg/m^3 where lichens or bryophytes are not present	Annual	EA (2016)
Sulphur Dioxide	10 µg/m^3 where lichens or bryophytes are present	Annual	AAD
	20 µg/m^3 where lichens or bryophytes are not present	Annual	EA (2016)
Nitrogen Oxides (as nitrogen dioxide)	30	Annual	AAD
	75	Daily	EA (2016)
Hydrogen Fluoride	5	Daily	EA (2016)
	0.5	Weekly	EA (2016)

Industrial Pollution Regulation

8.2.9 Atmospheric emissions from industrial processes are controlled in the UK through the Environmental Permitting (England and Wales) Regulations 2010 and subsequent amendments.[8] The Proposed Development will be regulated by the EA and hence will need an EP to operate. The EP will include conditions to prevent fugitive emissions of dust and odour beyond the boundary of the installation. The EP will also include limits on emissions to air.

8.2.10 The Industrial Emissions Directive (IED) (Directive 2010/75/EU) [9] was adopted on 7 January 2013. It is the key European Directive which covers almost all emissions regulation for industrial processes in the EU. Annex VI of the IED sets emission limit values (ELVs) which must be met by all waste incineration and co-incineration plants. These are set as daily and half hourly averages for emissions which require continuous monitoring and as sampling period averages for heavy metals. Within the IED, the requirements of the relevant sector Best Available Techniques Reference Document (BREF) become binding as Best Available Techniques (BAT) guidance, as follows:

- Article 13 of the IED requires that the European Commission develops BAT guidance documents (referred to as BREFs);

[8] HMSO. (2010). Environmental Permitting (England and Wales) Regulations 2016, http://www.legislation.gov.uk/uksi/2016/1154/contents/made
[9] European Commission. (2010). Industrial Emissions Directive. Directive 2010/75/EU

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- Article 15, paragraph 2 of the IED requires that Emission Limit Values (ELVs) are based on best available techniques, referred to as BAT; and
- Article 15, paragraph 3 of the IED requires that the competent authority shall set ELVs that ensure that, under normal operating conditions, emissions do not exceed the emission levels associated with BAT (i.e. the BAT conclusions will apply to the permitting of new plants immediately following publication).

8.2.11 The Waste Incineration BREF [10] was finalised by the European Integrated Pollution Prevention and Control (IPPC) Bureau in December 2019. This BREF introduces Best Available Techniques Associated Emission Levels (BAT AELs) which are more stringent than those currently set out in the IED. These are set as daily averages for emissions which require continuous monitoring and as sampling period averages for those that do not.

8.2.12 The Proposed Development will be designed to comply with the IED ELVs and BAT AELs set out in the Waste Incineration BREF for new plant, with the most stringent limit applying where these overlap. It should be noted that the BAT AELs are, in most cases, specified as a range of concentration values. Where this applies, the modelling has been based on the higher end of the range as a worst-case approach.

Local Air Quality Management

8.2.13 Under Section 82 of the Environment Act 1995 (Part IV), local authorities are required to periodically review and assess air quality within their area of jurisdiction, under the system of Local Air Quality Management (LAQM). This review and assessment of air quality involves assessing present and likely future ambient pollutant concentrations against AQALs. If it is predicted that levels at the facade of buildings where members of the public are regularly present (normally residential properties) are likely to be exceeded, then the local authority is required to declare an Air Quality Management Area (AQMA). For each AQMA, the local authority is required to produce an Air Quality Action Plan (AQAP), the objective of which is to reduce pollutant levels in pursuit of the relevant AQALs.

[10] *European Commission. (2019). Best Available Techniques (BAT) Reference Document for Waste Incineration: Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control).*

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Assessment Methodology

Construction Activities

8.2.14 There is the potential for dust to be released into the atmosphere as a result of construction and demolition phase activities. These fugitive dust emissions have been assessed on a qualitative basis in accordance with the methodology outlined within the 2014 Institute of Air Quality Management (IAQM) guidance document – 'Guidance on the assessment of dust from demolition and construction'.[11] This guidance sets out the methodology for assessing the air quality impacts of construction and demolition and identifies good practice for mitigating and managing air quality impacts. It is noted that the quantity of dust emitted would be directly related to the area of land being worked and the nature, magnitude and duration of construction activities.

8.2.15 The assessment methodology is based on the risk of a construction site giving rise to dust impacts and the sensitivity of the surrounding area. Activities are divided into four types to reflect their different potential impacts. These are:

- Demolition;
- Earthworks;
- Construction; and
- Trackout.

8.2.16 Trackout is a less well-known term. It is defined by IAQM as: *"The transport of dust and dirt from the construction / demolition site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network. This arises when lorries leave the construction / demolition site with dusty materials, which may then spill onto the road, and / or when lorries transfer dust and dirt onto the road having travelled over muddy ground on site."*

8.2.17 The assessment methodology considers three separate dust effects. These are:

- Annoyance due to dust soiling;
- Harm to ecological receptors; and
- The risk of health effects due to significant increase in exposure to PM_{10}.

[11] IAQM (2014) Guidance on the assessment of dust from demolition and construction, Version 1.1, Institute of Air Quality Management, February 2014.

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Vehicle Emissions

8.2.18 The EPUK (Environment Protection UK) & IAQM (Institute of Air Quality Management) guidance (EPUK & IAQM, 2017)[12] states that an air quality assessment is required where a development would cause a "*significant change*" in light duty vehicles (LDVs) or heavy goods vehicles (HGV). The indicative criteria to apply to an assessment are:

- A change in LDV flows of:
  - more than 100 Annual Average Daily Traffic (AADT) within or adjacent to an AQMA; or
  - more than 500 AADT elsewhere.
- A change in HGV flows of:
  - more than 25 AADT within or adjacent to an AQMA; or
  - more than 100 AADT elsewhere.

8.2.19 The IAQM guidance does not clearly state the level of assessment which is required. However, if the change in LDV and HGV flows does not exceed the above criteria, the Proposed Development is not expected to cause a significant change and the significance of effect is deemed to be negligible. Where the above criteria are exceeded, dispersion modelling has been undertaken using the ADMS-Roads 5 dispersion model, and the five most recent years for which weather data is available. The assessment has considered emissions of nitrogen dioxide, PM_{10} and $PM_{2.5}$ as these are the pollutants of greatest concern from vehicle emissions. The assessment of vehicle emissions during the operational phase has considered the impact of vehicle emissions in isolation and in-combination with process emissions.

8.2.20 Full details of the vehicle emissions dispersion modelling methodology and inputs can be found in **Appendix 8-5**. The model has been used to calculate concentrations of pollutants at identified sensitive receptor locations within 200 m of the affected roads.

Process Emissions

8.2.21 This assessment has been undertaken using the Atmospheric Dispersion Modelling System (ADMS) 5.2 dispersion model, and the five most recent years for which

[12] EPUK & IAQM. (2017). Land-Use Planning & Development Control: Planning for Air Quality, January 2017.

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weather data is available. Full details of the dispersion modelling methodology and inputs can be found in **Appendix 8-1**. The model has been used to predict the ground level concentration of pollutants on a long- and short-term basis across a grid of points. It has also been used to predict the concentration at nominated points to represent sensitive human receptors. Additionally, the model has been used to predict the maximum air concentration and acid and nitrogen deposition impacts at each local ecological sites.

8.2.22 It is noted that for some pollutants which accumulate in the environment, inhalation is only one of the potential exposure routes. Therefore, other exposure routes have been considered. A detailed Human Health Risk Assessment has been carried out using the Industrial Risk Assessment Program – Human Health (IRAP-h View – Version 5.1.0). The program, created by Lakes Environmental, is based on the United States Environment Protection Agency (USEPA) Human Health Risk Assessment Protocol. This Protocol is a development of the approach defined by Her Majesty's Inspectorate for Pollution in 1996, taking account of further research since that date. Full details of the modelling methodology and inputs can be found in **Appendix 8-2**.

Fugitive Dust and Odour

8.2.23 There is the potential for fugitive emissions of dust and odour to be released from the Proposed Development during the operational phase, especially during delivery, unloading and storing of materials. These have been assessed on a qualitative basis based on the potential for releases of dust and odour, the distance to nearest sensitive receptors, and the prevailing wind direction.

Assessment of Significance / Assessment Criteria

Construction Activities

8.2.24 The first stage of the assessment for the impact of fugitive emissions of dust during construction is to determine whether the impact can be screened out as 'negligible', or whether a more detailed assessment is required. The IAQM recommends that the developer will normally be required to undertake a detailed assessment where there is:

- A human receptor within 350 m of the boundary of the Site; or

- An ecological receptor within 50 m of the boundary of the Site; or
- A human or ecological receptor within 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the Site entrance(s).

8.2.25 If an impact cannot be screened out, the developer is to provide a clear description of the proposed demolition and construction activities, their location and duration, and any phasing of the development.

8.2.26 A human receptor, in this context, is any location where a person may experience the annoyance effects of airborne dust or dust soiling or suffer exposure to PM_{10} over a period of time relevant to the AQALs. These include:

- Residential dwellings;
- Schools;
- Hospitals;
- Care homes;
- Hotels;
- Gardens (where relevant public exposure is likely, i.e. excluding extremities of gardens or front gardens); and
- Sensitive commercial premises including vehicle showrooms, food manufacturers and electronics manufacturers.

8.2.27 Ecological receptors should include statutory and non-statutory designated sites.

8.2.28 If a detailed assessment is required, the second stage is to assess the risk of dust effects arising. A site is allocated to a risk category based on two factors: dust emission magnitude; and the sensitivity of the area. These factors are combined to give the risk of dust impact. The IAQM guidance on the assessment of dust from demolition and construction sets out criteria for categorising the dust emission magnitude for demolition activities, earthworks and construction activities and for defining the sensitivity of the area to dust soiling effects, human health impacts and ecological impacts.

8.2.29 The third stage is to define appropriate, site-specific mitigation measures. The final stage is to determine whether significant effects are likely. For almost all construction activities, the aim should be to prevent significant effects on receptors through the use of effective mitigation. Experience has shown that this is normally possible.

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Process Emissions during Operation of the Proposed Development

8.2.30 For the Proposed Development to operate it will need to satisfy industrial permitting requirements set out and monitored by the EA. However, EA guidance has not been developed specifically for conducting an assessment to accompany a planning application. Consequently, in 2017 the Environment Protection UK (EPUK) and the Institute of Air Quality Management (IAQM) published guidance, 'Land-Use Planning & Development Control: Planning for Air Quality [13] (the EPUK & IAQM Guidance) for use by professionals operating within the planning system. It provides planning officers and developers with a means of reaching sounds decisions, having regard to the air quality implications of development proposals. The EPUK & IAQM Guidance states that it may be adapted using professional judgement. Therefore, where appropriate, professional judgement has been informed by the EA's AER Guidance 2016.

8.2.31 The EPUK & IAQM Guidance provides a matrix which should be used to describe the air quality impact based on the change in the concentration relative to the AQS objective or EAL and the overall predicted concentration with the Proposed Development (i.e. the future baseline plus the process contribution (PC)). The appropriate AQS Objective or EAL is referred to as an AQAL in the matrix shown in Table 8.4. The matrix is designed to be used with annual mean concentrations and is not applicable to short-term concentrations.

Table 8.4: IAQM Magnitude of Change Descriptors

Long term average concentration at receptor in assessment year	Percentage change in concentration relative to AQAL			
	1 %	2–5 %	6–10 %	> 10 %
≤ 75 % of AQAL	Negligible	Negligible	Slight	Moderate
76–94 % of AQAL	Negligible	Slight	Moderate	Moderate
95–102 % of AQAL	Slight	Moderate	Moderate	Substantial
103–109 % of AQAL	Moderate	Moderate	Substantial	Substantial
≥ 110 % of AQAL	Moderate	Substantial	Substantial	Substantial

8.2.32 The matrix is intended to be used by rounding percentage pollutant concentrations, up or down to the nearest whole number, to make it clear which category the impact falls within. Therefore, any impact which is between 0.5 % and 1.5 % would be

[13] EPUK & IAQM. (2017). Land-Use Planning & Development Control: Planning for Air Quality, January 2017.

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classified as a 1 % change in concentration. An impact of less than 0.5 % is described as negligible, irrespective of baseline concentrations.

8.2.33 The EPUK & IAQM Guidance does not provide impact descriptors for short-term concentrations (i.e. averaging periods of less than a year). For assessment against short-term AQALs, the EA's AER Guidance 2016 has been used. This states that impacts can be considered insignificant if the short-term PC is < 10 % of the AQAL.

8.2.34 Where an impact cannot be screened out as "insignificant" based on the outputs of the initial screening and modelling, the significance of the effect has been determined based on professional scientific judgement of the likelihood of emissions causing an exceedance of an AQAL. This is a standard approach which allows the risk and likelihood of exceedance to be investigated and assessed in detail, following the first stage assessment.

8.2.35 In addition, the EA guidance document 'Guidance on assessing group 3 metals stack emissions from incinerators' [14] (Group 3 Metals Guidance, prepared for assessing the impact of emissions of metals relative to their respective AQALs), states that where the PC for any metal exceeds 1 % of the long-term or 10 % of the short-term environmental standard (in this case the AQAL), this is considered to have potential for significant pollution. Where the PC exceeds these criteria, the Predicted Environmental Concentration (PEC) (i.e. the PC plus background concentrations) should be compared to the environmental standard. The predicted environmental concentration (PEC) can be screened out where the PEC is less than the environmental standard. Where the impact is within these parameters, it can be concluded that there is no risk of exceeding the AQAL and, as such, the magnitude of change and significance of effect is considered negligible.

8.2.36 For those substances which have the potential to accumulate in the environment, Tolerable Daily Intakes (TDI) (the amount of contaminant which can be ingested daily over a lifetime without appreciable health risk) and Index Doses (ID) (a level of exposure which is associated with a negligible risk to human health), are defined. Where the impact of process emissions is within these levels, emissions are expected to make a negligible impact on human health.

[14] Environment Agency. (2016b). Releases from Waste Incinerators, Version 4, Guidance on assessing group 3 metal emissions from incinerators, June 2016.

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8.2.37 The EPUK & IAQM Guidance specifically states that it is not designed for assessing the impact at ecological sites; therefore, the EA's AER Guidance 2016 has been applied. This approach is considered appropriate as the Proposed Development will also require an EP to operate. The Guidance states the following significance criteria, applicable to both critical loads and critical levels:

- For Special Areas of Conservation (SACs), Special Protection Areas (SPAs), Ramsar sites and Sites of Special Scientific Interest (SSSIs), impacts may be considered insignificant where:
    - the short-term PC is less than 10 % of the short-term environmental standard
    - the long-term PC is less than 1 % of the long-term environmental standard.
- For local nature sites (ancient woodlands, Local Wildlife Sites (LWSs), National Nature Reserves (NNRs) and Local Nature Reserves (LNRs)), impacts may be considered insignificant where:
    - the short-term PC is less than 100 % of the short-term environmental standard
    - the long-term PC is less than 100 % of the long-term environmental standard.

8.2.38 Where impacts as not classed as insignificant, the combined PC and estimated background deposition (available from APIS) should be compared to the environmental standard.

8.2.39 In June 2019, the IAQM issued guidance [15] relating to the assessment of air quality impacts on designated nature conservation sites. The guidance suggests that for ecological impact assessments of projects and plans, LNRs and LWSs should be treated in the same manner as SSSIs and European sites (i.e. using 1 % and 10 % thresholds for screening of long-term and short-term effects, respectively) but notes that the determination of significance of an effect may be different.

8.2.40 As the Environment Agency criteria have historically been applied as a numerical indicator of significance for impacts on ecological sites in planning applications, these criteria have been applied as a preliminary determination of significance for LWSs in the AQA and are summarised in this Chapter. However, a detailed evaluation by an

[15] IAQM. (2019). A guide to the assessment of air quality impacts on designated nature conservation sites. Version 1.0, June 2019, Institute of Air Quality Management.

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ecologist taking into account the IAQM, 2019 guidance is presented in **Appendix 6-3** of the ES and the results of this evaluation are included in the conclusions relating to impact on ecological sites.

Plume Visibility

8.2.41 There is the potential for the plume to be visible under certain circumstances due to the water vapour in the exhaust gases condensing as they cool. However, the water vapour in the gases mixes with the ambient air as the plume disperses, so that the plume ceases to be visible once the water vapour content is low enough. If the exhaust gases are hot and dry, or if the weather conditions promote rapid dispersion and slow cooling, it is more likely that the water vapour will disperse before it condenses, so that the plume is not visible at all.

8.2.42 The number and extent of the visible plume has been predicted using the plume visibility module in ADMS 5.2. The model setup is identical to that used for the air quality assessment, except for the selection of plume visibility and the input of initial water content in the plume. The initial water vapour mixing ratio of the plume was set to 0.126 kg/kg (mass of water vapour per unit mass of dry release at the stacks). ADMS 5.2 defines the plume to be visible at a particular downwind distance if the ambient humidity at the plume centreline is below 98 %, above which it is considered the plume would be indistinguishable from clouds.

8.2.43 The distance from the stack to the Site boundary has been estimated for each wind direction to enable the number of daylight hours per year that the visible plume extends over the Site boundary to be calculated. Daylight hours have been assumed to be from 5 a.m. to 9 p.m. every day throughout the year. This will be an overestimation for the winter months and, therefore, the assessment can be classed as worst case.

8.2.44 A previous version of EA guidance note H1 (as published in 2003) [16] provided a methodology to quantify the potential impact from visible plumes. This methodology has not been incorporated into the latest version of the EA's guidance. However, in lieu of any other appropriate methodology, this has been used for the purpose of this

[16] Horizontal Guidance Note IPPC H1, Integrated Pollution Prevention and Control (IPPC) Environmental Assessment and Appraisal of BAT, Version 6, July 2003.

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assessment. The criteria against which the results of the dispersion modelling can be assessed are detailed in Table 8.5.

Table 8.5: Summary of Qualitative Plume Visibility Impacts

Impact	Qualitative description
Zero	No visible impacts resulting from the operation.
Insignificant	Plume length extends boundary < 5 % of the daylight hours per year. No local sensitive receptors.
Low	Plume length extends boundary < 5 % of the daylight hours per year. Sensitive local receptors.
Medium	Plume length extends boundary > 5 % of the daylight hours per year. Sensitive local receptors.
High	Plume length extends boundary > 25 % of the daylight hours per year with obscuration. Sensitive local receptors.

Limitations

8.2.45 Limitations of the assessment have been taken into account wherever possible. For instance:

- The assessment has been undertaken using standard methods outlined in guidance produced by the EA and EPUK & IAQM. Standard assessment criteria, developed by nationally recognised institutions, minimise any uncertainty on the applicability of the approach used;
- Baseline data has been collected from local and national monitoring networks. Worst-case assumptions have been made and if impacts cannot be screened out as negligible, irrespective of baseline concentrations, or insignificant when determining the significance of effect, then the choice of background concentrations has been considered in greater detail. A worst-case future baseline has been included to take into account the cumulative impact of the Proposed Development, the existing OCGTs and the existing coal-fired Power Station. All emissions are based on operation of each plant at the ELVs for all hours of the year, which is likely to overestimate actual conditions;
- The impact of process emissions from the Proposed Development has been determined, based on operation at the daily BAT AELs set out within the Waste Incineration BREF for long-term impacts on air quality (and daily, weekly and annual impacts on ecological sites) or the half-hourly IED ELVs for short-term impacts on air quality. For short-term impacts, it has been assumed that the Proposed Development operates for the entire year at the short-term emission

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limits so that periods of operation coincide with the worst-case meteorological conditions for dispersion. For metals, emissions are based on the sampling period BAT AELs. In practice, the Proposed Development will operate below the BAT AELs and the IED ELVs and will be offline for periods of maintenance;

- The assessment has used 5 years of meteorological data to ensure inter-annual variability is taken into account and considered the highest predicted concentrations within the five years at the point of maximum impact and receptor locations; and
- For the assessment of impacts on ecological sites, the lowest (i.e. most stringent) end of the critical load range for the most sensitive feature present has been selected and the highest deposition across any point on each site has been used. In the case of sulphur dioxide and ammonia, the more stringent critical level has been selected (see Table 8.3).

8.3 Baseline

8.3.1 A detailed review of baseline conditions is provided in **Appendix 8-1**. This has included a review of local and national monitoring networks.

8.3.2 Baseline conditions are taken from local monitoring sites, the Department for the Environment, Food and Rural Affairs (DEFRA) mapped background dataset and national monitoring datasets.

Sensitive Receptors

Dust Sensitive Receptors

8.3.3 It is anticipated that construction activities will take place at various locations across the Site. However, as a worst-case assumption, it has been assumed that dust generating activities will occur at the boundary of the Site.

8.3.4 The closest human receptors to the Proposed Development are the residential properties off Church Lane in Thrumpton, located around 700 m from the Site boundary. Thrumpton Cricket Pitch is located around 650 m from the Site boundary. Within the existing Power Station site, the Engineering Academy and Uniper Technology offices are over 800 m from the Site boundary. The offices and operational areas of the existing Power Station are not considered to be sensitive

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human receptors with respect to dust given the highly industrial nature of the Power Station site.

8.3.5 The closest ecological receptor to the Proposed Development is the Thrumpton Park LWS, which is located approximately 150 m from the Site boundary at its closest point.

8.3.6 Access to the Site for construction traffic would be via the A453 Remembrance West Leake Lane Junction northern roundabout. The road network within 500 m of the Site entrance comprises the existing Power Station site eastern access road, the northern roundabout of the Junction and a section of approximately 380 m of the A453 main carriageway. The closest human receptor is Winking Hill Farm which is around 100 m from the roadside, and the closest ecological receptor is the Ratcliffe-on-Soar Pond LWS which is around 200 m outside the Site entrance screening distance of 500 m.

8.3.7 Because the separation distances in Paragraphs 8.3.4 to 8.3.6 are greater than those advised by the IAQM (see Paragraph 8.2.24), the impact of fugitive dust emissions during construction can be screened out under Stage 1 of the IAQM assessment process as negligible and there is no requirement to undertake a detailed assessment. Similarly, as the impacts have been classed as negligible, it is reasonable to assume that there will be no cumulative effects associated with the High Speed 2 (HS2) rail development.

Process Emissions Sensitive Receptors

8.3.8 The general approach to the assessment is to evaluate the highest predicted process contribution to ground level concentrations. In addition, the predicted PC at a number of sensitive human receptor locations have been evaluated. These locations are displayed in Figure 8.1 and listed in Table 8.6.

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Table 8.6: Emission Sensitive Receptors

Reference	Description	OS Grid Reference	Distance from the Proposed Development (km)
R1	Church Lane, Thrumpton	451059, 331118	0.9
R2	Wood Farm, Thrumpton	451487, 330914	1.2
R3	Hillside Cottage	451869, 330662	1.4
R4	Stonepit Farm	452143, 329669	1.8
R5	Winking Hill Farm	450969, 329726	0.8
R6	Gotham Primary School	453241, 330149	2.8
R7	Main Street, Ratcliffe-on-Soar Village	449619, 329082	1.6
R8	Lock Lane, Sawley	449231, 330563	1.2
R9	Redhill Marina and Redhill Farm, Sawley	449353, 330111	1.1
R10	Kingston Hall, Gotham Road	450696, 327912	2.5
R11	Middlegate Farm	449420, 329814	1.2
R12	Little Lunnon, Barton-in-Fabis	452175, 332499	2.7
R13	Kegworth Road, Kingston-on-Soar	449943, 327760	2.7
R14	Cranfleet Farm	449485, 331365	1.4
R15	Trent Lock	448961, 331206	1.7
R16	Ludford Close, Long Eaton	449413, 331970	1.9

Vehicle Emissions Sensitive Receptors

8.3.9 Most traffic generated by the construction and operational phases of the Proposed Development, particularly HGVs traffic, will travel south-west along the A453 to Junction 24 of the M1 motorway. Traffic generated by the construction and operational phases will exceed the screening criteria detailed in Paragraph 8.2.18. The only receptor locations that may be impacted by vehicle emissions generated by the Proposed Development are those that lie within 200 m of the A453 between the A453 / West Leake Lane roundabout and junction 24 of the M1 motorway. These locations are listed in Table 8.7.

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Table 8.7: Vehicle Emissions Human Sensitive Receptors

Reference	Description	OS Grid Reference
R1	Dowells Barn Cottage	448267,328106
R2	Long Lane Farm	449215,328904
R3	Cedar Isle 1	449256,328933
R4	Cedar Isle 2	449632,329128
R5	Winking Hill Farm	450927,329760

8.3.10 The impacts of emissions to air on all relevant designated and non-designated ecological sites in the locality of the Proposed Development have been assessed in line with the distance criteria specified in the EA AER Guidance 2016, namely 10 km for SACs, SPAs or Ramsar sites, and 2 km for SSSIs, NNRs, LNRs, Ancient Woodlands and LWSs.

8.3.11 There are no SACs, SPAs or Ramsar sites within 10 km of the Proposed Development. There are no Ancient Woodlands or NNRs within 2 km of the Proposed Development.

8.3.12 There is one SSSI (the Lockington Marshes SSSI), one LNR (Forbes Hole LNR) and 40 LWSs within 2 km of the Proposed Development. The locations of these sensitive ecological receptors are displayed in Figure 8.2 (the SSSI and LNR) and Figure 8.3 (the LWSs). The full list of LWSs is included in the Figure 8.3 key.

8.3.13 The impacts of air quality and deposition for each site were determined based on the maximum modelled impact across any point on the site and based on the highest impact over the five years of meteorology modelled. Full details of the modelling approach and the selection of appropriate critical levels and critical loads for each site can be found in **Appendix 8-1**.

8.4 Assessment of Effects

Incorporated Mitigation

8.4.1 The Proposed Development will require an EP in order to operate, which will include a list of conditions including limits on emissions to air known as ELVs based on the new waste incineration plant requirements set out in the IED and the Waste Incineration BREF. For the purpose of this ES Chapter, it has been assumed that

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the Proposed Development complies with the minimum requirements of the Waste Incineration BREF and IED as a worst-case approach from an emissions perspective.

Construction Effects

8.4.2 Potential air quality impacts during the construction phase have been identified as:

- Generation of dust from construction activities on Site; and
- Generation of exhaust pollutants from construction phase traffic.

Generation of Dust from Construction Activities on Site

8.4.3 No potentially sensitive human or ecological receptors were identified within the screening distances set out in the IAQMs 2014 guidance on the assessment of dust from demolition and construction and, therefore, the need for a detailed assessment has been screened out. The screening criteria were deliberately chosen by IAQM to be conservative and the guidance states that where the need for a more detailed assessment is screened out, it can be concluded that the level of risk is “negligible”, and any effects will not be significant.

Generation of Exhaust Pollutants from Construction Phase Traffic

8.4.4 Dispersion modelling of vehicle emissions during the construction phase has been undertaken. Full details of the modelling methodology, input parameters, assumptions, analysis, and results can be found in **Appendix 8-5**.

8.4.5 It should be noted that the assessment is considered highly conservative as it assumes that:

- The number of vehicles generated is the maximum predicted daily level during the construction phase, when in reality the number of vehicles averaged over a year will be significantly lower; and
- Vehicle emissions factors and background pollutant concentrations do not improve from 2017 levels in future years.

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8.4.6 As a conservative measure the maximum predicted annual mean concentrations from any of the five years of meteorological data at each receptor location have been presented.

8.4.7 The assessment has shown that, during the construction phase of the Proposed Development, the impact at all receptor locations considered is ‘negligible’ irrespective of the total concentration for all pollutants considered.

Operational Phase Effects

8.4.8 Potential air quality impacts during the operational phase have been identified as:

- generation of exhaust pollutants from operational phase traffic, which has been assessed on a qualitative basis;
- operational phase process emissions, which have been assessed on a quantitative basis; and
- operational phase dust and odour emissions, which have been assessed on a qualitative basis.

Operational Phase Traffic Emissions

8.4.9 Dispersion modelling of vehicle emissions during the operational phase has been undertaken. Full details of the modelling methodology, input parameters, assumptions, analysis, and results can be found in **Appendix 8-5**.

8.4.10 It should be noted that the assessment is considered highly conservative as it assumes that:

- Vehicle emissions factors and background pollutant concentrations do not improve from 2017 levels in future years;
- The process contribution from the Proposed Development includes the contribution from the EMERGE Centre, the OCGTs and the coal-fired Power Station, as per emissions scenario D detailed in **Appendix 8.1**; and
- For the assessment of the in-combination impact of vehicle and process emissions, the maximum contribution from any year of meteorological data from vehicle emissions has been added to the maximum contribution in any year from process emissions for each receptor. In reality, the maximum contributions from vehicle and process emissions are likely to occur under different

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meteorological conditions and therefore in different years of meteorological data.

8.4.11 The assessment has shown that, during the operational phase of the Proposed Development, the impact of vehicle emissions alone at all receptor locations considered is 'negligible' irrespective of the total concentration for all pollutants considered. The in-combination impact of vehicle and process emissions at all receptor locations is 'negligible' for all pollutants considered.

Operational Phase Process Emissions – Human Receptors

8.4.12 The only source of process emissions from the Proposed Development would be the two main chimney stacks associated with the Proposed Development. Given their proximity, the two stacks have been modelled as a combined stack for the purposes of this assessment. It has been assumed that the Proposed Development operates at the half hourly IED ELVs for assessing short-term impacts and at the daily mean BAT AELs set out in the Waste Incineration BREF for assessing long-term effects and daily, weekly and annual impacts on ecological sites. For heavy metals, emissions are based on the sampling period BAT AEL.

8.4.13 Full details of the modelling methodology, input parameters, assumptions, analysis, and results can be found in **Appendix 8-1**. The process emission results described in the following sections cover Scenario A, corresponding to the Proposed Development operating continuously including only the buildings associated with the Proposed Development as this represents the most representative scenario in relation to future operations. The impacts in combination with the existing Power Station and OCGTs are discussed in Section 8.6.

8.4.14 It should be noted that the first stage of the assessment is considered highly conservative as it assumes that:

- The Proposed Development operates at the long-term BAT AEL for the entire year or the short-term ELV for the entire averaging period, as appropriate;
- The EA conversion rates of NO_x to NO_2 have been applied;
- The entire dust emissions are assumed to consist of either PM_{10} or $PM_{2.5}$;
- The entire volatile organic compound (VOC) emissions are assumed to consist of either benzene or 1,3-butadiene;

- Cadmium is released at the combined BAT AEL for cadmium and thallium; and
- The nine Group 3 metals (Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V) are individually released at the combined BAT AEL for Group 3 metals.

8.4.15 This first stage analysis has shown that the annual mean impacts for all pollutants listed in Table 8.1, except for nitrogen dioxide, VOCs, cadmium, arsenic, chromium (VI), manganese and nickel, are less than 0.5 % of the AQAL and the short-term impacts for all pollutants are less than 10 % of the AQAL. Hence the magnitude of change is described as negligible or insignificant, irrespective of baseline concentrations, for all pollutants and averaging periods (see Paragraphs 8.2.32 and 8.2.33) with the exception of the seven listed above.

8.4.16 Where the magnitude of change cannot be described as negligible or insignificant, irrespective of baseline concentrations, further consideration of the baseline concentrations has been undertaken. The next stage of assessment within the EPUK & IAQM Guidance for annual mean concentrations is to assess the change in the concentration relative to the AQAL and the overall predicted concentration (i.e. the future baseline plus the process contribution). Table 8.4 shows the relevant matrix taken from the EPUK & IAQM Guidance. This shows that for pollutants where the long-term average concentration at the receptor is less than 75 % of the AQAL, then a change of 5 % or less can be classed as a negligible impact. Therefore, the impact of annual mean nitrogen dioxide, VOCs, cadmium, manganese and nickel can be classed as negligible as the long-term average concentration at the maximum impact point is less than 75 % and the change in concentration relative to the AQAL is less than 5 %.

8.4.17 Following the EA Group 3 Metals Guidance on the assessment of Group 3 metals, annual mean arsenic concentrations can be classed as insignificant as the predicted environmental concentration (PEC) (PC plus background concentrations) are less than 100 % of the AQAL.

8.4.18 The PEC for chromium (VI) is above the AQAL due to very high baseline concentrations. The EA's Group 3 Metals Guidance has been followed as detailed in **Appendix 8-1**. This has shown that the impact can be screened out if it is assumed that emissions from the Proposed Development would be no greater than the maximum monitored from an existing permitted waste facility. As such, the

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significance of effect of process emissions of chromium (VI) on human health is considered negligible.

8.4.19 Four local AQMAs have been designated within 5 km of the Proposed Development in relation to the annual mean NO_2 air quality objective, with the M1 AQMA also designated in relation to the 1-hour NO_2 air quality objective. Annual mean PCs were less than 1 % of the annual mean AQAL and the PECs were only 62 % of the annual mean AQAL at all four AQMAs and hence the impacts are considered negligible. Similarly, the PCs were less than 10 % of the one hour NO_2 AQAL at the M1 AQMA and hence the impact at this location can be considered insignificant.

8.4.20 Therefore, the assessment within **Appendix 8-1** has drawn the following conclusions in relation to the representative future operation of the Proposed Development:

- The PC for most pollutants can be described as negligible, irrespective of baseline concentration at the point of maximum impact. However, further analysis has been needed for annual mean impacts of nitrogen dioxide, VOCs, cadmium, arsenic, chromium (VI), manganese and nickel;
- When the baseline concentrations are taken into account, the magnitude of change of annual mean nitrogen dioxide, VOCs, cadmium, manganese and nickel process emissions are negligible at the maximum impact point;
- Annual mean arsenic concentrations can be classed as insignificant when considering the PEC to be less than 100 % in line with the EA Group 3 Metals Guidance on metals screening; and
- Annual mean chromium (VI) concentrations can be classed as insignificant when following the second step in the EA's Group 3 Metals Guidance.

8.4.21 A Human Health Risk Assessment has been undertaken (see **Appendix 8-2**). This considers the potential impact of persistent pollutants which have the potential to accumulate in the food chain and ingestion and inhalation pathways. This has shown the Proposed Development is predicted to have a negligible effect on human health.

8.4.22 Using professional judgement, based on the conservatism in the process emissions modelling assumptions, the overall emissions associated with the Proposed Development are predicted to have a negligible effect on human health.

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Operational Phase Process Emissions – Ecological Receptors

8.4.23 Dispersion modelling has been used to predict the maximum air concentrations and nitrogen and acid deposition at the local SSSI and LNR and at the 40 local LWSs. The air concentrations have been compared against the critical levels set out in the EA's AER Guidance 2016 and the deposition has been compared against the applicable acid and nitrogen critical loads extracted from APIS.

8.4.24 The assessment has shown that the PC for all species are below the relevant EA significance thresholds in relation to the applicable critical levels and acid and nitrogen critical loads at the Forbes Hole LNR and at all local LWSs and these impacts can therefore be classed as insignificant at these sites.

8.4.25 The PC of NO_x, SO_2 and HF are below the relevant EA significance thresholds in relation to the applicable critical levels at the Lockington Marshes SSSI and can therefore be classed as insignificant.

8.4.26 The maximum PC to ground level concentrations of NH_3 at the Lockington Marshes SSSI is 1.4 % of the annual ammonia critical level and is less than 1 % of current ammonia background concentrations.

8.4.27 The maximum PC to nitrogen deposition at the Lockington Marshes SSSI is 1.5 % of the most stringent applicable critical load and is less than 0.5 % of the background nitrogen deposition.

8.4.28 The maximum PC to acid deposition at the Lockington Marshes SSSI is 1.8 % of the most stringent applicable critical load and is less than 2 % of the background acid deposition.

8.4.29 The ecological assessment has a number of conservative assumptions built in, notably:

- The Proposed Development is assumed to operate with a 100 % annual load factor;
- The assessment is based on the worst-case meteorological year;
- The assessment is based on the highest impact point over each ecological site;

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- The more stringent critical levels for features showing extra sensitivity to SO_2 and NH_3 have been used for all ecological sites; and
- The lowest end of the critical load range for the most sensitive feature present on each ecological site has been used for nitrogen and acid deposition.

8.4.30 A review of the sources contributing to background concentrations of ammonia, background nitrogen deposition and background acid deposition at the Lockington Marshes SSSI showed that farming, transport and emission sources located in Ireland and on the European mainland were the dominant contributing sectors, with low contributions from industrial and commercial sources.

8.4.31 Taking into account the sources of background concentrations at the Lockington Marshes SSSI and given the precautionary approach adopted and the low levels of impact relative to the applicable critical levels and critical loads, it can reasonably be concluded that emissions from the Proposed Development would not be at levels which could lead to significant adverse effects on the ecological features at the Lockington Marshes SSSI under all of the scenarios considered based on the EA assessment criteria.

8.4.32 A more detailed review by the project ecologist (detailed in **Appendix 6-3**), taking into account the recent IAQM 2019 guidance relating to the assessment of air quality impacts on designated nature conservation sites, confirmed the above conclusion.

Plume Visibility

8.4.33 The plume visibility assessment has been undertaken in which the distance from the stack to the site boundary has been estimated for each wind direction. The full plume visibility results are detailed in **Appendix 8-3**. Using the EA significance criteria detailed in Table 8.5 as the plume length extends beyond the site boundary for more than 5 % of the year, the visual impact of the plume is “medium”. However, the visible plume is not predicted to extend above any identified residential receptors. The visual effects of the plume are assessed within Chapter 5.0 Landscape and Visual Effects.

Operational Phase Dust and Odour – Context and Inherent Mitigation

8.4.34 The closest existing residential receptors are located approximately 700 m from the Site boundary. All Site operations would be conducted within enclosed buildings, and

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vehicles will deposit the waste into an enclosed tipping hall. The building will be totally enclosed except for the roll-up doors. The tipping hall will be held under negative pressure, with the air being used in the combustion process which will destroy odours due to the high temperatures achieved (around 850 °C). This prevents the release of odours and dust from the building when the doors are opened for short periods for deliveries.

8.4.35 There would be storage of waste within the waste bunker, albeit this would be within the enclosed tipping / bunker hall and waste would not be stored for prolonged periods. There would be no waste stored outside the buildings. Any odours drawn into the combustion process would be eliminated by the combustion process itself; therefore, there would be no release of odour from the main stack. Additionally, anaerobic conditions within the refuse bunkers, which could cause odour, would be prevented by regular mixing of the waste by the crane operators. It should be noted that as part of the EP for the Proposed Development, all emissions, including fugitive dust and odour, would be controlled to ensure there is no impact beyond the installation boundary and a detailed odour control plan will be included with the EP application.

8.4.36 The above design measures ensure that the potential risk of fugitive releases from the operation of the Proposed Development is negligible.

8.4.37 The only other source of odour and dust from the Proposed Development would be from vehicles associated with the delivery of waste. Access to the Site would be from the grade separated junction off the A453 onto Barton Lane, which is signed as the Power Station HGV entrance. This route does not pass any sensitive receptors. Vehicle cargo will be enclosed to prevent the fugitive release of dust and odour. Odour and dust are released as the waste is disturbed, which, in this case, occurs within the enclosed tipping hall, which will be subject to negative pressure as described above. As such, the risk of fugitive releases of dust and odour from the delivery of waste is negligible.

8.5 Carbon Assessment

8.5.1 The Proposed Development will combust around 500,000 tonnes of waste per year, exporting around 43.4 MW of electricity to the grid. Over half of the CO_2 emissions associated with this combustion will derive from biogenic carbon and can hence be

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considered to be climate neutral. The Proposed Development will also avoid the significant releases of methane that would be associated with the landfilling of this waste.

8.5.2 **Appendix 8-4** presents the results of an assessment of the impacts of processing waste for energy recovery in the Proposed Development relative to the alternative option of disposing of waste in a landfill in terms of greenhouse gas releases. The assessment considers greenhouse gas emissions from the Proposed Development and from the associated transport of waste and consumables to the Site, and the removal of incinerator bottom ash and air pollution control residues from the Site.

8.5.3 The carbon assessment concludes that the recovery of energy from waste in the Proposed Development will deliver a net carbon benefit of 106 kt of carbon dioxide equivalent emissions per year for the expected Net Calorific Value (NCV) case and 125 kt of carbon dioxide equivalent emissions per year for the low NCV case, relative to the disposal of the equivalent volume of waste in landfill. The results have been demonstrated to be robust to the consideration of the carbon intensity of grid generation displaced by the Proposed Development, to assumptions regarding the capture rates of methane in landfill and to assumptions regarding the sequestration of biogenic carbon in landfill.

8.5.4 **Appendix 8-4** also sets out credible options to deliver net zero carbon emissions from the Proposed Development in line with the UK Government's statutory target to reduce emissions of greenhouse gases to net zero by 2050. These are discussed in Chapter 4.0 of the ES.

8.6 Cumulative Effects

8.6.1 Chapter 2.0 identifies High Speed Rail Phase 2b (HS2b, West Midlands to Leeds) as the only new local project that has the potential to give rise to cumulative effects with the Proposed Development. The HS2b scheme will not release process emissions or odour at a level significant enough to require cumulative assessment. As the impacts of construction dust from the Proposed Development have been screened out from the requirement for detailed assessment, no cumulative assessment is required.

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8.6.2 The assessment of vehicle emissions includes all relevant committed developments in the baseline traffic flows for the construction and operational phases. As such, the assessment of vehicle emissions represents an assessment of cumulative effects with other plans and projects, and no further assessment is required. Details of the relevant committed developments are included in the Transport Assessment which is provided as a standalone document in support of the planning application.

8.6.3 As the existing Power Station is due to close by October 2025, in line with Government policy, and the Proposed Development would start operations in 2025, subject to securing the required consents, there is a nine-month period of potential overlap in operation. There are also a number of large buildings associated with the existing Power Station which will eventually be demolished, but might remain in place for a period following closure of the Power Station. The OCGTs on the existing Power Station site may also be retained, although their operation is limited to a maximum of 500 hours per year. The air quality modelling, therefore, considered three additional scenarios to account for the above, namely:

- Scenario B: The Proposed Development and the OCGTs operating continuously including only the buildings associated with the Proposed Development;
- Scenario C: The Proposed Development and the OCGTs operating continuously including the Proposed Development buildings and buildings on the Power Station site above 30 m in height (above one-third of the lowest stack height); and
- Scenario D: The Proposed Development, the OCGTs and the Power Station all operating continuously including the Proposed Development buildings and buildings on the Power Station site above 30 m in height (above one-third of the lowest stack height).

8.6.4 The following sections set out the results associated with Scenario D as this was the highest impact cumulative assessment scenario, noting that this scenario of overlapping operation is unlikely to persist for more than nine months. Full details of the modelling methodology, input parameters, assumptions, analysis and results for the additional scenarios can be found in **Appendix 8-1**.

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Cumulative Impacts at Human Sensitive Receptors

8.6.5 Scenario D considers those pollutants emitted by the Proposed Development which would also be subject to regulation under the EP emission limits for the Power Station following revision to meet the new requirements of the Large Combustion Plan BREF, namely NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$, HCl, HF, NH_3 and Hg.

8.6.6 The cumulative modelling results show that, assuming all three plants operate at full load continuously throughout the year, the annual mean impact for all pollutants except for nitrogen dioxide, sulphur dioxide and mercury, is less than 0.5 % of the AQAL and the short-term impact for all pollutants is less than 10 % of the AQAL except for nitrogen dioxide, sulphur dioxide and mercury. Hence, the magnitude of change is described as negligible or insignificant, irrespective of baseline concentrations, for all pollutants and averaging periods, with the exception of the three listed above.

8.6.7 Where the magnitude of change cannot be described as negligible, irrespective of baseline concentrations, or insignificant, further consideration of the baseline concentrations has been undertaken. The next stage of assessment within the EPUK & IAQM guidance for annual mean concentrations is to assess the change in the concentration relative to the AQAL and the overall predicted concentration (i.e. the future baseline plus the PC). Table 8.4 shows the relevant matrix taken from the EPUK & IAQM guidance. This shows that for pollutants where the long-term average concentration at the receptor is less than 75 % of the AQAL then a change of 5 % or less can be classed as a negligible impact. Therefore, the impact of annual mean nitrogen dioxide, sulphur dioxide and mercury can be classed as negligible as the long-term average concentration at the maximum impact point is less than 75 % and the change in concentration relative to the AQAL is less than 5 %.

8.6.8 The short-term impacts of nitrogen dioxide are predicted to be a maximum of 16 % of the AQAL at the maximum impact point, which is above the insignificance threshold of 10 %. However, the PEC is predicted to be only 41 % of the AQAL which shows that the AQAL will be met by a significant margin at the maximum impact point. The short-term nitrogen dioxide concentration for the cumulative impact assessment is predicted to be below 10 % at all local human receptor points, except for Gotham Primary School which is just above significance at 10.42 %, where the PEC is again well below the AQAL.

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8.6.9 The short-term impacts of sulphur dioxide are predicted to be a maximum of 40 % of the AQAL at the maximum impact point for all three short-term statistics. The maximum PEC for short-term sulphur dioxide concentrations is predicted to be 42 % of the AQAL, showing that the AQALs will be met by a significant margin. The maximum short-term sulphur dioxide concentration for the cumulative impact assessment is predicted to be below 10 % at approximately half of the human health receptors. The maximum PEC for short-term sulphur dioxide concentrations at any of the human health receptors are 28 % of the AQAL, which shows that the short-term sulphur dioxide AQALs will easily be met at all the local human receptor points.

8.6.10 The short-term impacts of mercury are predicted to be a maximum of 16 % of the AQAL at the maximum impact point, which is above the insignificance threshold of 10 %. However, the PEC is predicted to be only 17 % of the AQAL, which shows that the AQAL will be met by a significant margin at the maximum impact point. The short-term mercury concentration for the cumulative impact assessment is predicted to be below 10 % at all local human receptor points.

8.6.11 The cumulative impact assessment within **Appendix 8-1** has drawn the following conclusions:

- The PC for most pollutants can be described as negligible, irrespective of baseline concentration at the point of maximum impact. However, further analysis has been needed for annual mean and short-term impacts of nitrogen dioxide, sulphur dioxide and mercury;
- When the baseline concentrations are taken into account, the magnitude of change of annual mean nitrogen dioxide, sulphur dioxide and mercury process emissions are negligible at the maximum impact point;
- Short-term concentrations of nitrogen dioxide and sulphur dioxide are predicted to be above the insignificance threshold of 10 % at some of the human health receptor points, but the AQAL is met by a significant margin (over 50 %) even when background concentrations are included;
- Short-term concentrations of mercury are predicted to be above the insignificance threshold of 10 % at the maximum impact point, but are below 10 % at all human health receptor points. The PEC is significantly below the AQAL, showing that the risk of the AQAL being breached is very low;
- The majority of the short-term impacts for nitrogen dioxide, sulphur dioxide and mercury are due to the operation of the Power Station. Once the Power Station

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ceases operation, the predicted impact significantly decreases to levels below the insignificance threshold; and

- There is some double accounting of ground level concentrations from the OCGTs and the Power Station as the baseline concentrations will include a contribution from these two sources as they are already operating.

8.6.12 Using professional judgement, based on the conservatism in the process emissions for all three installations modelled, the overall emissions associated with the cumulative assessment are predicted to have a negligible effect on human health.

Cumulative Impacts at Ecological Receptors

8.6.13 The modelling has shown that the process contributions for all species are below the relevant EA significance thresholds in relation to the corresponding critical levels and acid and nitrogen critical loads at the Forbes Hole LNR and all local LWSs and the impacts at these sites can therefore be classed as insignificant.

8.6.14 The annual mean process contributions of NO_x and SO_2 are 1.5 % and 2.6 % of the corresponding critical levels, respectively, at the Lockington Marshes SSSI, and below the critical levels in combination with background concentrations.

8.6.15 The maximum weekly mean and maximum daily mean process contributions of HF are 19.5 % and 8.4 % of the corresponding critical levels at the Lockington Marshes SSSI, and below the critical levels in combination with background concentrations.

8.6.16 The maximum daily mean process contribution of NO_x is 27.9 % of the corresponding critical level at the Lockington Marshes SSSI, and below the critical level in combination with background concentrations.

8.6.17 The maximum process contribution to ground level concentrations of NH_3 at the Lockington Marshes SSSI is 1.5 % of the annual ammonia critical level and less than 1 % of current ammonia background concentrations.

8.6.18 The maximum process contribution to nitrogen deposition at the Lockington Marshes SSSI is 2.7 % of the most stringent applicable critical load and less than 1 % of the background nitrogen deposition.

8.6.19 The maximum process contribution to acid deposition at the Lockington Marshes SSSI is 6.8 % of the most stringent applicable critical load and less than 6 % of the background acid deposition.

8.6.20 The cumulative ecological assessment has a number of conservative assumptions built in, notably:

- The Proposed Development, OCGTs and Power Station were assumed to operate with a 100 % annual load factor;
- The assessment is based on the worst-case meteorological year;
- The assessment is based on the highest impact point over each ecological site;
- The more stringent critical levels for features showing extra sensitivity to SO_2 and NH_3 have been used for all ecological sites;
- The lowest end of the critical load range for the most sensitive feature present on each ecological site has been used for nitrogen and acid deposition; and
- The background concentrations and deposition data already include contributions from the Power Station and OCGTs.

8.6.21 The review by the project ecologist noted that the closure of the existing coal-fired Power Station is likely to result in a net reduction in nitrogen and acid deposition rates at nature conservation sites in the vicinity of the Proposed Development, providing further certainty that there would be no adverse ecological effects as a consequence of emissions from the Proposed Development.

8.6.22 Taking into account the sources of background concentrations at the Lockington Marshes SSSI, the limited period of operational overlap between the existing Power Station and the Proposed Development, and given the precautionary approach adopted and the low levels of impact relative to the applicable critical levels and critical loads, it can reasonably be concluded that emissions from the Proposed Development would not be at levels which could lead to significant adverse effects on the ecological features at the Lockington Marshes SSSI under the cumulative scenario considered.

8.7 Mitigation

8.7.1 The construction dust assessment has identified the risks associated with construction dust as negligible. Best practice measures for control of dust will still be

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implemented as part of the construction plan and would be anticipated to include the following:

- Developing and implementing a Construction Environmental Management Plan (CEMP);
- Recording any dust and air quality complaints, identifying the cause(s), taking appropriate measures to reduce emission in a timely manner, and recording the measure taken;
- Removing materials that have the potential to produce dust from Site as soon as possible, unless being reused on-site. If materials are being reused on-site, covers, fencing or temporary seeding will be used to prevent wind whipping of dust from the stockpiles;
- Ensuring sand and other aggregates are stored in designated areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place;
- Ensuring an adequate water supply on the Site for effective dust / particulate matter suppression;
- Ensuring equipment is readily available on-site to clean any dry spillages as soon as reasonably practicable after the event;
- Ensuring all vehicles switch off engines when stationary;
- Ensure vehicles entering and leaving the Site are covered to prevent escape of materials during transport; and
- Utilising the on-site wheel washing system.

8.7.2 In relation to operational impacts, no additional mitigation is required beyond that embedded into the design and required by legislation regulated by the EA under the EP.

8.8 Residual Effects and Conclusions

8.8.1 This ES Chapter has assessed the impact of the Proposed Development on air quality, human health and odour using industry standard approaches.

8.8.2 The main air quality effect would be as a result of emissions from the stacks associated with the Proposed Development. Vehicle emissions during the construction and operational phases have also been considered. Detailed dispersion

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modelling of vehicle and process emissions has been undertaken using a number of conservative assumptions.

8.8.3 In order to define the magnitude of change, details of the future baseline are also needed. Cumulative modelling of the Proposed Development, the existing OCGTs and the existing Power Station has been carried out.

8.8.4 The assessment has shown that process emissions from the Proposed Development are predicted to have a negligible effect on human health. The assessment has also concluded that the impact of the Proposed Development in combination with the OCGTs and the Power Station would not be significant.

8.8.5 The assessment has also shown that vehicle and process emissions from the Proposed Development are predicted not to be at levels that could lead to significant adverse effects on the ecological features at the local SSSI, LNR or LWSs.

8.8.6 The Proposed Development also has the potential to cause impacts associated with the release of dust and odour. A qualitative analysis has been undertaken, which takes into account the control measures in place and the distance to the nearest receptors. This has concluded that the impact of the operation of the Proposed Development would not be significant.

8.8.7 In conclusion, the Proposed Development is not predicted to give rise to significant environmental effects on air quality, human health and odour.

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CHAPTER 9.0 GROUND CONDITIONS

APPENDICES (Volume 3 bound separately)

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9.0 GROUND CONDITIONS

9.1 Introduction

9.1.1 This Chapter of the Environmental Statement (ES) provides an assessment regarding ground conditions incorporating aspects of geology, hydrogeology, contamination and geotechnical stability at the Site.

9.1.2 Soils, geology and hydrogeology play an important role in determining the environmental character of an area. Development schemes can have both direct and indirect effects on geology and groundwater. Existing soil conditions, particularly land contamination, can impose constraints on development. Conversely, development can create pathways for the migration of groundwater and contamination, both in the short term, during construction, and in the long term, during operation. Ground conditions can also introduce physical constraints on the construction of structures (e.g. historic mining, foundations, hard standing, services and excavations).

9.1.3 This Chapter assesses these issues in a systematic manner in accordance with the procedures described below.

Competence

9.1.4 This chapter has been prepared by Uniper Technologies Ltd, incorporating a team of degree-qualified environment consultants providing knowledge and experience across multiple projects of contaminated land, geo-environmental assessment and site investigation. Civil engineering input has been provided by the Civil Engineering Team, providing many years' experience across large civil engineering projects, power generation plants, and undertaking front end engineering design (FEED) for foundations, including assessment of foundation types and sizing to assessment for risk of liquification during seismic events.

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9.2 Methodology and Scope of Assessment

Legislation and Guidance

9.2.1 The assessment presented in this ES Chapter has been prepared in accordance with relevant legislation, including the EU Environmental Liability Directive (2004/35/EC) as transposed by the Environmental Damage (Prevention and Remediation) Regulations 2009 as amended.[1] Based on the polluter pays principle, this legislation imposes obligations on operators of economic activities, requiring them to prevent, limit or remediate serious environmental damage to land, water and to species and habitats. The Regulations define the term 'environmental damage' as including: *"damage to a body of groundwater such that its conductivity, level or concentration of pollutants changes sufficiently to lower its status…"* (as defined in accordance with other EU Directives) and *"contamination of land by substances, preparations, organisms or micro-organisms that results in a significant risk of adverse effects on human health."*

9.2.2 Other national legislation that has been considered in the preparation of this ES Chapter includes:

- Environmental Protection Act 1990 as amended by the Environment Act 1995 and subsequent amendments – Part IIA of the Environmental Protection Act 1990 [2] sets out a regime for the risk assessment, identification, management and remediation of land contamination across the UK. The legislation is supported by statutory guidance last updated in 2012 [3]; Construction (Design and Management) Regulations 2015 [4] regulates design and construction activities to minimise risks to people and the environment; and
- Contaminated Land (England) (Amendment) Regulations 2012 [5] defines pollution of controlled waters.

9.2.3 The following guidance documents set out the UK approach to the assessment of contaminated land and other matters of relevance to this ES Chapter:

- CLR 11 (DEFRA) [6] is the UK industry technical framework used for applying a risk management process when dealing with land impacted by contamination.

[1] http://www.legislation.gov.uk/uksi/2009/153/contents/made
[2] *DEFRA (1990) Environmental Protection Act: Part 2A Contaminated Land Statutory Guidance. HM Government.*
[3] https://www.gov.uk/government/publications/contaminated-land-statutory-guidance
[4] https://www.hse.gov.uk/construction/cdm/2015/index.htm
[5] http://www.legislation.gov.uk/uksi/2012/263/made
[6] *Defra/Environment Agency Report CLR11 "Model Procedures for the Management of Land Contamination".*

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This sets out a procedure for carrying out an environmental risk assessment based on a source–pathway–receptor relationship, referred to as a pollutant linkage. This allows an assessment of potential environmental risk to be determined, based on the nature of the contaminant, the degree of exposure of a receptor to a contaminant and the sensitivity of the receptor;

- BS10175:2011+A2 2017 [7] provides recommendations for the investigation of land potentially affected by contamination and provides guidance. It is designed to be used by those with an understanding of the risk-based approach described in CLR 11;
- BS 5930:2015 [8] deals with the investigation of sites to assess their suitability for construction and to identify the characteristics of a site that affect the design and construction of a project. It also considers related issues including the environment and the security of adjacent land and property. BS 5930 provides guidance on the integration of geotechnical investigations with investigations for contamination or ground gas and other types of investigations; and
- Contaminated Land Statutory Guidance (2012) [9] on the implementation of Part 2A of the Environmental Protection Act 1990.

Assessment Methodology

Study Area

9.2.4 As described in greater detail in Chapter 1.0 of this ES, the Ratcliffe-on-Soar Power Station (the Power Station) site covers an overall area of circa 273 ha, including circa 167 ha lying to the north of the A453 and circa 106 ha to the south of the carriageway. The application Site is located at the central northern end of the Power Station site, on an open area covering circa 4 ha. A diagram showing the area of the Site is included in **Appendix 9-1**.

9.2.5 The Site comprises a small and a larger car parking area, with a gravelly laydown area to the west and north. The elevation of the Site is approximately 8 m higher than the area immediately to the south.

[7] *BS 10175:2011+A1 20132 – Investigation of Potentially Contaminated Sites - Code of Practice.*
[8] *BS 5930:20153 – Code of practice for ground investigations.*
[9] https://www.gov.uk/government/publications/contaminated-land-statutory-guidance

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Baseline Surveys – Desk Based Research

9.2.6 The baseline conditions, described within the following section, present the summary findings of a Phase 1 Geo-Environmental Assessment Report[10] undertaken by Uniper Technologies Ltd in April 2020 (**Appendix 9-1**).

9.2.7 The following data sources have been consulted as part of the production of this report:

- Groundsure Enviro & Geo Insight Report (Reference EMS-594347 795878);
- Ordnance Survey mapping (Reference EMS-594347 795877);
- British Geological Survey website, mapping and borehole data;
- Previous site investigation reports;
- Zetica Online UXO Risk Maps;[11] and
- Defra MAGIC map application.[12]

Baseline Surveys – Field Surveys

9.2.8 A walkover of the Site was carried out on 3 March 2020 by a representative of Uniper Technologies Ltd.

9.2.9 No project-specific intrusive field surveys were undertaken prior to the production of this ES Chapter. However, the understanding of the Site was supported by the findings of a site investigation carried out in 2008, covering approximately the same area, a review of which is included in **Appendix 9-1**.

Assessment of Significance / Assessment Criteria

9.2.10 This section outlines the methodology adopted to assess the likely significant environmental impacts on ground conditions resulting from the Proposed Development.

9.2.11 To assess the significance of identified risks and effects, the definitions presented in Table 9.1 of severity/magnitude have been used. The probability of the potential

[10] *Uniper Technologies Ltd - Phase 1 Geo-Environmental Assessment UTG/20/PMP/158/R, April 2020 (Appendix 9-1).*
[11] https://zeticauxo.com/downloads-and-resources/risk-maps/
[12] https://magic.defra.gov.uk/MagicMap.aspx

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impact occurring is classified according to the criteria given in Table 9.2. The criteria are based upon those presented within CIRIA Document C552[13] and DETR Guidance Document (2000).[14]

Table 9.1: Consequence / Severity of Impact

Classification	Definition
Severe	Short-term (acute) risk to human health likely to result in "significant harm" as defined by the Environmental Protection Act 1990, Part IIA. Short-term risk of pollution of controlled waters. Catastrophic damage to buildings/property. A short-term risk to a particular ecosystem, or organism forming part of such ecosystem.
Medium	Chronic damage to human health ("significant harm"). Pollution of controlled waters. A significant change in a particular ecosystem, or organism forming part of such ecosystem.
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services. Damage to sensitive buildings/structures/services or the environment.
Minor	Harm, although not necessarily significant harm, which may result in a financial loss, or expenditure to resolve. Non-permanent health effects to human health (easily prevented by measures such as protective clothing, for example). Easily reparable effects of damage to buildings, structures and services.

Table 9.2: Probability of Impact Occurring

Classification	Definition
High Likelihood	Pollutant linkage may be present, and impact is almost certain to occur in the long term, or there is evidence of harm to the receptor.
Likely	Pollutant linkage may be present, and it is probable that the impact would occur over the long term.
Low Likelihood	Pollutant linkage may be present and there is a possibility of the impact occurring although there is no certainty that it would do so.
Unlikely	Pollutant linkage may be present but the circumstances under which harm would occur are improbable.

9.2.12 An overall evaluation of the level of Significance of Effect has been gained from a comparison of the Consequence / Severity of Impact and Probability of Impact Occurring as shown in Table 9.3.

[13] *Construction Industry Research and Information Association (CIRIA) Document C552 'Contaminated land risk assessment. A guide to good practice', 2001.*
[14] *Department of the Environment, Transport and the Regions - Document 'A Guide to Risk Assessment and Risk Management for Environmental Protection', July 2000.*

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Table 9.3: Significance of Effect

Probability of Impact Occurring	Consequence / Severity of Impact			
	Severe	**Medium**	**Mild**	**Minor**
High Likelihood	Severe	Major	Moderate	Minor
Likely	Major	Moderate	Minor	Not Significant
Low Likelihood	Major/Moderate	Moderate/Minor	Minor	Not Significant
Unlikely	Moderate/Minor	Minor	Minor	Not Significant

9.2.13 An assessment was undertaken to identify and assess risks of contamination relating to the construction and operation of the Proposed Development.

9.2.14 Drawing upon the findings of the Phase 1 Site Investigations and other relevant information (contained within **Appendix 9-1**), a source–pathway–receptor (SPR) model was developed to identify likely significant environmental effects related to potential contamination at the Site. The level and significance of such effects were assessed qualitatively, using professional judgement, by considering the sensitivity of receptors in relation to geology, hydrogeology, human health and the general environmental context of the Site.

9.2.15 For the purposes of this assessment, effects assessed as Severe, Major, Moderate or Moderate / Minor will be regarded as Significant and effects assessed as Minor or below will be regarded as Not Significant.

9.2.16 It is recommended that a supplementary Phase 2 Intrusive Investigation is undertaken to further refine and reduce the potential environmental and geotechnical risks at the Site prior to construction.

Mitigation

9.2.17 Mitigation measures have been defined based on professional judgement using professional experience of designing remedial measures to deal with unacceptably high risks associated with ground contamination and geotechnical constraints.

Limitations

9.2.18 At the time of writing, no project-specific Phase 2 Intrusive Investigation has been undertaken at the Site. A Phase 1 Desk Study has been produced (see **Appendix 9-1**). This was based on an environmental database search (Groundsure Geo Insight and Enviro Insight Report) for the Site. An historical ground investigation (2008) has been carried out at the Site (other historical ground investigations have also partially overlapped the Site footprint) and the findings of these investigations are considered in more detail within **Appendix 9-1**.

9.2.19 Relevant limitations and assumptions are presented in that report and apply equally to the assessments presented below.

Scope of Assessment

9.2.20 The proposed scope of this ES Chapter was set out in the EIA Scoping Report (**Appendix 2-1**) submitted to Nottinghamshire County Council (NCC) on 14 February 2020. The formal Scoping Opinion was provided on 6 April 2020 (**Appendix 2-2**) and confirmed that: *“The scoping report clearly identifies the relevant issues which would need to be addressed in a planning application Environmental Statement. The approach and assessment criteria are detailed within the scoping documentation and appears to consider all the aspects required for each of the relevant assessments. The findings of the individual reports may however generate further comment once the Environmental Statement, supported by the assessment documentation is finally submitted.”*

9.3 Baseline

9.3.1 The following sections briefly summarise the baseline ground conditions at the Site. Existing baseline conditions are described in detail within **Appendix 9-1**.

Site History

9.3.2 Historical mapping indicates that the Site comprised undeveloped land prior to the development of the Power Station in the mid-1960s. The Site spans several field boundaries including Drypot Barn located immediately to the south-east of the Site, indicating the land was likely to have been used for agriculture.

9.3.3 During the 1980s and 1990s the Site was in use as a sports field, known to comprise football pitches, cricket pitches and ancillary clubhouse buildings. The Site is known to have been used as a temporary laydown and car parking area during the

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construction of the Flue Gas Desulphurisation (FGD) Plant in the 1990s. Small workshop structures were also present at this time.

9.3.4 A contractor's car parking area was constructed on the east of the Site from the early 2000s, which currently occupies the area to the south of the Site. More recently, the Site provided temporary laydown during construction of the Selective Catalytic Reduction (SCR) frame structure at the Power Station.

Off-Site Historical / Current Land Uses

The Wider Ratcliffe-on-Soar Power Station Site

9.3.5 Historically, the Power Station site was occupied by agricultural land and wooded areas. Two 'Old Shaft' (likely old mineshafts associated with gypsum extraction) were identified from 1900. The Power Station plant was constructed in the 1960s and commissioned in 1968. During construction of the Power Station it is reported that considerable land raising, basement excavation and deep foundations were constructed; therefore, localised deeper Made Ground may be present.

Other Surrounding Land Use

9.3.6 Two gypsum mines are located approximately 700 m west and 800 m south-east of the Site respectively, noted as disused after the 1899 mapping. Wood Hill and Wright's Hill plantations are recorded close to the northern Site boundary, and are still present today.

9.3.7 The East Midlands Main Line railway is shown to run in its current location (trending north–south) since the earliest (1884) OS mapping. Several gypsum mines are noted from the earliest mapping, located to the north, west and south-east of the Site. A branch from this railway runs into and loops around the Power Station site.

9.3.8 During the 1960s, the A453 (formerly the A648) was constructed to the south of the Power Station site, running broadly east to west. The A453 was converted to a dual carriageway and partially rerouted in 2013–15.

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Geology

9.3.9 British Geological Survey (BGS) geological mapping and information from historical site investigations (discussed in greater detail in Section 3 of **Appendix 9-1**) indicate that superficial deposits are absent across the Site.

9.3.10 The bedrock geology is known to comprise the Branscombe Mudstone Formation (BMF) of the Mercia Mudstone Group (red brown mudstone with thin intercalations of green grey, hard, dolomitic siltstone or sandstone). The BMF is known to contain abundant gypsum that occurs as veins, nodules and thick beds. Two thick beds of gypsum (the Newark Gypsum and Tutbury Gypsum) are known to be present in the East Midlands and have been identified at the Site during previous investigations.

9.3.11 Two faults are mapped as trending roughly north–south, immediately to the west of the Site. The faults may have led to a greater depth of gypsum dissolution, resulting in an increased thickness of heavily weathered mudstone.

9.3.12 Made Ground is known to overlie the BMF in the majority of the Power Station Site, up to a maximum recorded thickness of 8.3 m. The Made Ground beneath the Site was recorded to be generally less than 1.5 m in depth, though up to 3 m deep in the north and the south of the Site.

Hydrogeology

9.3.13 Based on the published geological records referred to above and knowledge of the Site from previous investigations and monitoring, the hydrogeology of the Site is likely to be characterised by a prevailing south-westerly groundwater flow.

9.3.14 The groundwater flow direction beneath the Power Station site is roughly towards the south and south-east, though indications from other groundwater monitoring in the area suggest that the deep foundations and underground structures associated with the Power Station affect the flow somewhat. In addition, groundwater is dominated by fracture flow and dissolution of gypsum veins, further complicating the scenario.

Hydrology

9.3.15 Surface water features on the wider Power Station site comprise ash settling lagoons, attenuation ponds, water filled gypsum cells and various drainage ditches.

9.3.16 The River Trent is located approximately 600 m to the north-west of the Site and the River Soar is located approximately 1 km to the west.

Ground Gases

9.3.17 The significant thicknesses of Made Ground present onsite, represent a potential source of hazardous ground gasses (carbon dioxide / methane).

9.3.18 During a previous investigation at the Site, ground gases were encountered in marginally elevated concentrations; methane was recorded at a maximum of 0.8 % and carbon dioxide at a maximum of 5.8 %.

9.3.19 The marginally elevated levels of ground gases, identified from previous investigation, mean that sections of the Site will likely fall into Characteristic Situation 2 (CS2) in accordance with CRIA C655 [15] and will require gas protection measures to be incorporated into the design.

Potential Sources of Contamination

9.3.20 The main pollutant linkages are associated with low levels of heavy metal contamination and potential asbestos in the Made Ground, as identified during previous ground investigation. The Made Ground predominantly poses a risk to groundworkers during the construction phase of the development, which can be mitigated through the adoption of appropriate personal protective equipment (PPE), toolbox talks and good hygiene. The levels of contamination identified from previous investigations are found to fall below the Generic Assessment Criteria (GAC) for a commercial development, with the predominantly hardstanding cover of the Proposed Development limiting any potential pathways for heavy metal contamination or asbestos to impact future site users.

[15] *Construction Industry Research and Information Association (CIRIA). 2007, Report C665, Assessing Risk Posed by Hazardous Ground Gases to Buildings.*

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9.4 Assessment of Effects

9.4.1 No environmental effects have been scoped out of this Chapter.

Potential Sources of Effect

9.4.2 The potential pathways that have been identified for the site include the following:

- Direct contact with contaminated soils;
- Ingestion of contaminated soil, dust, liquid, etc.;
- Inhalation of dust;
- Horizontal migration of contaminants in the soil leachate;
- Vertical migration of contaminants in the soil leachate;
- Upward vertical migration of ground gasses into buildings / structures; and
- Direct contact with chemically aggressive strata.

9.4.3 Potential human health, controlled water and ecological receptors include:

- Future site users – using the site post development for commercial purposes;
- Groundworkers – working on site during the construction phase;
- Offsite human health receptors – Neighbouring site users working in or visiting the surrounding area (the Power Station, etc.);
- Surface water features – various minor surface water features on the Power Station site including ash settling lagoons, attenuation ponds, water filled gypsum cells and various drainage ditches. The River Trent approximately 600 m to the north-west of the Site and the River Soar approximately 1 km to the west of the Site;
- Groundwater – BMF is a Secondary B Aquifer underlying the Site;
- Local flora and fauna, during and post-demolition and construction; and
- Underground services such as buried structures and foundations.

Construction Phase

Human Health Risk

9.4.4 A potential pollutant linkage has been identified in the conceptual model concerning human health of the construction workers (via direct contact, ingestion or inhalation of contaminated soil, dust, liquid, etc.) and neighbouring site users (via wind-blown

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dust). The contaminants of concern are low levels of heavy metal contamination and potential asbestos in the Made Ground. The limited chemical testing data available from historical site investigations at the Site identified low levels of heavy metals (below the commercial GAC) and potential asbestos (a single exploratory location in the south of the Site) within the Made Ground. In the absence of additional information, the severity of impact (without implementing any mitigation measures to limit contact of construction workers or neighbouring site users to contaminants) is conservatively assessed as Medium.

9.4.5 During the construction phase, the excavation and removal activities may expose construction workers to potentially contaminated Made Ground during the development of the Site. Also, marginally elevated levels of carbon dioxide and methane arising from organic rich strata have the ability to accumulate in confined spaces and impact human health. As construction workers are likely to come into physical contact with potentially contaminated materials during the excavation / removal of Made Ground during construction, the probability is assessed as Likely. Thus, the significance of effect is judged to be **Moderate** (significant).

9.4.6 Regarding neighbouring site users, the exposure to chemical contaminants is most likely to occur via wind-blown dust from the construction site. The lack of nearby sites to the east, north and west of the development means that few potential receptors of wind-blown dust exist, and the probability of the pollutant linkage being realised is Unlikely. This results in a significance of the effect that is **Minor** (not significant).

Impact upon Controlled Waters

9.4.7 The Site is absent of natural superficial deposits, with predominantly cohesive Made Ground previously proved to overly BMF bedrock (a Secondary B Aquifer). The environmental database report indicates that there are no active licensed groundwater abstractions within a 1 km radius of the Site and no potable water abstraction licenses within 2 km of the Site. The site is not located within a groundwater Source Protection Zone (SPZ).

9.4.8 Surface water features on the Power Station site comprise ash settling lagoons, attenuation ponds, water filled gypsum cells and various drainage ditches. The River Trent is located approximately 600 m to the north-west of the Site and the River Soar is located approximately 1 km to the west. Two surface water abstractions are

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granted from the River Trent; one approximately 500 m north-west of the Site for process water to the Power Station site granted to Uniper UK Limited and the other approximately 8090 m north-west of the Site for fish farming at the Thrumpton Hall fish ponds.

9.4.9 During the construction of the Proposed Development, construction activities may result in spillages of bulk storage fuels / chemicals, with incident precipitation causing vertical migration of these contaminants into the underlying soils and bedrock. There is also the potential that contaminants are present within the Made Ground; when exposed during construction, after rainfall and / or following the movement of material around the Site, these could migrate into the groundwater.

9.4.10 The potential for mobilisation and migration of any Made Ground contaminants into the underlying strata causing an adverse impact to any groundwater in the BMF bedrock is considered to be low, due to the lack of identified sources of significant contamination. In the unlikely event of localised fuel / chemical spills, low permeability cohesive Made Ground would act as an aquitard, reducing the vertical and lateral migration of contaminants in the soil leachate. In both cases, the low sensitivity of underlying groundwater in the BMF (Secondary B aquifer), and known poor background water chemistry of the groundwater within the BMF (high calcium and sulphate levels due to gypsum dissolution) means that the severity of any impacts is likely to be Mild. Thus, the potential significance of these effects is judged to be **Minor** (not significant).

9.4.11 The likelihood of contaminants migrating from off-site sources is also deemed to be Low due to the predominantly cohesive nature of the underlying strata. Without mitigation the severity of impact is assessed as Mild and the probability as Low. Thus, the potential significance of effect is judged to be **Minor** (not significant).

9.4.12 The strata beneath Site are unlikely to be in hydraulic continuity with the low sensitivity surface water features of the Power Station site. The higher sensitivity surface water bodies (the Rivers Trent and Soar) are located sufficiently far away that lateral migration of contaminants from the Site through ground or surface water run-off is deemed unlikely. The severity of impact is assessed as Medium and the probability as Unlikely. Hence, the potential significance of effect is judged to be **Minor** (not significant).

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Impact on Building Occupants due to Geotechnical / Ground Stability Issues

9.4.13 If insufficient information is gathered on the geotechnical properties of the ground beneath the Proposed Development, there is a risk that foundations are not designed and installed correctly. Consideration should be given to the appropriate method of piling (if required) considering the nature of the ground conditions at the Site.

9.4.14 The Site is underlain by bedrock of the BMF, which is known to be gypsiferous and prone to the development to underground voids due to dissolution of gypsum. Underground voids have been identified during historical investigation in the immediate surroundings of the Power Station site. The varying depths of Made Ground also present the risk of differential settlement, resulting from the foundations spanning strata of different strengths (i.e. Made Ground and BMF).

9.4.15 In the absence of mitigation measures, the severity of impact is assessed as Medium, due to the potential for direct effects on human health of the building occupants, resulting from instability or collapse of the structure. The current understanding of the ground conditions beneath the Site (taking into account the ground conditions encountered within the Power Station site) mean that further geotechnical information is likely required to inform the final design of the Proposed Development; hence the probability of impact occurring without mitigation is Likely. Thus, the potential significance of effect is judged to be **Moderate** (significant).

Impact upon Ecological Receptors

9.4.16 No plausible linkage has been identified in the conceptual model between ecological receptors as no sensitive ecological receptors were identified in close proximity to the Site. It is considered unlikely that significant concentrations of contamination via air, dust or water would migrate off-site during the construction or operational phases. A detailed ecological assessment is provided in Chapter 6.0 of this ES. Thus, the potential significance of effect is judged to be **Not Significant**.

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Operational Phase

Impact upon Human Health

9.4.17 Future site users of a commercial nature may come into contact with contaminated Made Ground (via direct contact, ingestion or inhalation of contaminated soil, dust, liquid, etc.). The limited chemical testing data available from historical site investigations at the Site identified low levels of heavy metals (below the commercial GAC) and potential asbestos (a single exploratory location in the south of the Site) within the Made Ground. In the absence of additional information, the severity of impact (without implementing any mitigation) is conservatively assessed as Medium.

9.4.18 Post-construction, the built environment will act as an inherent barrier, limiting any pathways that may expose future site users to contaminated soils; hence the probability of any impact occurring is Unlikely. Thus, the significance of effect is judged to be **Minor** (not significant).

Impact upon Controlled Waters

9.4.19 During the ongoing operation of the Proposed Development, construction activities may result in spillages of bulk storage fuels / chemicals, with incident precipitation causing vertical migration of these contaminants into the underlying soils and bedrock. The presence of near-surface low permeability cohesive Made Ground would act as an aquitard and reduce the vertical and lateral migration of contaminants in the soil leachate. The low sensitivity of underlying groundwater in the BMF (Secondary B aquifer), and known poor background water chemistry of the groundwater within the BMF (high calcium and sulphate levels due to gypsum dissolution) means that the severity of any impacts is likely to be Mild.

9.4.20 Furthermore, the vast majority (upward of 90 % of the total area) of the Proposed Development would be occupied by hardstanding cover, inherently limiting rainfall percolation and downward migration of any contaminants from surface level. Hence, the probability of impact is judged to be unlikely. The significance of effect is considered to be **Minor** (not significant).

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Impact upon Construction Materials

9.4.21 A likely linkage exists between potentially aggressive chemical conditions in the Made Ground and natural soils, with below ground concrete used in the new development. It is likely that aggressive ground conditions are present within the underlying BMF due to the gypsiferous nature of the Mercia Mudstone Group, which has been identified from previous testing at the Site. Without mitigation, the severity of impact is assessed as Medium and the probability as Likely. Thus, the potential significance of effect is judged to be **Moderate** (significant).

Impact from Ground Gases

9.4.22 A potential pollutant linkage has been identified relating to the migration and accumulation of hazardous ground gasses impacting future site users. Previous ground investigation at the Site identified slightly elevated levels of carbon dioxide, meaning that sections of the site would likely be classified as Characteristic Situation 2 (CS2). Without mitigation the severity of impact is assessed as Moderate to Severe and the probability as Low. Thus, the potential significance of effect without mitigation is judged to be **Moderate** (significant).

9.5 Cumulative Effects

Assessment of Cumulative Effects

9.5.1 In this section, consideration is given to the potential for likely significant inter-cumulative and intra-cumulative effects to arise from the Proposed Development.

Assessment of Construction Phase Cumulative Effects

9.5.2 None identified.

Assessment of Operational Phase Cumulative Effects

9.5.3 If any contamination enters water supply pipes, this could affect the potable water supply to the Proposed Development. However, the severity of impact is judged to be Mild and the probability is expected to be Low given the mitigation measures

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outlined in Section 9.6; as such the significance of effect is determined to be **Not Significant**.

Inter-project Cumulative Effects

9.5.4 As set out in Chapter 2.0 of this ES, the only project identified as potentially having implications in terms of cumulative effects relates to the High Speed Rail Phase 2b (HS2b) development.

9.5.5 Any significant impacts on the Site resulting from HS2b are unlikely to occur due to the distance from the Site, with the severity of any impacts on ground conditions at the Site is judged to be Minor. The probability of any adverse effects arising is considered to be Unlikely. As such, the significance of effect is determined to be **Not Significant.**

9.6 Mitigation

Construction Phase

Human Health (groundworkers and site neighbours)

9.6.1 Prior to construction, the Site would be subject to intrusive investigation which would provide site-specific, contemporary, environmental information pertaining to the:

- Presence of contaminants at the Site (if any);
- Groundwater quality and levels at the Site; and
- Presence of ground gases at the Site (if any).

9.6.2 A potential pollutant linkage has been identified in the conceptual model concerning human health of the construction workers (via direct contact, ingestion or inhalation of contaminated soil, dust, liquid, etc.) and neighbouring site users (via wind-blown dust). These effects would occur over a temporary short-term basis, during the excavation and removal of Made Ground.

9.6.3 To mitigate the potential impacts of the construction phase, the construction would adhere to a site-specific Construction Environmental Management Plan (CEMP) as

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described in Chapter 4.0 of this ES. All working practices on site will be carried out in accordance in accordance with CIRIA C741 [16], including:

- measures to minimise dust generation;
- provision of PPE, such as gloves, barrier cream, overalls etc., to minimise direct contact with soils;
- provision of adequate hygiene facilities and clean welfare facilities for all construction site workers;
- monitoring of confined spaces for potential ground gas accumulations, restricting access to confined spaces, i.e. by suitably trained personnel, and use of specialist PPE, where necessary; and
- preparation and adoption of a site and task specific health and safety (construction phase) plan.

9.6.4 If unexpected contamination is observed during the construction phase, the material would be segregated and tested. A suitably qualified person (such as an environmental consultant) would be responsible for inspecting and testing any material which displays any visual and / or olfactory signs of contamination. Based on the results of testing, the soils would be reused, treated or disposed of off-site as required.

9.6.5 Proposed criteria for the reuse of soils would be included in the earthworks specification for the development. Earthworks will be designed such that they result in the most sustainable solution being adopted, normally one that minimises the need for off-site disposal by reuse of materials on site. Where such a solution is possible, the works will be undertaken in compliance with a Materials Management Plan prepared in accordance with the CL:AIRE Definition of Waste: Development Industry Code of Practice.[17]

9.6.6 Earthworks would be carried out by qualified and experienced contractors working to an industry-standard specification which would include a requirement for dust-suppression measures and mandatory use of PPE by the workforce. All human health risks associated with contaminants in residual Made Ground will thus be mitigated.

[16] *Construction Industry Research and Information Association (CIRIA) C741 – Environmental Good Practice on Site, 4th Edition, 2015.*
[17] *CL:AIRE - The Definition of Waste: Development Industry Code of Practice, Version 2, March 2011.*

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Impact upon Controlled Waters

9.6.7 If unexpected contamination is identified during the construction phase, the material would be segregated and tested. A suitably qualified person (such as an environmental consultant) would be responsible for inspecting and testing any material which displays any visual and / or olfactory signs of contamination. Based on the results of testing, the soils would be reused, treated or disposed of off-site as required.

9.6.8 During construction of the Proposed Development, construction activities may result in spillages of bulk storage fuels / chemicals, with incident precipitation causing vertical migration of these contaminants into the underlying soils and bedrock. Hence, fuels and chemicals would be stored in accordance with the Control of Pollution (Oil Storage) (England) Regulations 2011 [18], either in double skin tanks or within single skin tanks within appropriately sized bunds. Such storage containers would be inspected regularly for leaks or damage. Cement, concrete, other chemicals and materials would be stored securely. Prior to construction, an emergency response system would be set up to deal with incidents of construction spillages. Appropriate measures would be required to intercept, prevent and reduce any contamination through the agreed emergency response procedures. Following any significant event, testing and management of groundwater during Site development will prevent migration and contamination.

9.6.9 If significant contamination were to be identified during the intrusive investigation preceding the development, then a Remediation Strategy would need to be produced and implemented. The implementation of any such required measures would be confirmed through a Verification Report. This would be conditioned as part of the planning permission.

Geotechnical / Ground Stability Issues

9.6.10 The intrusive site investigation would provide data for robust foundation design requirements based on ground conditions encountered and the structural loads imparted by the building. The design work would be undertaken by experienced

[18] *http://www.legislation.gov.uk/uksi/2001/2954/contents/made*

professionals. The overall outcome would be mitigation of the risk of building instability during the construction and operational phases.

9.6.11 The geotechnical design work would also be expected to lead to foundation solutions that will mitigate any adverse effects on nearby buildings or infrastructure during operation.

Operational Phase

Impact upon Human Health (future commercial site users)

9.6.12 Once the Proposed Development has been constructed, the vast majority (upward of 90 % of the total area) would be occupied by hardstanding cover at surface level, limiting pollutant linkages to future workers and commercial site users in these areas. The remaining areas of soft landscaping would incorporate a clean topsoil capping layer and textile membrane to further limit dermal contact with potentially contaminated Made Ground in these areas.

9.6.13 Thus, the built environment mitigates any potentially adverse human health effect associated with localised ground contamination. There will be no opportunity for contact between building users and any contamination associated with Made Ground remaining on the Site.

Impact upon Controlled Waters

9.6.14 The Proposed Development would be operated subject to an Environmental Permit, and this would require chemicals and fuels to be stored and utilised in a manner that would not present a risk to soils or groundwater. As such the operation of the Proposed Development would not give rise to any effects on soils or groundwater. Measures taken to ensure the protection of controlled water bodies will include appropriate fuel storage, Environmental Management Systems (EMS) certified to ISO 14001, and use of fuel interceptors.

9.6.15 The predominantly hardstanding cover of the Proposed Development will limit percolation of any contaminants (arising from any localised contamination occurring from the Proposed Development) into the underlying of the BMF. The drainage system at the Site will connect to the drainage infrastructure of the Power Station

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Site, which ultimately discharges to the River Trent. The proposed on-site drainage system for the EMERGE Centre and the existing system for the Power Station site features fuel interceptors, settlement tanks, auto closure devices and penstocks to ensure pollution does not enter the River Trent. These features are to be modified and retained by the EMERGE Site after the operations of the Power Station cease.

Impact upon Construction Materials

9.6.16 It is likely that aggressive ground conditions are present within the BMF underlying the Site, as shown by previous testing, which could result in damage to underground concrete structures. The ground conditions should be characterised, and an appropriate concrete design class selected in accordance with BRE Special Digest 1.[19]

9.6.17 In Made Ground, contaminants may impact upon potable water piping and taint the water supply. In the case of water supply pipes, additional site investigation data will inform the need for impervious barrier piping to protect the potable water supply.

Impact from Ground Gases

9.6.18 A supplementary ground investigation is recommended, to confirm the ground gassing regime beneath the site, in accordance with CIRIA C665.[20]

9.6.19 In the event that ground gas risk is considered to be significant, the required level of gas protection measures determined from the additional site investigation data would be incorporated into the design of the building to fully mitigate the effect.

9.7 Residual Effects and Conclusions

9.7.1 When the mitigation measures are applied to reduce any effects regarded as significant, no significant residual effects are anticipated, as sources of contamination or pathways to receptors have been sufficiently modified or removed entirely. A summary is presented in Table 9.4.

[19] *Building Research Establishment – Special Digest 1 Third Edition. Concrete in Aggressive Ground (2005).*
[20] *Construction Industry Research and Information Association (CIRIA). 2007, Report C665, Assessing Risk Posed by Hazardous Ground Gases to Buildings.*

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9.7.2 The further ground investigation and / or mitigation measures recommended in this assessment would need to be agreed with the Nottinghamshire County Council Contaminated Land Officer (or similar) on behalf of the planning authority.

Table 9.4: Residual Impacts

Phase	Description	Pre-Mitigation Significance	Mitigation	Post-Mitigation Significance
Construction	Impact upon human health (construction workers and neighbouring site users)	Moderate (significant)	Implementation of an appropriate Construction Environmental Management Plan (CEMP).	Negligible residual impact and **not significant.**
	Impact upon Controlled Waters	Minor (not significant)	Fuels and chemicals would be stored in accordance with the Control of Pollution (Oil Storage) Regulations. Implementation of a remediation strategy (if required).	Negligible residual impact and **not significant.**
	Impact on Building Occupants due to Geotechnical / Ground Stability Issues	Moderate (significant)	Site investigation to provide geotechnical data that will be used by engineering professionals to design foundations correctly.	Negligible residual impact and **not significant.**
	Impact upon ecological receptors	Not Significant	-	Negligible residual impact and **not significant.**
Operational	Impact upon human health (site end users and site maintenance workers)	Minor (not significant)	Inherent mitigation of the built environment. Hardstanding cover / clean topsoil capping and textile membrane in soft landscaping areas.	Negligible residual impact and **not significant.**
	Impact upon controlled waters	Minor (not significant)	Environmental Permit procedures including appropriate EMS and use of fuel interceptors, grit traps and shut-off valves.	Negligible residual impact and **not significant.**
	Impact upon construction materials (water supply pipes and buried structures / foundations)	Moderate (significant)	Site investigation to provide data that will be used by professionals to design water supply pipes and buried structures / foundations to resist chemical attack.	Negligible residual impact and **not significant.**
	Impact upon site end users from ground gasses	Moderate (significant)	Site investigation to provide data that will be used by professionals to design incorporated gas protection measures (if necessary).	Negligible residual impact and **not significant.**

NCC received 29.06.2020

CHAPTER 10.0 SURFACE WATER AND FLOOD RISK

APPENDICES (Volume 3 bound separately)

NCC received 29.06.2020

10.0 SURFACE WATER AND FLOOD RISK

10.1 Introduction

10.1.1 This Chapter considers the constraints that surface water and flood risk may place upon the Proposed Development, including:

- Flood risk;
- Surface water quality (watercourses [rivers and canals]; reservoirs, lakes and ponds; and wetlands);
- Flood risk management; and
- Land drainage.

10.1.2 The Study Area used for this assessment includes both the Application Site (hereafter referred to as the 'Site') and its nearby relevant hydrological features (extending at least 1 km from the Site), including the catchments of local watercourses, surface water features and dependent habitats. It also includes hydrogeological features, including underlying geology, aquifers and nearby groundwater dependent features.

10.1.3 This Chapter utilises the results of the site specific Flood Risk Assessment (FRA) prepared for the Proposed Development as a requirement of and in accordance with the National Planning Policy Framework (NPPF) and the associated Planning Practice Guidance. The FRA is included as **Appendix 10-1**.

10.1.4 The assessment covers the construction and operational phases of the Proposed Development and identifies aspects that have the potential to affect the existing baseline situation. The following issues have been considered:

- Effects on groundwater levels, flow and quality;
- Effects on surface water quality;
- Effects on groundwater dependent terrestrial ecosystems;
- Changes to the natural drainage patterns;
- Effects on base flows;
- Effects on run-off rates and volumes;
- Effects on erosion and sedimentation;
- Effects on water resources (both private and public water supplies); and
- Effects on flooding and impediments to flow.

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10.1.5 Where likely effects are predicted, their significance has been assessed taking into account measures incorporated into the design to mitigate or reduce the significance of these effects. Additional mitigation measures are then outlined to reduce any outstanding significant effects with significance then assigned to any residual effects following the implementation of the additional mitigation measures. Potential cumulative effects with other schemes are also considered.

Statement of Competence

10.1.6 This Chapter was written by a consultant who has over 17 years of experience in hydrology, flood risk and the planning process. The consultant is a member of the British Hydrological Society and a Member of the Chartered Institute of Water and Environmental Management (CIWEM). In addition, the consultant has written more than 1,000 FRAs and Environmental Statement (ES) chapters and has had formal training in use of the Flood Estimation Handbook, Urban Hydrology, sustainable drainage systems (SuDS), FRAs, water quality and planning. Finally, the consultant has successfully delivered both site and strategic assessments for a range of private and public sector clients nationwide, including developers, planning consultants, architects, private individuals, local planning authorities (LPAs) and the Environment Agency (EA).

10.2 Methodology and Scope of Assessment

Legislation and Guidance

10.2.1 This assessment takes into account the following legislation and policies that are directly relevant to surface water and flood risk issues including the NPPF, Planning Practice Guidance, Local Policy, as well as the EA Policies and Pollution Prevention Guidelines. These are listed in Table 10.1.

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Table 10.1: Summary of Published Legislation and Best Practice

Topic	Sources of Information
National Policy & Legislation	A Better Quality of Life: A Strategy for Sustainable Development for the UK Making Space for Water The Pitt Review Flood and Water Management Act 2010 Land Drainage Act and Water Resources Act 1991 The Water Framework Directive
National Planning Policy	National Planning Policy Framework (2019) Planning Practice Guidance (2014) Waste Management Plan for England (2013) National Planning Policy for Waste (2014)
County and Local Policy and Guidance	Nottinghamshire and Nottingham Waste Core Strategy (2013) Nottinghamshire and Nottingham Waste Local Plan (2002) Rushcliffe Borough Council Local Plan 1: Core Strategy (2014) Rushcliffe Borough Council Local Plan 2: Land and Planning Policies (2014) Greater Nottingham Strategic Flood Risk Assessment Addendum (2017) Nottinghamshire and Nottingham Level 1 Strategic Flood Risk Assessment, Minerals and Waste (2011)
Environment Agency Pollution Prevention Guidelines *	PPG1 Understanding your Environmental Responsibilities – Good Environmental Practices (2013) PPG2 Above Ground Oil Storage Tanks (2001) PPG3 Use and Design of Oil and Separators in Surface Water Systems (2006) PPG4 Treatment and Disposal of Sewage where no Foul Sewer is available (2000) PPG5 Works or Maintenance in or Near Water (2007) PPG6 Working at Construction and Demolition Sites (2012) PPG7 The Safe Operation of Refuelling Facilities (2011) PPG8 Safe Storage and Disposal of used Fuels (2004) PPG13 Vehicle Washing and Cleaning (2007) PPG21 Incident Response Planning (2009) PPG22 Dealing with spills (2011) Environment Agency Guidance 'Oil Storage Regulations for Businesses' (2015) Environment Agency Guidance 'Manage Water on Land: Guidance for Land Managers' (2015)
Other Guidelines	CIRIA C502 Environmental Good Practice on Site CIRIA C532 Control of Water Pollution from Construction Sites CIRIA C753 The SuDS Manual Preparation of Environmental Statement for Projects that require Environmental Assessment. A Good Practice Guide (1995) Flood Risk to People Methodology (FD2321/TR1) Flood Risk Assessment Guidance for New Development (FD2320/TR2) Improving the Flood Performance of New Buildings; Flood Resilient Construction (2007)
** (now withdrawn, but still with useful points of reference)*	

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Assessment Methodology

10.2.2 The approach to the assessment considers the degree (or the 'significance') of the likely effects upon the hydrological characteristics of the Site.

10.2.3 The Study Area used for this assessment includes both the Site and its nearby relevant hydrological features (extending at least to 1 km from the Site), including the catchments of local watercourses, surface water features and dependent habitats. It also includes hydrogeological features, including underlying geology, aquifers and nearby groundwater dependent features.

10.2.4 The following criteria have been used in evaluating the significance of the effects of the Proposed Development:

- The significance is defined taking into account the sensitivity of the receiving environment and the potential magnitude of the effect as defined;
- The sensitivity of the receiving water environment is assessed, as defined in Table 10.2; and
- The magnitude of the effect has been evaluated, as defined in Table 10.3.

10.2.5 The sensitivity of the receiving environment together with the magnitude of the effect defines the significance of the effect prior to application of mitigation measures as outlined within Table 10.4. Professional judgement is used to assess the findings in relation to each of these criteria to give an assessment of significance for each effect. This approach has been used to inform the assessment of predicted effects.

Assessment of Significance / Assessment Criteria

10.2.6 Significance has been defined considering the sensitivity of the receiving environment and the potential magnitude of the impact.

10.2.7 The sensitivity of the receiving water environment, i.e. its ability to absorb the effect without perceptible change, is defined in Table 10.2.

Table 10.2: Definition of Sensitivity of the Receiving Environment

Sensitivity	Definition
High	• Receptor with a high quality and rarity, regional or national scale and limited potential for substitution / replacement. • Inner Source Protection zone (Zone 1). • Site of Special Scientific Interest (SSSI) or Special Area of Conservation (SAC). • Excellent water quality. • Large scale industrial agricultural abstractions > 1000 m^3/day within 2 km downstream, or abstractions for public drinking water supply. • Designated salmonid fishery and/or salmonid spawning grounds present. • Watercourse widely used for recreation, directly related to watercourse quality (e.g. swimming, salmon fishery etc.) within 2 km downstream. • Conveyance of flow and material, main river > 10 m wide. • Active floodplain area (important in relation to flood defence), i.e. Flood Zone 3b.
Medium	• Receptor with a high quality and rarity, local scale and limited potential for substitution / replacement or receptor with a medium quality and rarity, regional or national scale and limited potential for substitution / replacement. • Outer Source Protection Zone (Zone 2). • Principal Aquifer. • Good water quality. • Large scale industrial agricultural abstractions 500–1000 m^3/day within 2 km downstream. • Surface water abstractions for private water supply for more than 15 people. • Designated salmonid fishery and / or cyprinid fishery. • Watercourse used for recreation, directly related to watercourse quality (e.g. swimming, salmon fishery etc.). • Conveyance of flow and material, main river > 10 m wide. • Active floodplain area (important in relation to flood defence), i.e. Flood Zone 3b and land having a 1 in 100 or greater annual probability of flooding, i.e. Flood Zone 3a.
Low	• Receptor with a medium quality and rarity, local scale and limited potential for substitution / replacement or receptor with a low quality and rarity, regional or national scale and limited potential for substitution / replacement. • Total Catchment Source Protection Zone (Zone 3). • Secondary Aquifer. • Fair water quality. • Industrial / agricultural abstractions 50–499 m^3/day within 2 km downstream. • Designated cyprinid fishery or undesignated for fisheries – Occasional or local recreation (e.g. local angling clubs). • Groundwater abstractions 50–500 m^3/day – Private water supplies present. • Designated cyprinid fishery, salmonid species may be present and catchment locally important for fisheries. • Watercourse not widely used for recreation, or recreation use not directly related to watercourse quality. • Land having between a 1 in 100 or greater annual probability of flooding, i.e. Flood Zone 2.
Negligible	• Receptor with a low quality and rarity, local scale and limited potential for substitution / replacement. • No SPZ. • Unproductive strata. • Environmental equilibrium stable and resilient to changes that are greater than natural fluctuations, without detriment to its present character. • Polluted / poor water quality. • Industrial / agricultural abstractions < 50 m^3/day within 2 km downstream. • Fish sporadically present or restricted, no designated fisheries; not used for recreation. • Watercourse < 5 m wide. • Area does not flood / is located in Environment Agency Flood Zone 1. • Receptor heavily engineered or artificially modified and may dry up during summer months.

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10.2.8 The magnitude of the effect includes the timing, scale, size and duration of the effect. For the purposes of this assessment, the magnitude criteria are defined in Table 10.3. These may be reported as either beneficial or adverse. The list is not exhaustive and is intended as a guide.

Table 10.3: Magnitude of Effect

Magnitude	Criteria	Description and example
High	Adverse: results in loss of attribute and / or quality and integrity of an attribute	Adverse: Increase in peak flood level* (> 100 mm); loss of fishery; deterioration in surface water ecological or chemical Water Framework Directive (WFD) element status or groundwater or quantitative WFD element status.
	Beneficial: creation of new attribute or major improvement in quality of an attribute	Beneficial: Creation of additional flood storage and decrease in peak flood level* (> 100 mm), increase in productivity of size of fishery; improvement in surface water ecological or chemical WFD element status; improvement in groundwater qualitative or quantitative WFD element status.
Medium	Adverse: loss of part of an attribute or decrease in integrity of an attribute	Adverse: Increase in peak flood level* (> 50 mm); partial loss of fishery; measurable decrease in surface water ecological or chemical quality or flow with potential for deterioration in surface waste WFD element status or groundwater or quantitative WFD element status. Reversible change in the yield or quality of an aquifer, such that existing users are affected, with potential for deterioration in WFD element status.
	Beneficial: moderate improvement in quality of attribute	Beneficial: Creation of additional flood storage and decrease in peak flood level* (> 50 mm), measurable increase in surface water ecological or chemical quality or flow with potential for WFD element status to be improved. Measurable increase in the yield or quality of an aquifer, benefiting existing users, with potential for WFD element status to be improved. Improvement in groundwater qualitative or quantitative WFD element status.
Minor	Adverse: measurable change to the integrity of an attribute	Adverse: Increase in peak flood level* (> 10 mm); measurable decrease in surface water ecological or chemical quality or flow; decrease in yield or quality of aquifer, not affecting existing users or changing any WFD element status.
	Beneficial: measurable increase, or reduced risk of negative effect to an attribute	Beneficial: Creation of flood storage and decrease in peak flood level* (> 10 mm); measurable increase in surface water ecological or chemical quality; increase in yield or quality of aquifer not affecting existing users or changing any WFD element status. Measurable but limited change in a ground water supply reliability and quality.
Negligible	No change to integrity of attribute	Negligible change to peak flood level* (< ±10 mm); discharges to watercourse or changes to an aquifer which lead to no change in the attribute's integrity and / or in a ground water supply reliability and quality.

* Peak flood level for floods up to and including a 1 % annual probability event, including climate change. Where access or egress routes are affected, the magnitude of the impact will be defined by the change in the Flood Hazard Rating as defined in Defra/Environment Agency report FD2320.

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10.2.9 The sensitivity of the receiving environment together with the magnitude of the effect defines the significance of the effect prior to application of mitigation measures as outlined within Table 10.4.

Table 10.4: Significance Criteria

		Magnitude of Effect			
		High	**Medium**	**Minor**	**Negligible**
Receptor Sensitivity	**High**	Major	Moderate to Major	Minor	Negligible or Minor
	Medium	Moderate to Major	Moderate	Minor	Negligible
	Low	Minor to Moderate	Minor	Negligible or Minor	Negligible
	Negligible	Negligible or Minor	Negligible	Negligible	Negligible

10.2.10 Likely effects are therefore concluded to be of major, moderate, minor or negligible. Professional judgement is used to determine effects which are likely to be significant. The shaded boxes in Table 10.4 represent those effects that are considered to be significant in terms of the Environmental Impact Assessment (EIA) Regulations.

Scope of Assessment

10.2.11 Consultation has taken place with the relevant statutory bodies via the submission of an EIA Scoping Report to Nottinghamshire County Council (NCC). This confirmed that: *"NCC's Flood Risk Management Team recommend the following drainage characteristics should be incorporated within the design of the development.*

- *The development should not increase flood risk to existing properties or put the development at risk of flooding.*
- *Any discharge of surface water from the site should look at infiltration – watercourse – sewer as the priority order for discharge location.*
- *SUDS should be considered where feasible and consideration given to ownership and maintenance of any SUDS proposals for the lifetime of the development.*
- *Any development that proposes to alter an ordinary watercourse in a manner that will have a detrimental effect on the flow of water (e.g. culverting / pipe crossing) must be discussed with the Flood Risk Management Team at Nottinghamshire County Council."*

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Limitations

10.2.12 The assessment in this Chapter is reliant on the data presented in the FRA for the scheme and comments from NCC as the Lead Local Flood Authority (LLFA) and the EA. The EA's flood data can change over time. However, it is not considered that the above limitations would have a significant bearing on the outcome of this assessment.

10.3 Baseline

10.3.1 The sources of information used in this desktop study are listed in Table 10.5.

Table 10.5: Data Sources

Topic	Sources of Information
Topography	Ordnance Survey Maps. Site topographic survey.
Geology	BGS Bedrock and Superficial Geological Map. BGS online data.
Hydrogeology	Environment Agency online data. Relevant scientific literature.
Hydrology	Meteorological Office Historic Rainfall Data. FEH CD-ROM. National Soil Resource Institute. Environment Agency Flood Risk Maps.

Site Description and Topography

10.3.2 The Site is located on land at the Ratcliffe-on-Soar Power Station (hereafter referred to as the 'Power Station site'). The National Grid Reference (NGR) is 450472, 330464.

10.3.3 The Power Station site covers an overall area of circa 273 hectares (ha). This includes circa 167 ha lying to the north of the A453 Remembrance Way and circa 106 ha to the south of the A453. The main built elements of the Power Station and its related infrastructure are located in the northern part of the site (the Northern Power Station site). The Proposed Development would be located centrally of the Northern Power Station site, on an open area covering circa 4 ha. The Site is relatively flat and sits between 38.0 metres Above Ordnance Datum (m AOD) and 38.6 m AOD.

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10.3.4 The application Site has never previously been 'developed', but has been utilised as a laydown area and car park for contractors working on the wider Power Station site. As a consequence of this activity, it is surfaced with a mixture of tarmac and compacted stone hardstanding which benefits from drainage infrastructure (as described below).

Catchment Hydrology and Existing Drainage

10.3.5 All surface water bodies in the Study Area fall within the Trent Lower and Erewash, and Soar management catchments of the Humber river basin district (RBD).

10.3.6 The Site is located within the catchment of the River Soar as per the Flood Estimation Handbook (FEH) web service. Located within the vicinity of the Site is the River Soar and the River Trent; the River Soar is a tributary of the River Trent. The River Trent is located circa 650 m to the north-west of the Site and the River Soar is located circa 1.1 km to the west of the Site.

10.3.7 A drainage ditch is also located to the south-west of Uniper's Technology Centre which flows west (under the East Midlands Parkway Station) towards the River Soar. The Lockington Marshes SSSI, which lies in the floodplains of the River Soar and River Trent, is located circa 1.2 km to the west of the Site. Two waterbodies forming part of the surface water management scheme for the East Midlands Parkway Station are located to the west of the Site.

10.3.8 Surface water features on the Power Station site comprise ash settling lagoons, attenuation ponds, water filled gypsum cells and various drainage ditches. Currently the Site is positively drained to lagoons located to the south-west of the Site via petrol / oil interceptors and grit trap before ultimately discharging into the River Trent. The surface water drainage network including the lagoons provide significant attenuation storage capacity and controls the flow of suspended solids. However, at this stage it is not possible to demonstrate the attenuation storage capacity within the existing Power Station site system.

10.3.9 The existing on-site permeable or semi-permeable surfaces are constructed from granular surfacing that is positively drained via French drains linking into the existing Power Station site surface water drainage system. It is understood that the existing drainage infrastructure efficiently and effectively manages surface water run-off

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generated at the Site. As there is no history of surface water flooding at the Site it is likely that the current drainage system is sufficient for the current and proposed use.

10.3.10 The current system is oversized and would be adequate for the proposed flow rates taking into account climate change during the next 60 years which is the lifetime of the development. The existing site drainage would be adequate in specification and capacity to accept the discharges from the Proposed Development.

10.3.11 The Power Station site also benefits from its own foul sewerage network which directs foul water to an existing sewage farm (located to the south of the existing cooling towers). The foul water is treated before being pumped by existing pipework to the lagoons which form part of the drainage system (described previously) and ultimately the River Trent. This system is not connected to the mains foul sewerage system.

Rainfall

10.3.12 The Site is located within an area of low rainfall. The 1961–1990 Standard Average Annual Rainfall (SAAR) for the Site, as recorded in the FEH web service, is 601 mm per annum. The UK national average is 832 mm per annum.

Ground Conditions

10.3.13 British Geological Survey (BGS) geological mapping and information from historical site investigations indicates that superficial deposits are absent across much of the Site. A limited area of Quaternary Head deposits (silts and clays with infrequent gravels of Mercia Mudstone towards the base) are present toward the north of the Site.

10.3.14 The bedrock geology is known to comprise the Branscombe Mudstone Formation of the Mercia Mudstone Group (red brown mudstone with thin intercalations of green grey, hard, dolomitic siltstone or sandstone). The Branscombe Mudstone Formation is known to contain abundant gypsum that occurs as veins, nodules and thick beds. Two thick beds of gypsum (the Newark Gypsum and Tutbury Gypsum) are known to be persistent in the East Midlands and have been identified at the Site during previous investigation works.

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10.3.15 Made Ground is known to overlie the Branscombe Mudstone Formation in the majority of the Power Station site, up to a maximum recorded thickness of 8.3 m. The Made Ground beneath the Site was recorded to be generally less than 1.5 m in depth, though up to 3 m deep in the north and the south of the Site.

10.3.16 Information from the National Soil Resources Institute details the Site as being situated on slightly acid loamy and clayey soils with impeded drainage. The soil classification for WRAP (Soil) type is 4: 'clayey or loamy over clayey soils with an impermeable layer at shallow depth'.

Hydrogeology

10.3.17 The superficial deposits are designated as Secondary Undifferentiated. This is assigned where it is not possible to attribute either Category A or B to a rock type. In general, these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.

10.3.18 The bedrock deposits are designated as a Secondary B Aquifer. This comprises predominantly lower permeability layers that may store / yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.

10.3.19 The Site is not located within a Source Protection Zone (SPZ).

Surface Water Quality

10.3.20 The surface water body WFD designations within 2 km of the Site are shown in Table 10.6.

Table 10.6: WFD Surface Water Bodies

Distance (m) / Direction	Type	Name	Overall Rating	Chemical Rating	Ecological Rating	Year
1,120 W	River	Soar from Long Wharton Brook to Trent	Bad	Good	Bad	2016
650 NW	River	Trent from Soar to The Beck	Moderate	Good	Moderate	2006

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10.3.21 The area is designated as a Nitrate Vulnerable Zone (NVZ).

Groundwater Water Quality

10.3.22 The groundwater body WFD designations within 2 km of the Site are shown in Table 10.7.

Table 10.7: WFD Groundwater Bodies

Location	Name	Overall Rating	Chemical Rating	Ecological Rating	Year
On site	Soar - Secondary Combined	Good	Good	Good	2015

Surface Water Abstractions

10.3.23 The surface water abstraction licences extracting more than 20 m^3 of water a day within 2 km of the Site are shown in Table 10.8.

Table 10.8: Surface Water Abstraction Licences

Distance (m)	Direction	NGR	Details	
780	W	449600, 330800	Status: Historical Licence No: 03/28/60/0002 Details: Process Water Direct Source: Surface Water Midlands Region Point: RATCLIFFE-ON-SOAR POWER STATION – RIVER TRENT Data type: Point Name: UNIPER UK LTD	Annual volume (m^3): 61,234,620 Max daily volume (m^3): 217,398.80 Original Application No: - Original start date: 22/02/1966 Expiry date: - Issue No: 103 Version start date: 23/12/2016 Version end date: -
800	W	449600, 330120	Status: Historical Licence No: 03/28/59/0010 Details: Spray Irrigation - Direct Direct Source: Surface Water Midlands Region Point: REDHILL FARM - TRIBUTARY OF RIVER SOAR Data Type: Point Name: MORLEY	Annual Volume (m^3): 4,000 Max Daily Volume (m^3): 200 Original Application No: - Original Start Date: 16/07/1992 Expiry Date: - Issue No: 100 Version Start Date: 01/04/1994 Version End Date: -
813	NW	449600, 330900	Status: Active Licence No: 03/28/60/0001 Details: Fish Farm/Cress Pond Throughflow Direct Source: Surface Water Midlands Region Point: THRUMPTON HALL FISH PONDS - R TRENT Data Type: Point Name: SEYMOUR	Annual Volume (m^3): 199,660.32 Max Daily Volume (m^3): 545.52 Original Application No: - Original Start Date: 10/02/1966 Expiry Date: - Issue No: 101 Version Start Date: 01/04/2004 Version End Date: -
1,030	N	450250, 331610	Status: Historical Licence No: 03/28/60/0006 Details: Spray Irrigation - Direct Direct Source: Surface Water Midlands Region	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: - Original Start Date: 05/09/1997

Distance (m)	Direction	NGR	Details	
			Point: LAND AT LONG EATON - RIVER TRENT Data Type: Line Name: F W TAYLOR & SON	Expiry Date: - Issue No: 100 Version Start Date: 05/09/1997 Version End Date: -
1,349	1349	451320, 331600	Status: Historical Licence No: 03/28/60/0007 Details: Spray Irrigation - Direct Direct Source: Surface Water Midlands Region Point: THRUMPTON - RIVER TRENT Data Type: Line Name: C A STRAWSON FARMING LTD	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: - Original Start Date: 09/06/1999 Expiry Date: - Issue No: 1 Version Start Date: 09/06/1999 Version End Date: -
1,349	NE	451320, 331600	Status: Historical Licence No: 03/28/60/0007/1 Details: Spray Irrigation - Direct Direct Source: Surface Water Midlands Region Point: THRUMPTON - RIVER TRENT Data Type: Line Name: STRAWSON LTD	Annual Volume (m3): 110,000 Max Daily Volume (m3): 2,200 Original Application No: - Original Start Date: 16/01/2003 Expiry Date: 31/03/2017 Issue No: 101 Version Start 13/08/2004 Version End Date: -
1,474	SW	449603, 329114	Status: Historical Licence No: MD/028/0059/001 Details: Dust Suppression Direct Source: Surface Water Midlands Region Point: POINT 'A' ON THE RIVER SOAR, NOTTINGHAMSHIRE Data Type: Point Name: Laing O'Rourke Infrastructure Limited	Annual Volume (m^3): 16,000 Max Daily Volume (m^3): 200 Original Application No: - Original Start Date: 07/10/2013 Expiry Date: 31/03/2016 Issue No: 1 Version Start Date: 07/10/2013 Version End Date: -
1,682	NE	451380, 331970	Historical Licence No: 03/28/60/0005 Details: Spray Irrigation - Direct Direct Source: Surface Water Midlands Region Point: LAND AT THRUMPTON - RIVER TRENT (1) Data Type: Point Name: PLOWRIGHT	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: - Original Start Date: 23/05/1996 Expiry Date: - Issue No: 102 Version Start Date: 30/07/2000 Version End Date: -
1,719	NE	451376, 332016	Status: Active Licence No: MD/028/0060/001 Details: Spray Irrigation - Direct Direct Source: Surface Water Midlands Region Point: RIVER TRENT AT THRUMPTON, NOTTINGHAM Data Type: Point Name: J & J BURNETT LTD	Annual Volume (m^3): 60,000 Max Daily Volume (m^3): 1,200 Original Application No: - Original Start Date: 03/06/2010 Expiry Date: 31/03/2027 Issue No: 1 Version Start Date: 03/06/2010 Version End Date: -
1,739	NW	448874, 331505	Status: Active Licence No: 03/28/60/0004 Details: Process Water Direct Source: Surface Water Midlands Region Point: TRENTLOCK DRYDOCK - EREWASH CANAL Data Type: Point Name: Canal and River Trust	Annual Volume (m^3): 10,000 Max Daily Volume (m^3): 200 Original Application No: - Original Start Date: 20/09/1968 Expiry Date: - Issue No: 102 Version Start Date: 16/03/2018 Version End Date: -
1,740	NW	448870, 331500	Status: Historical Licence No: 03/28/60/0004 Details: Process Water Direct Source: Surface Water Midlands Region Point: TRENTLOCK DRYDOCK - EREWASH CANAL	Annual Volume (m^3): 10000 Max Daily Volume (m^3): 10000 Original Application No: - Original Start Date: 20/09/1968 Expiry Date: - Issue No: 101

Distance (m)	Direction	NGR	Details	
			Data Type: Point Name: Canal and River Trust	Version Start Date: 18/04/2008 Version End Date: -
1,824	S	450690, 328560	Status: Active Licence No: 03/28/58/0016 Details: Spray Irrigation - Direct Direct Source: Surface Water Midlands Region Point: LAND AT WEST LEAKE - RATCLIFFE MAIN DYKE (2) Data Type: Point Name: RT HON LORD BELPER	Annual Volume (m^3): 38,641.76 Max Daily Volume (m^3): 863.76 Original Application No: - Original Start Date: 10/03/1966 Expiry Date: - Issue No: 100 Version Start Date: 01/04/2019 Version End Date: -
1,868	N	451150, 332300	Status: Historical Licence No: 03/28/60/0007 Details: Spray Irrigation - Direct Direct Source: Surface Water Midlands Region Point: BARTON IN FABIS - RIVER TRENT Data Type: Line Name: C A STRAWSON FARMING LTD	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: - Original Start Date: 09/06/1999 Expiry Date: - Issue No: 1 Version Start Date: 09/06/1999 Version End Date: -
1,868	N	451150, 332300	Status: Historical Licence No: 03/28/60/0007/1 Details: Spray Irrigation - Direct Direct Source: Surface Water Midlands Region Point: BARTON IN FABIS - RIVER TRENT Data Type: Line Name: STRAWSON LTD	Annual Volume (m^3): 110,000 Max Daily Volume (m^3): 2,200 Original Application No: - Original Start Date: 16/01/2003 Expiry Date: 31/03/2017 Issue No: 101 Version Start Date: 13/08/2004 Version End Date: -
1,881	S	449800, 328500	Status: Historical Licence No: 03/28/57/0090 Details: Spray Irrigation - Direct Direct Source: Surface Water Midlands Region Point: CHURCH FARM, KINGSTON - RATCLIFFE BROOK Data Type: Line Name: N BEEBY & SON	Annual Volume (m^3): 14,879.058 Max Daily Volume (m^3): 654.62 Original Application No: - Original Start Date: 13/03/1966 Expiry Date: - Issue No: 100 Version Start Date: 16/03/2005 Version End Date: -
1,894	SW	449160, 328913	Status: Historical Licence No: MD/028/0059/001 Details: Dust Suppression Direct Source: Surface Water Midlands Region Point: POINT ‘B’ ON THE RIVER SOAR AT RATCLIFFE ON SOAR, NOTTS Data Type: Point Name: Laing O'Rourke Infrastructure Limited	Annual Volume (m^3): 16,000 Max Daily Volume (m^3): 200 Original Application No: - Original Start Date: 07/10/2013 Expiry Date: 31/03/2016 Issue No: 1 Version Start Date: 07/10/2013 Version End Date: -

Groundwater Abstractions

10.3.24 The groundwater abstraction licences extracting more than 20 m^3 of water a day within 2 km of the Site are shown in Table 10.9.

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Table 10.9: Groundwater Abstraction Licences

Distance (m)	Direction	NGR	Details	
1,093	W	449300, 330100	Status: Historical Licence No: 03/28/59/0001 Details: General Farming & Domestic Direct Source: Groundwater Midlands Region Point: REDHILL – WELLS (1) Data type: Point Name: MORLEY	Annual volume (m^3): - Max daily volume (m^3): - Original Application No: - Original start date: 03/02/1996 Expiry date: - Issue No: 100 Version start date: 01/04/2000 Version end date: -
1,094	SW	449500, 329700	Status: Historical Licence No: 03/28/59/0001 Details: General Farming & Domestic Direct Source: Groundwater Midlands Region Point: REDHILL – WELLS (3) Data type: Point Name: MORLEY	Annual volume (m^3): - Max daily volume (m^3): - Original Application No: - Original start date: 03/02/1996 Expiry date: - Issue No: 100 Version start date: 01/04/2000 Version end date: -
1,119	SW	449400, 329800	Status: Historical Licence No: 03/28/59/0001 Details: General Farming & Domestic Direct Source: Groundwater Midlands Region Point: REDHILL – WELLS (2) Data type: Point Name: MORLEY	Annual volume (m^3): - Max daily volume (m^3): - Original Application No: - Original start date: 03/02/1996 Expiry date: - Issue No: 100 Version start date: 01/04/2000 Version end date: -
1,863	NW	448710, 331470	Status: Active Licence No: 03/28/49/0003 Details: Spray Irrigation - Direct Direct Source: Groundwater Midlands Region Point: LAND AT SAWLEY - WELL Data type: Point Name: K B A & E M DEVELOPMENTS LTD	Annual volume (m^3): 4,500 Max daily volume (m^3): 65 Original Application No: - Original start date: 12/09/1996 Expiry date: - Issue No: 100 Version start date: 01/04/2008 Version end date: -

Potable Water Supply

10.3.25 The Power Station benefits from its own private water supply.

Flooding

10.3.26 An FRA (**Appendix 10-1**) has been carried out for the Proposed Development in accordance with guidance contained within the NPPF and associated Planning Practice Guidance. The FRA identifies and assesses the risks of all forms of flooding to and from the Proposed Development and demonstrates how these flood risks would be managed so that the Proposed Development remains safe throughout its lifetime, taking climate change into account. The FRA includes an assessment of the existing and proposed surface water drainage of the Site.

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10.3.27 The Site is not at risk of flooding from a major source (e.g. fluvial and / or tidal). The Site has a 'low probability' of fluvial / tidal flooding as it is located within Flood Zone 1 with less than a 1 in 1,000 annual probability of river or sea flooding in any year (< 0.1 %). A secondary flooding source (surface water flooding) has been identified which may pose a low risk to the Site.

10.3.28 The proposed use of the Site is 'essential infrastructure' in line with Planning Practice Guidance. 'Essential infrastructure' uses are appropriate within Flood Zone 1 after the completion of a satisfactory FRA. In conclusion, the flood risk to the Site can be considered as limited; the Site is situated in Flood Zone 1, with a low annual probability of flooding and from all sources. The Site is unlikely to flood except in very extreme conditions.

Water Dependent Habitats

10.3.29 There are no European conservation sites protected under the Habitats Regulations ('Habitat sites') located within 10 km of the Site.

10.3.30 There are two statutory designated sites within 2 km of the Site:

- Lockington Marshes SSSI, located approximately 1.2 km to the west of the Site boundary at its nearest point; and
- Forbes Hole Local Nature Reserve (LNR), located approximately 1.8 km to the north of the Site of the Site boundary at its nearest point.

10.3.31 Information on non-statutory designated sites (i.e. Local Wildlife Sites (LWSs)) within 2 km of the Proposed Development has been obtained from local biological records centres. Information provided through pre-application dialogue with the Environment Agency in relation to the Environmental Permit for the EMERGE Centre was also incorporated into this process. The location of the LWSs is provided in Table 3.1 of the Preliminary Ecological Appraisal which can be found in **Appendix 6-1**.

Recreation and Fisheries

10.3.32 There are designated fishery watercourses and / or watercourses used for recreation within 2 km of the Site.

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10.3.33 There are records of fish from the River Soar and River Trent, including species such as European bullhead and spined loach (both listed on Annex II of the EC Habitats Directive), European eel, barbel (Annex V) and brown trout.

10.3.34 Redhill marina is located on the River Soar circa 1 km to the west of the Site. The Ashfield Angling Club at Thrumpton Park is located on the River Trent approximately 800 m to the north west of the Site. The lakes to the south east of Long Eaton, used by the Trent Windsurfing Club are located circa 1.2 km to the north of the Site.

Sensitivity of Hydrological and Hydrogeological Receptors

10.3.35 The sensitivity of the identified receptors is shown in Table 10.10.

Table 10.10: Sensitivity of Identified Receptors

Receptor	Comment	Sensitivity
River Soar	Surface water flows from the Site would drain to the River Trent and should not affect the River Soar.	High
River Trent	Surface water flows from the Site would drain to the River Trent.	High
Other watercourses / water bodies (e.g. Lockington Marshes SSSI, Forbes Hole LNR)	Surface water flows from the Site would drain to the River Trent and should not affect other watercourses / bodies.	High

Future Baseline

10.3.36 The future baseline considers two possible scenarios, as set out below.

10.3.37 Baseline 1 ‘Current Baseline’: This would comprise the Site and its context as they now exist, including the operational coal-fired Power Station, with both Proposed Development construction and operational phases. Under Baseline 1, both the Power Station and the Proposed Development would operate for a 9-month period before the Power Station closes in September 2025. This would mean that any identified effects occurring during both the operation of the Power Station and the Proposed Development would be temporary in duration.

10.3.38 Baseline 2 ‘Future Baseline’: This would comprise the operational Proposed Development, but assumes that the Power Station and related components have been removed. However, the following development / infrastructure would remain:

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the Uniper Engineering Services offices; the National Grid substations and power lines, the gas turbine generating facility; the railway sidings; the gypsum and limestone storage buildings and their conveyor links to the sidings; and other lesser elements of infrastructure such as internal roads linking the preceding elements.

10.4 Assessment of Effects

10.4.1 The Proposed Development has the potential to affect the hydrology and hydrogeology in the vicinity of the Site, impacting surface water run-off, groundwater levels, flow direction and quality.

10.4.2 The significance of any potential pollution or changes in groundwater levels and flow would be dependent on the nature of the incident, incorporated mitigation measures and sensitivity of the potential receptor.

Incorporated Mitigation

10.4.3 A SuDS Strategy is proposed as part of the Proposed Development, details of which are contained in the FRA, **Appendix 10-1**. The SuDS Strategy ensures that a sustainable drainage solution can be achieved, which reduces the peak discharge rate to manage and reduce the flood risk posed by the surface water run-off from the Site as well as providing water quality benefits.

10.4.4 The existing Power Station site surface water drainage network including the lagoons (with restricted outfall to the River Trent) provides significant attenuation storage capacity and controls the flow of suspended solids. The lagoons provide attenuation storage and treatment; the system is subject to regular flushing, monitoring and cleaning. However, at this stage it is not possible to demonstrate the attenuation storage capacity within the existing Power Station site system. Therefore, it is proposed that the SuDS Strategy would take the form of an existing attenuation lagoons with a restricted outfall (note this is provided within the existing Power Station drainage system) with the following measures provided on the Site:

- Underground attenuation storage (oversized pipes / tanks / cellular storage) with a restricted outfall;
- Permeable surfaces (e.g. grass and / or gravel);
- Rainwater harvesting;
- Swale;

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- Reed bed;
- Grit trap; and
- Petrol / oil interceptors.

10.4.5 Consequently, surface water would pass through a swale, reed bed, grit trap, petrol / oil interceptors, all of which provide treatment for chemical spillages and suspended fine sediment on the Site. Thereafter it would be discharged into the attenuation lagoons, which would offer another stage of treatment (i.e. settlement), prior to the water ultimately being discharged into the River Trent.

10.4.6 The SuDS Manual identifies the number of treatment trains or SuDS devices through which flow should pass from various point sources of run-off. This is designed to ensure that the receiving environment is not put at risk of pollution by new development. Sufficient treatment train components are incorporated for both the sensitivity of the receiving watercourse and the nature of the development, as well as sediment control methods.

10.4.7 The surface water run-off from the site would be restricted to 7.67 litres / second (i.e. QBAR, or mean annual maximum flow rate), for all events up to and including the 1 in 100 year (+40 % allowance for climate change) event before discharge to the wider Power Station site surface water drainage network. As a consequence of limiting the rate of discharge from the Site, at times of heavy rainfall the volume of water leaving the Site would be significantly less than that currently draining from it. There would be no increase in flooding to people or property off-site as a result of the Proposed Development and no surface water flooding of the Site. It is therefore deemed sustainable to reuse the Power Station sites existing discharge to the River Trent.

10.4.8 In order to prevent water backing up in the on-site system and potentially causing flooding, surface water would be stored at the Site, through the incorporation of 3,059 m^3 of attenuation storage. The size of the attenuation storage has been calculated such that the Proposed Development has the capacity to accommodate the 1 in 100 year rainfall event including a 40 % increase in rainfall intensity that is predicted to occur as a result of climate change.

10.4.9 Development of the Site would take place with separate systems for surface water run-off from the roof areas and process water. The surface water drainage network would provide attenuation storage and treatment before discharge to the wider

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Power Station sites drainage system. Additional storage would be provided within the manholes, pipes and drainage gullies which would provide betterment.

10.4.10 The Proposed Development would give rise to surface water run-off from roads, vehicle parking areas, roofs of buildings, and other hard standings. Surface water run-off would be directed to the drainage system through drainage gullies located around the perimeter of the buildings and through contouring of the hardstanding areas. Incidental areas around the buildings would either be grassed or finished with granular (gravel) material and thus be permeable. Surface water flows from areas susceptible to pollution e.g. roads and parking areas, would pass through interceptors prior to being discharged into the surface water drainage system. Run-off arising from roof areas would not need to pass through interceptors and some of the collected run-off has the potential to be used in rainwater harvesting, subject to detailed design. Penstocks would also be fitted to the discharge points to enable the system to be isolated in the event of a pollution event.

10.4.11 The SuDS Strategy would improve the water quality by removing pollutants (through a grit trap and interceptors) reduce potable water demand (through rainwater harvesting) and, improve amenity and biodiversity (through a swale and reed bed features) in the proposed landscaping.

10.4.12 The drainage system, including proposed attenuation, would be maintained by the Site owner over the lifetime of the Proposed Development. These methods would reduce / slow peak flows and the volume of run-off and would provide a suitable SuDS solution for this Site.

10.4.13 In adopting these principles, it has been demonstrated that a Proposed Development would not increase the risk of flooding on the Site or in the wider hydrological catchment.

10.4.14 At this stage of the planning process it is proposed that the detailed drainage design would be secured by a planning condition attached to any planning permission. The details would be approved by NCC prior to works commencing. Ultimately, the proposed conceptual drainage design may be re-visited if it can be demonstrated that the attenuation storage can be met within the existing Power Station site surface water drainage network.

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10.4.15 The Proposed Development would be subject to strict management and regulation under the controls imposed by the Environmental Permit (EP) issued and regulated by the Environment Agency (EA). Therefore, design measures would be in place to prevent gross-pollutants from entering the surface water drainage system associated with the Proposed Development.

10.4.16 The flood risk posed to the Site would be reduced by using the following mitigation measures:

- Finished Floor Level: There is no minimum finished floor level proposed as a result of flooding;
- Flood Resilience and Resistance: The development of the layout should always consider that the Site is potentially at risk from an extreme event and as such the implementation of flood resilience and resistance methods should be assessed. To make buildings / structures more resistant to seepage they would be constructed from hard wearing materials and would be sealed against water ingress; and
- Access and Egress: The chance of flooding from all sources each year is low or not significant, therefore a permanently safe and dry access can be maintained.

10.4.17 In terms of foul sewerage, as identified previously the Power Station site benefits from its own network which directs foul water to the existing sewage farm (located to the south of the existing cooling towers). The foul water is treated before being pumped by existing pipework to the existing lagoons which form part of the drainage system and ultimately the River Trent. During the construction phase the compound would be able to connect into and benefit from the existing system. Following the closure of the Power Station it is anticipated that the network between the Site and the sewerage farm would be destroyed. As such, it is proposed to install a septic tank on the Site. The sewerage would be transferred between the Site and existing sewage farm by tanker until such time as a new connection can be made.

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Construction Phase

Assessment of Effects against Current Baseline

10.4.18 Potential effects that may arise during the construction phase of the Proposed Development are outlined below:

- Construction Site Run-off – Suspended Fine Sediments;
- Construction Site Run-off – Chemical Spillages;
- Temporary Increase in Impermeable Area;
- Impact on Groundwater Recharge; and
- Impact on Flood Risk.

Construction Site Run-off – Suspended Fine Sediments

10.4.19 The water environment and the flora and fauna that it supports may be adversely affected by excessive levels of fine sediment contained within surface water run-off originating from construction activities at the Site. Furthermore, the construction activities would involve the excavation and movement of soil / ground at the Site and therefore increase the potential for leaching of pollutants into surface water receptors.

10.4.20 Run-off laden with fine sediment is principally generated by rain falling onto land that has been cleared of any vegetation and the ground potentially compacted, preventing infiltration. Other potential sources of water containing high levels of fine sediment at the Site include run-off from material stockpiles, dewatering of excavations, mud on site and local access roads, and generated as part of the construction works themselves (e.g. vehicle washing).

10.4.21 Generally, excessive fine sediment in run-off is chemically inert and affects the water environment through smothering of riverbeds and plants, changing water quality (e.g. increased turbidity); consequently, it can have physical impacts on aquatic organisms. However, at this Site, where much of the ground within the main Proposed Development area comprises Made Ground, there is also the potential for fine sediments to impact the chemical status of water bodies.

10.4.22 Without mitigation in place watercourses would be susceptible to sediment laden water affecting water quality. Suspended fine sediment has the potential to affect

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fisheries, causing a measurable decrease in ecological and chemical quality on watercourses. However, suspended fine sediment would be diluted rapidly within watercourses such that any effect would only be present over a short distance of the watercourse compared to its overall length.

10.4.23 The Site includes areas of hardstanding and compacted gravel and is devoid of vegetation cover. As such some parts of the Site are already susceptible to erosion. Consequently, during significant rainfall events it is likely that sediment laden run-off currently enters the Power Station sites existing surface water drainage network, noting that the existing system includes a grit trap and the settling lagoons. However, this would be exacerbated during construction as the ground is disturbed during earthworks.

10.4.24 Therefore, without mitigation measures, suspended fine sediment could have a **minor** or **medium** adverse effect on watercourses, depending on the sensitivity of the receptors.

10.4.25 Through the application of the construction phase mitigation measures set out in Subsection 10.6 of this Chapter, alongside the infrastructure in the wider Power Station existing surface water drainage network., surface water run-off from the construction areas would have a **negligible** or **minor** adverse effect on watercourses offsite, depending on the sensitivity of the receptor.

Construction Site Run-off – Chemical Spillages

10.4.26 A number of potentially polluting materials may be used during the construction phase. These include oils, diesels, fuels, hydraulic fluids, cement / concrete, heavy metals / metalloids, bentonite, solvent / paints and flocculants. The accidental spillage of these may result in the contamination of surface water or groundwater.

10.4.27 Chemical spillages have the potential to affect fisheries, causing a measurable decrease in ecological and chemical quality on nearby watercourses. However, chemical spillages would be diluted rapidly within the watercourse such that any effect would only be present over a short distance of the watercourse, compared to its overall length.

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10.4.28 Therefore, without mitigation measures, spillages of chemicals / fuel stored and / or used on-site could have a **minor** or **medium** adverse effect on watercourses, depending on the nature of the spillage and on the sensitivity of the receptor.

10.4.29 Through the application of the construction phase mitigation measures set out in Subsection 10.6 of this Chapter, alongside the infrastructure in the wider Power Station existing surface water drainage network, spillages would be trapped and treated prior to leaving the Site and wider Power Station site, and there would be minimal effect on watercourses. Consequently, with mitigation, surface water run-off from the construction areas could have a **negligible** or **minor** adverse effect on watercourses offsite, depending on the sensitivity of the receptor.

Temporary Increase in Impermeable Area

10.4.30 As the Proposed Development is being constructed, the enlarged area of impermeable surface has the potential to increase surface water run-off rates and volumes. A temporary increase in impermeable area across the Site could result in increased run-off rates and volumes that would not otherwise occur.

10.4.31 Much of the existing Site is formed of impermeable areas, Made Ground, positively drained through impermeable and permeable surfaces that already give rise to relatively high run-off rates and volumes during rainfall events. However, the construction of the Proposed Development may exacerbate this, increasing run-off rates and volumes during rainfall events.

10.4.32 The temporary increase in impermeable area is likely to result in relatively small and / or short-lived increase in run-off rates and volumes compared to the existing situation. Any associated increase in peak flood levels would be minor due to the limited temporary additional run-off rate and volume when compared to the large catchment area of the watercourses and probable capacity in the Power Station site system.

10.4.33 Therefore, without mitigation measures, the temporary increase of impermeable areas, and consequent increase in surface water run-off, could have a **minor** or **medium** adverse effect on watercourses, depending on the sensitivity of the receptor.

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10.4.34 However, all surface water run-off from the Site would pass through the pipe work and lagoons that forms part of the Power Station site's existing surface water drainage network. Consequently, surface water run-off during the temporary construction phase would be restricted and attenuated before leaving the Power Station site and there would be minimal effect on watercourses. As such, surface water run-off from the construction areas would have a **negligible** or **minor** adverse effect on watercourses, depending on the sensitivity of the receptor.

Impact on Groundwater Recharge

10.4.35 Construction of the Proposed Development and the corresponding impermeable surface has the potential to affect groundwater recharge in this area. However, it is considered that groundwater recharge would not be affected significantly as the ground conditions in this area are identified as having poor permeability properties. Accordingly, the magnitude of the effect is considered to have a **negligible** adverse effect.

Impact on Flood Risk

10.4.36 Parts of the Site have been identified as being at risk of flooding from surface water flooding. Any alteration of ground levels or obstructions placed within areas considered to be at risk of surface water flooding during construction, therefore, has the potential to increase flood risk to the Site. Additionally, on and off-site flood risk may increase due to increased run-off due to soil compaction on-site.

10.4.37 Much of the existing Site is formed of impermeable areas, Made Ground, positively drained through impermeable and permeable surfaces which already give rise to relatively high run-off rates and volumes during rainfall events. However, the construction of the Proposed Development may exacerbate this, increasing run-off rates and volumes during rainfall events.

10.4.38 As explained above, construction of the Proposed Development would result in limited increases in run-off rates and volumes compared to the existing situation. All surface water run-off from the Site would pass through the lagoons that form part of the Power Station site's existing surface water drainage network. Consequently, surface water run-off from the Site would be restricted and attenuated before leaving the Power Station site. Any flooding effects resulting from temporary construction

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activities are likely to be very localised within the Site itself or present in areas immediately adjacent to the Site.

10.4.39 Therefore, without mitigation, the increase in flood risk during construction is considered to have a **medium** adverse effect. With mitigation, the impact on flood risk is a **minor** adverse effect.

10.4.40 Table 10.11 summarises the likely construction related effects.

Table 10.11: Potential Effects – Construction Phase

Potential Effects	Receptors	Sensitivity	Magnitude of Effect prior to Mitigation	Significance of Effect prior to Mitigation	Magnitude of Effect following Mitigation	Significance of Effect following Mitigation
Construction site run-off – suspended fine sediments	River Soar	High	Minor	Minor	Negligible	Negligible or Minor
	River Trent	High	Medium	Moderate to Major	Minor	Minor
	Other *	High	Minor	Minor to Moderate	Negligible	Negligible or Minor
Construction site run-off – chemical spillages	River Soar	High	Minor	Minor	Negligible	Negligible or Minor
	River Trent	High	Medium	Moderate to Major	Minor	Minor
	Other *	High	Minor	Minor	Negligible	Negligible or Minor
Temporary increase in impermeable areas	River Soar	High	Minor	Minor	Negligible	Negligible or Minor
	River Trent	High	Medium	Moderate to Major	Minor	Minor
	Other *	High	Minor	Minor	Negligible	Negligible or Minor
Impact on flood risk	The Site	Medium	Medium	Moderate	Minor	Minor
* watercourses / water bodies *(e.g. Lockington Marshes SSSI, Forbes Hole LNR)*						

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Operational Phase

Assessment of Effects against Current Baseline

Water Quality

10.4.41 A number of potentially polluting materials may be used during the operation of the Proposed Development. These include oils and hydraulic fluids. The accidental spillage of these may result in the contamination of surface water and groundwater.

10.4.42 Other potential sources of pollution include oils and fuels from vehicles operating within the Site and potential increases in suspended sediment loads, i.e. run-off from roads and hardstanding areas.

10.4.43 Chemical spillages and suspended fine sediment have the potential to affect fisheries, causing a measurable decrease in ecological and chemical quality on nearby watercourses. However, chemical spillages and suspended fine sediment would be collected by the existing Power Station site system and diluted rapidly within the watercourses, such that their effect would only be present over short distance of the watercourse compared to its overall length.

10.4.44 Therefore, without mitigation measures, spillages of chemicals / fuel stored and / or used on-site would have a magnitude of effect that is considered to be **minor** or **medium** adverse, depending on the nature of the spillage.

10.4.45 Surface water would pass through an on-site swale, reed bed, grit trap, petrol / oil interceptors, all of which provide treatment for chemical spillages and suspended fine sediments. Then surface water is discharged into attenuation lagoons that provide another stage of treatment, i.e. settlement, prior to the water ultimately being discharged into the River Trent. The on-site system and surface water attenuation lagoons also include penstock valves to allow isolation in the event of a pollution event occurring.

10.4.46 Sufficient treatment train components are incorporated into the on-site design for both the sensitivity of the receiving watercourse and the nature of the development, in addition to the sediment control methods. These are designed to ensure that the

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receiving environments are not put at risk of pollution from operation of the Proposed Development.

10.4.47 Consequently, the Proposed Development would have a **minor** adverse or **negligible** overall impact on water quality and sediment loading into the receiving watercourses and therefore into the catchment as a whole.

10.4.48 In addition, and as described above under the heading 'Incorporated Mitigation', the Proposed Development would be operated under an EP that would ensure adequate protection is provided to surface water resources from potentially polluting substances stored and processed at the Proposed Development.

Increase in Impermeable Area

10.4.49 Increasing the area of impermeable surface has the potential to increase surface water run-off rates and volumes. An increase in impermeable area across the Site could result in increased rates and volume of run-off that would not otherwise occur. However, much of the existing Site is formed of impermeable areas, Made Ground, positively drained through impermeable and permeable surfaces that already give rise to relatively high run-off rates and volumes during rainfall events. However, the Proposed Development may exacerbate this, increasing run-off rates and volumes during rainfall events.

10.4.50 The SuDS Strategy has been designed to control surface water discharge by restricting the surface water run-off to QBAR for all events up to and including the 1 in 100 year (+40 % allowance for climate change) event before discharge to the Power Station site surface water drainage network. As a consequence of limiting the rate of discharge from the Site at times of heavy rainfall, the volume of water leaving the Site would be significantly less than that currently draining from it.

10.4.51 On this basis the Proposed Development would have a **minor** or **negligible** adverse overall effect on flood risk into the receiving watercourses and therefore into the catchment as a whole.

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Groundwater Body

10.4.52 Construction of the Proposed Development and the corresponding impermeable surface has the potential to affect groundwater recharge in this area. However, it is considered that groundwater recharge would not be affected significantly as the soils in this area are considered to have poor permeability properties. Accordingly, the magnitude of the effect is considered to be **negligible** adverse.

Impact on Flood Risk

10.4.53 Parts of the Site have been identified as being at risk of flooding from surface water flooding. Any alteration of ground levels or obstructions placed within areas considered to be at risk of flooding from surface water during operation therefore has the potential to increase flood risk to the Site and elsewhere. Without mitigation measures, an increase in flood risk could have a **medium** adverse effect.

10.4.54 The incorporated mitigation measures noted above include those appropriate for climate change predictions. The SuDS Strategy also provides adequate attenuation to ensure that there would be no increase in peak surface water run-off, and consequent flooding. The SuDS Strategy also makes an allowance of 40 % for increase in rainfall intensity resulting from climate change throughout the lifetime of the Proposed Development. On this basis the risks from flood risk would have a **minor** magnitude of effect.

10.4.55 Table 10.12 summarises the likely operational related effects on the identified receptors.

Table 10.12: Potential Effects – Operational Phase: Current Baseline

Potential Effects	Receptors	Sensitivity	Magnitude of Effect prior to Mitigation	Significance of Effect prior to Mitigation	Magnitude of Effect following Mitigation	Significance of Effect following Mitigation
Water Quality	River Soar	High	Minor	Minor	Negligible	Negligible or Minor
	River Trent	High	Medium	Moderate to major	Minor	Minor
	Other *	High	Minor	Minor	Negligible	Negligible or Minor

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Potential Effects	Receptors	Sensitivity	Magnitude of Effect prior to Mitigation	Significance of Effect prior to Mitigation	Magnitude of Effect following Mitigation	Significance of Effect following Mitigation
Increase in impermeable areas	River Soar	High	Minor	Minor	Negligible	Negligible or Minor
	River Trent	High	Medium	Moderate to major	Minor	Minor
	Other *	High	Minor	Minor	Negligible	Negligible or Minor
Impact on flood risk	The Site	Medium	Medium	Moderate	Minor	Minor
* watercourses / water bodies *(e.g. Lockington Marshes SSSI, Forbes Hole LNR)*						

Assessment of Effects against Future Baseline

10.4.56 The effect on water quality; increase in impermeable area; groundwater body, and impact on flood risk would be the same as that described in assessment of effects against the current baseline above. As such, the text has been repeated here and the effects would be the same as that illustrated in Table 10.12.

10.5 Cumulative Effects

10.5.1 Subsection 4.6 of the EIA Scoping Report considers the potential for cumulative effects. It identifies a single scheme, High-Speed Rail Phase 2b (HS2b), that it is considered should be covered within the ES for cumulative impact which may have the potential to give rise to likely significant effects on surface water and flood risk.

10.5.2 Uniper [1] has stated that it would need to retain its existing tunnel access through Redhill throughout both the HS2b construction phase and when it becomes operational. This would allow the Power Station to maintain water abstraction and discharge locations on the River Trent.

10.5.3 HS2b has undertaken an assessment of effects on surface water quality and flood risk, including measures to ensure that the development does not give rise to unacceptable effects on flood risk and water quality. However, as HS2b lies within the same catchment as the Proposed Development, there is the potential for some

[1] *High Speed Two Phase 2b: Crewe to Manchester and West Midlands to Leeds Consultation on the working draft Environmental Statement, June 2019, Ipsos MORI for HS2 Ltd.*

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degree of cumulative effect on flood risk and water quality, in particular in a scenario where an extreme weather event occurs which exceeds the capacity of the designed surface water management schemes.

10.5.4 The Proposed Development includes mitigation measures as described above. If an extreme weather events occurs that exceeds the capacity of the SuDS Strategy, there is additional capacity with the system to accommodate this (i.e. within the manholes, pipes, etc.). Consequently, the impact of an exceedance event is not considered to represent any significant flood hazard.

10.5.5 On the basis that both HS2b and the Proposed Development include flood risk and surface water quality mitigation, it is considered unlikely that the cumulative effects of these developments, when considered at a catchment scale, would give rise to significant effects.

10.6 Mitigation

Construction Phase

10.6.1 The management of run-off during construction would be included in the Construction Environmental Management Plan (CEMP), which would be produced at the pre-construction phase. In summary, withdrawn Pollution Prevention Guidance [2] (PPG), Environment Agency guidance [3] and CIRIA guidance [4] identify that the following methods of surface water management should be put in place during the construction phase to ensure pollution, sediment and erosion control.

Excavated Ground and Exposed Ground

10.6.2 To limit the volume of run-off reaching the exposed ground, run-off diversion or interception devices can be placed upstream. To help prevent pollution from entering a watercourse, silt fences, hay bales or stilling ponds can be placed downstream.

10.6.3 The extent of all excavations would be minimised as far as is reasonably practicable. During construction activities, surface water flows would be captured through a

2 Pollution Prevention Guidelines (PPG) 1, 6, 7,8,13,21 & 22.
[3] Environment Agency Guidance 'Oil storage regulations for businesses' (2015). / Environment Agency Guidance 'Manage water on land: guidance for land managers' (2015).
[4] CIRIA C502 Environmental Good Practice on Site. / CIRIA C532 Control of Water Pollution from Construction Sites. / CIRIA C753 The SuDS Manual.

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series of cut-off drains to prevent water entering excavations or eroding exposed surfaces. If dewatering of excavations is required, pumped discharges would be passed through a washout area, settlement / attenuation ponds and silt fences to capture sediments before release to a watercourse / drain.

Stockpiles

10.6.4 Stockpiles would be located away from the Site drainage system to prevent leaching of contaminants, where possible. Protective coverings could help prevent run-off stripping a stockpile, should this be necessary.

Plant and Wheel Washing

10.6.5 Plant wheel washing would take place in designated locations. The area would be tanked and would not be allowed to discharge into a watercourse or infiltrate to groundwater. Some proprietary vehicle washing systems offer a recycling facility, which filter and settle solids, with effluent being pumped back into the system. The solid waste materials from this process need to be treated as contaminated waste due to the high hydrocarbon content.

10.6.6 Mud deposits would be controlled at entry and exits to the Site using wheel washing facilities and / or road sweepers operating during earthworks or other times as considered necessary.

10.6.7 Tools and plant would be washed out and cleaned in designated areas within the Site compound where run-off can be isolated for treatment before discharge to surface water drainage, under an appropriate consent and / or agreement with the EA, or otherwise removed from Site for appropriate disposal at a licenced waste management facility.

Haul Roads

10.6.8 Haul roads would be designed so that the length is kept to a minimum, but still serve its purpose. Haul roads would be sprayed regularly to reduce dust. If any section of a haul road is hard surfaced, then it would be swept on a regular basis to prevent accumulation of dust and mud. Gullies would be covered when not in use before the final bituminous running surface is laid.

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10.6.9 The movement of construction traffic would be controlled via defined tracks and hardstanding areas.

Oils and Hydrocarbons

10.6.10 Simple measures can be taken to prevent oil and hydrocarbons becoming pollutants, such as:

- Maintenance of machinery and plant;
- Drip trays;
- Regular checking of machinery and plant for oil leaks;
- Correct storage facilities;
- Check for signs of wear and tear on tanks;
- Care with specific procedures when refuelling;
- Designated areas for refuelling;
- Emergency spill kit located near refuelling area;
- Regular emptying of bunds; and
- Tanks located in secure areas to stop vandalism.

10.6.11 In accordance with the EA PPGs, all fuel tanks on-site would have a bunded containment of a minimum of 110 % fuel tank capacity. There would be no drainage point from the bunded catchment area and tamperproof taps / valves would be installed. All empty fuel containers or drums would be stored within a catchment area prior to their removal from the Site. Oil traps would be incorporated in pertinent drainage systems to prevent accidental spillage being discharged into the surface run-off. Furthermore, spill kits would be stored at refuelling areas in the event of accidental spillage.

10.6.12 Best practice measures would be undertaken when refuelling plant and machinery. Where fuelling of large machinery is required, drip trays and absorbent mats or pellets would be utilised. General maintenance would also be undertaken in a designated area and similar contamination prevention measures would be adopted.

10.6.13 All run-off from the Site would be intercepted and treated to remove sediment, oils and other substances prior to discharge. As construction of the Proposed Development progresses the drainage system would be progressively implemented and would also include pollution prevention control systems.

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Watercourses / Drainage Channels

10.6.14 The gradient of any constructed drainage channels needs to be carefully considered. If the gradient is made too flat, then the channel is likely to silt up and reduce the flow capacity of the channel and prevent sediment travelling downstream. Alternatively, if the gradient is made too steep, this can increase erosion of the ditch banks which would result in an increase in the quantity of sediments which migrate downstream.

10.6.15 The River Trent could be monitored throughout the construction period to identify any enhanced scouring of the catchment surface. If sediment from disturbed ground was found to be excessively mobilised through the minor channels network, this would be mitigated by temporary sediment control measures (e.g. geotextiles / straw bales).

Operational Phase

10.6.16 During the operational phase, an Environmental Management System (EMS), certified to ISO 14001 (for which the Applicant is already accredited) would be implemented across the Site. The EMS would form an integral part of the Integrated Management System (IMS) for the Proposed Development. The IMS would draw together all relevant policies and procedures, including a site Environmental Management Plan (EMP).

10.6.17 The General Manager would be responsible for the day to day management and compliance of the Proposed Development in accordance with the EMS and the control of these matters would be monitored and enforced by the EA through the EP.

10.6.18 Storage and handling of fuels and oils at the Site would comply with the withdrawn EA PPGs[5], EA Guidance[6], CIRIA Guidance[7] and would form part of the EMS. Standard pollution prevention procedures to mitigate the risks to surface water quality would be implemented throughout operation of the Proposed Development. Examples of some of the measures that would be adopted at the Site are: bunded fuel storage; provision of spill kits, etc.; and minimising the amount of exposed ground. The same tank bund containment (i.e. minimum of 110 % fuel tank capacity)

[5] *Pollution Prevention Guidance 1, 2, 3, 4, 7, 8, 13, 21 and 22.*
[6] *EA Guidance 'Oil storage regulations for businesses' and 'Manage water on land: guidance for land managers' (2015).*
[7] *CIRIA C502 Environmental Good Practice on Site. / CIRIA C532 Control of Water Pollution from Construction Sites. / CIRIA C753 The SuDS Manual.*

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and best practice measures (as set out in paragraphs 10.6.11 and 10.6.12) would also apply and to avoid repetition have not been repeated here.

10.7 Water Framework Directive Preliminary Assessment

10.7.1 This assessment has considered the potential adverse impacts on the WFD water bodies identified in Tables 10.6 and 10.7 from the construction of the Proposed Development (e.g. the risk from excess fine sediment and chemicals in construction site run-off) and operation of the Proposed Development (e.g. the treatment of diffuse run-off and management of foul water).

10.7.2 On the basis of the assessment presented it is possible to provide a preliminary assessment of whether the Proposed Development is likely to result in a deterioration of any WFD quality element or prevent the predicted improvement for the watercourses.

10.7.3 No physical modifications are proposed to the water bodies and therefore there would be no hydro-morphological effects on the watercourses.

10.7.4 In terms of construction phase effects, the assessment identified the potential for some adverse effects to occur in relation to the mobilisation of increased sedimentation and the potential for chemical spillages polluting the watercourses. However, a range of pollution prevention measures have been proposed to mitigate these effects. The assessment concludes that the implementation of the mitigation measures described would reduce the magnitude of construction phase effects to minor or negligible.

10.7.5 Overall, taking into account the Site specific circumstances, the short term and temporary nature of construction phase effects and the proposals for mitigation measures, it is concluded that there would be no deterioration of any WFD quality element or prevention of the improvement predicted for the watercourses. The SuDS Strategy includes on-site and wider Power Station site infrastructure for attenuation storage and the treatment of surface water.

10.7.6 There are a number of potential activities at the Site that could give rise to pollution during operation. However, these have been considered above and demonstrate that appropriate site drainage measures are in place to prevent pollutants reaching key

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watercourses. In addition, the Proposed Development would be operated under an EP that would ensure adequate protection is provided to surface water resources from potentially polluting substances stored and processed on the Site.

10.7.7 The SuDS Strategy would also improve the water quality by removing pollutants (through a grit trap and interceptors), reducing potable water demand (through rainwater harvesting), and improving amenity and biodiversity (through swale and reed bed features) in the proposed landscaping.

10.7.8 As a result, and on the basis that the Proposed Development would have the potential to reduce contaminated run-off from entering the watercourses while also providing other benefits, it is therefore considered that there would be no deterioration of any WFD quality element or prevention of the improvement predicted for these watercourses. Indeed, the Proposed Development has the potential to assist in achieving a more favourable status for the watercourses, particularly if the enhancement measures are developed to improve the water quality of the River Trent (e.g. water quality control and biodiversity benefits).

10.8 Residual Effects and Conclusions

10.8.1 This Chapter has considered the impact of the Proposed Development on water quality, the impact of flood risk to the Proposed Development from various sources of flooding and the impact of surface water run-off from the Proposed Development on receptors during the construction and operational phases. A Flood Risk Assessment (FRA) (**Appendix 10-1**) has been prepared to inform this Chapter.

10.8.2 The Site is not at risk of flooding from a major source (e.g. fluvial and / or tidal). The Site has a ‘low probability’ of fluvial / tidal flooding as it is located within Flood Zone 1 with less than a 1 in 1000 annual probability of river or sea flooding in any year (< 0.1 %). A secondary flooding source (surface water flooding) has been identified which may pose a low risk to the Site.

10.8.3 The proposed use of the Site is ‘essential infrastructure’. ‘Essential infrastructure’ uses are appropriate within Flood Zone 1 after the completion of a satisfactory FRA. In conclusion, the flood risk to the Site can be considered to be limited.

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10.8.4 The flooding sources would only inundate the Site to a relatively low water depth and velocity. Such inundation would only last a short period of time, occurring only in very extreme cases and would not have an impact across the whole of the Site. The chance of flooding from all sources each year is low or not significant. As a result, there would be a low overall impact on the Proposed Development from either source of flooding.

10.8.5 This impact assessment has considered the potential adverse impacts on the waterbodies at or near the Site from the Proposed Development. The principal risks during construction are considered to be the risk from excess fine sediment, hydrocarbons, chemicals polluting surface water run-off and waterbodies. This could be exacerbated by the earthworks that would be required at the Site during construction.

10.8.6 Accordingly, a range of pollution prevention and mitigation measures have been described that, if implemented, would adequately manage the pollution risk during construction. The assessment concludes that the mitigation measures would reduce the magnitude of impacts to a minor or negligible level and would prevent significant adverse effects arising.

10.8.7 In terms of operational impacts, a series of mitigation measures are incorporated into the design to avoid potential adverse effects on water quality. The on-site surface water drainage system would include pollution control infrastructure and attenuation for all events up to and including the 1 in 100 year (+40 % allowance for climate change) event before discharge to the wider Power Station site surface water drainage network. Surface water would then be directed into attenuation lagoons within the wider Power Station drainage system, which provide an additional treatment stage, allowing any particulates to settle out of the water prior to flowing into the River Trent. The Proposed Development would be required to operate under an EP, which would require specific controls to be introduced to prevent pollution of water resources.

10.8.8 A SuDS Strategy has been developed to ensure that a sustainable drainage solution can be achieved at the Site. The SuDS Strategy would not only reduce the surface water run-off rate and volume (when compared to the existing situation), but would also improve the water quality by removing pollutants (through a grit trap and interceptors), reducing potable water demand (through rainwater harvesting), and

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improving amenity and biodiversity (through swale and reed bed features) in the proposed landscaping. The on-site system would then discharge into the existing wider Power Station site drainage system which provides further pollution controls prior to ultimately being discharged into the River Trent.

10.8.9 The SuDS Manual identifies the number of treatment trains or SuDS devices through which flow should pass from various point sources of run-off. This is designed to ensure that the receiving environments are not put at risk of pollution by new development. Sufficient treatment train components are incorporated for both the sensitivity of the receiving watercourse and the nature of the development, as well as sediment control methods.

10.8.10 The Proposed Development would have a minor or negligible overall effect on surface water run-off rates / volumes and water quality into the receiving watercourse and therefore into the catchment as a whole.

10.8.11 A preliminary WFD assessment has been undertaken that concludes the Proposed Development would not result in the deterioration of any WFD quality element or prevention of the improvement predicted for this waterbody.

10.8.12 The findings of this assessment have demonstrated that the development would not result in any significant residual adverse impacts on surface waters, ground waters or flood risk.

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CHAPTER 11.0 TRANSPORT

APPENDICES (Volume 3 bound separately)

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11.0 TRANSPORT

11.1 Introduction

11.1.1 This Chapter of the Environmental Statement (ES) has been prepared to consider the highways and transport related environmental impact of the construction and operation of the Proposed Development.

11.1.2 Detailed transport-related operational analysis has been considered in a formal Transport Assessment (TA) document which is provided as a standalone document in support of the planning application. This includes an assessment of development-related traffic forecasts (both for the construction and operational phases), highway safety and the accessibility of the Application Site (hereafter referred to as the 'Site') by non-car modes of transport. The details contained within the TA are not repeated in this Chapter, but a summary of the key findings is provided.

Proposed Development

11.1.3 The Proposed Development is a multifuel Energy Recovery Facility (ERF), recovering energy from waste on a 24 hour, 365 days a year basis. The anticipated waste throughput of the Proposed Development would be circa 472,100 tonnes per annum (tpa), based on a combination of the forecast plant availability and the waste characteristics (namely its calorific value – CV). However, it is important to note that the tonnage throughput at the Proposed Development is dictated by a combination of the thermal capacity of the plant, the number of hours per year it operates (i.e. the availability) and the CV of the waste treated.

11.1.4 Accordingly, for the purposes of the Environmental Impact Assessment (EIA), and to ensure a worst-case scenario is considered, a 'sensitivity scenario' whereby the waste CV is assumed to fall to 9 MJ/kg (with availability remaining the same) has been assessed in the TA and in this ES Chapter. In the 'sensitivity scenario', the theoretical waste throughput would rise to 524,550 tpa. This level of throughput represents a worst-case scenario in terms of trip generation and therefore transport-related environmental effects.

11.1.5 The Ratcliffe-on-Soar Power Station (the Power Station site) benefits from its own railway line (a branch from the East Midlands Main Line). The railway line enters the

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Power Station site on its western side and runs in a loop to the south of the Site. Alongside the line lies sidings with associated unloading infrastructure and conveyor belts; storage buildings linked to the sidings are located to the west of the Site. This infrastructure provides the opportunity to deliver residual waste (in sealed containers) to the Site by rail.

11.1.6 Deliveries would be transferred to the Proposed Development via slave vehicles using internal private roads. At this stage, the opportunity to utilise rail relies on a range of influences that cannot be guaranteed, especially in the short term. Accordingly, for the purposes of forecasting HGV trips to / from the Site, it has been assumed that all materials would be transported by road. The assessment of transport related effects has therefore been carried out on a worst-case scenario in terms of vehicular trip generation and can be considered as being highly robust.

11.1.7 Vehicular access to the Proposed Development (for both construction and operational phases) would be provided via the existing dumb-bell grade separated junction off the A453 Remembrance Way which is located to the south-east of the Site. From this junction an un-named road leads directly to the perimeter access barriers for the Power Station, circa 115 m from the roundabout. Once beyond the access barriers an existing internal tarmac access road leads to the Site.

11.1.8 The Proposed Development would be operated and managed by 45 suitably qualified and trained personnel. Employees would either be ‘shift staff’ or ‘day staff’ as set out below:

- 22 day shift staff working in two teams covering 07:00 to 19:00;
- 10 night shift staff working in two teams covering 19:00 to 07:00; and
- 13 day staff working a conventional day shift of 08:00 to 17:00.

11.1.9 For the purposes of the assessment, it has been anticipated that there would typically be 5 visitors per day. A total of 43 employee and visitor car parking spaces (including 3 accessibility and 3 electric vehicle charging spaces) are included in the Proposed Development.

11.1.10 As is currently the case for other delivery vehicles, it is proposed that waste deliveries would be able to take place 24 hours, 365 days per year. However, through AXIS’ experience with similar operational energy from waste schemes, it is known that the

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vast amount of HGV movements would occur during weekdays between 06:00 and 18:00, with only a limited number of movements occurring outside of these times.

11.1.11 It is proposed that construction operations could take place 24 hours per day, 365 days per year, as has happened historically at the Power Station, over many years. However, in reality it is likely that the main focus of construction activity will be during weekdays in the daytime.

11.1.12 As set out in Chapter 4.0 of this ES, the construction period is anticipated to take circa 36 months, with the programmed date for the Proposed Development to be operational being December 2024. There would be a temporary period (circa 9 months in 2025) when the Proposed Development and the Power Station would operate at the same time. The traffic impacts on the highway network will therefore be temporary during this time. After September 2025, the Power Station would be decommissioned.

Competence

11.1.13 The author of this assessment has 20 years' experience in the field of transport planning with a Bachelors' Degree in Civil Engineering. He is also a Member of the Chartered Institution of Highways and Transportation and is a Chartered Engineer.

11.2 Methodology and Scope of Assessment

Legislation and Guidance

11.2.1 Policy contained with the National Planning Policy Framework and the statutory Development Plan are set out in both the TA and Planning Statement (submitted as a separate standalone documents) and have not been repeated here.

11.2.2 In accordance with best practice, the assessment of transport effects has been undertaken in line with advice set out in the:

- National Planning Practice Guidance (NPPG) 'Transport Assessments and Statements' (Ref: 42-014-20140306);
- Department for Transport's Guidance on Transport Assessment (GTA, 2007); and

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- ‘Guidelines for the Environmental Assessment of Road Traffic’ produced by the Institute of Environmental Assessment (March 1993), now Institute of Environmental Management & Assessment (IEMA). Hereafter referred to as the ‘IEMA RTA Guidelines’.

Study Area

11.2.3 The study area for the assessment includes the following road links:

- Link 1 – A453 between M1 and Western Access;
- Link 2 – A453 between Western and Eastern Access;
- Link 3 – A453 east of Eastern Access;
- Link 4 – A453 south of Crusader Roundabout;
- Link 5 – A453 north of Crusader Roundabout;
- Link 6 – Eastern Site Access Road, north of Barton Lane;
- Link 7 – Hartness Road, north of Crusader Roundabout; and
- Link 8 – Clifton Lane, south of Crusader Roundabout.

Assessment Criteria and Assignment of Significance

11.2.4 In accordance with the IEMA RTA Guidelines, the significance of effects has been assessed by considering the interaction between the magnitude of the impact and the sensitivity of the receptor in the study area.

11.2.5 The IEMA RTA Guidelines recommend two rules be considered when assessing the impact of development traffic on a road link:

- Rule 1: include highway links where traffic flows will increase by more than 30 % (or the number of heavy goods vehicles (HGV) will increase by more than 30 %); and
- Rule 2: include any other specifically sensitive areas where total traffic flows have increased by 10 % or more.

11.2.6 The above guidance is based upon research, knowledge and experience of environmental effects of traffic, with less than a 30 % increase generally resulting in imperceptible changes in the environmental effects of traffic. At a simple level, the guidance considers that projected changes in total traffic flow of less than 10 %

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creates no discernible environmental effect, hence the second threshold as set out in Rule 2.

11.2.7 In cases where these thresholds are exceeded, the IEMA RTA Guidelines set out a list of environmental effects that should be assessed for their magnitude of change.

11.2.8 Definitions of each of the potential effects identified in the IEMA RTA Guidelines are summarised below: pedestrian delay, pedestrian amenity; accidents and safety; driver delay; severance of routes; severance of footpaths and hazardous loads. These descriptions are accompanied by explanatory text relating to the assessment criteria used to determine the magnitude of impact. It is on this basis that the assessment in this Chapter has been undertaken.

11.2.9 It is acknowledged at paragraph 2.4 of the IEMA RTA Guidelines that not all of the effects set out below (and as listed in Column 3 of Table 2.1 of the Guidelines) would be applicable to every development. Accordingly, an analysis of the surrounding road network is incorporated, to assist the assessment identify those that are relevant.

11.2.10 The environmental effects of traffic considered in other chapters of this ES include the following:

- Landscape and Visual Effects – set out in Chapter 5.0 of the ES;
- Ecological and Nature Conservation Effects – set out in Chapter 6.0 of the ES;
- Noise – potential effects relating to traffic related noise are assessed in Chapter 7.0 of the ES;
- Air Quality and Human Health – the potential effects relating to air quality as a result of traffic and construction dust and dirt from construction traffic are assessed in Chapter 8.0 of the ES; and
- Archaeology and Cultural Heritage – set out in Chapter 13.0 of the ES.

11.2.11 The environmental effects of traffic considered in this Chapter are discussed below. Where an effect is not being considered, justification is provided for its omission.

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Pedestrian Delay

11.2.12 Changes in the volume, composition or speed of traffic may affect the ability of people to cross roads. In general terms, increases in traffic levels are likely to lead to increases in pedestrian delay.

11.2.13 The Power Station site is located reasonably close to a number of built-up areas, which present some opportunity for staff and visitors to walk to the Proposed Development. These areas, however, comprise a number of small villages and the total number of houses within a reasonable walking distance is fairly low.

11.2.14 Additionally, many people travelling to the Power Station site would be employees working shift patterns, which typically requires staff to travel during times of darkness when walking would not be an attractive option.

11.2.15 On this basis, the number of pedestrians using the roads around the Site is considered to be low. Consequently, the effects of the Proposed Development in terms of pedestrian delay are not considered in this Chapter.

Pedestrian Amenity

11.2.16 The term pedestrian amenity is broadly defined as the relative pleasantness of a journey; it is considered to be affected by traffic flow, traffic composition and pavement width / separation from traffic. This definition also includes pedestrian fear and intimidation, and can be considered to be a much broader category including consideration of the exposure to noise and air pollution, and the overall relationship between pedestrians and traffic.

11.2.17 The IMEA RTA Guidelines suggests that a tentative threshold for judging the significance of changes in pedestrian amenity would be where the traffic flow (or its lorry component) is halved or doubled.

11.2.18 As set out in the section that discusses pedestrian delay, the number of pedestrian movements in the study area is considered to be low; consequently, the effects of the Proposed Development in terms of pedestrian amenity have limited relevance and are not considered in this Chapter.

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Accidents and Safety

11.2.19 The TA contains a detailed analysis of recent accident data on the study area. The analysis concludes that the highways network has a low accident rate and there are no clusters of accidents that could be evidence of accident ‘hotspots’.

11.2.20 On this basis the effects of the Proposed Development in terms of accidents and safety are not considered in this Chapter.

Driver Delay

11.2.21 Where roads affected by development are at or near capacity, the traffic associated with such development can cause or add to vehicle delays. Some roads can typically operate at or near capacity during the weekday AM and PM peak hours.

11.2.22 Where relevant, the effects of the Proposed Development on driver delay are considered in this Chapter. The TA presents the results of detailed junction capacity assessments that have been undertaken during the weekday AM and PM peak hours and these have been used to undertake the assessment of driver delay.

Severance

11.2.23 Severance is the perceived division that can occur within a community when it becomes separated by a major traffic artery. The term is used to describe a complex series of factors that separate people from places and other people. Severance can also result from difficulty in crossing a heavily trafficked road (IEMA, March 1993).

11.2.24 The Proposed Development will not create new routes that would cause severance effects to the general public, and the proposed uplift in vehicular traffic from the development is not predicted to introduce new severance effects. Furthermore, the Proposed Development will not affect any Public Rights of Way (PRoW) or footways.

11.2.25 Consequently, severance is not likely to occur as an impact of the Proposed Development and so the effect of severance of routes has not been considered in this Chapter.

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Hazardous Loads

11.2.26 Some developments may involve transporting dangerous or hazardous loads by road in the construction or decommissioning and operational phases of the development, such as special wastes, toxic materials and chemicals.

11.2.27 The Proposed Development would not accept hazardous waste. However, hazardous loads will be presented through the removal of Air Pollution Control Residue (APCR) and the delivery of some reagents (depending on the concentration).

11.2.28 As set out in the ES Scoping Report, the effects of the transportation of hazardous material are considered within this Chapter.

Railway Safety

11.2.29 As part of the EIA Scoping process with NCC, Network Rail requested that the EIA should consider the impact of the Proposed Development upon operational railway safety both during construction and once operational.

11.2.30 Construction vehicle movements associated with the Proposed Development would access the Site from the A453 and existing Power Station HGV Delivery Access gates which are located on the eastern side of the Power Station site. Vehicles would then travel along an existing tarmac access internal road to reach the Site. This route does not require vehicles to cross railway assets (such as bridges or level crossings) and therefore it is not considered that the construction of the Proposed Development would cause any railway safety issue.

11.2.31 Once operational, vehicles associated with the Proposed Development would also follow the same route as described above and therefore it is also considered that there would be no railway safety issues.

11.2.32 As set out in Chapter 4.0 'Scheme Description' of the Environmental Statement, the Power Station site includes its own railway which loops around the Power Station site and includes its own sidings. As such, should it become feasible in the future, the potential for residual waste to be delivered by rail would be explored.

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11.2.33 Slave vehicles transporting sealed containers between the existing sidings and the Proposed Development would need to travel along existing internal roads within the Power Station site and also cross over the railway line via an existing bridge which is currently used by HGVs associated with operations at the Power Station. Therefore, it has been concluded that should this activity take place, it would also not cause any railway safety issue.

11.2.34 On the basis of the above, the impact of the Proposed Development upon operational railway safety has not been considered further.

Receptor Sensitivity / Value

11.2.35 Paragraph 2.5 of the IEMA RTA Guidelines explains that groups or locations that may be sensitive to changes in traffic conditions could include people at home, people in work places, sensitive groups such as children, the elderly or the disabled, sensitive locations such as hospitals, churches, schools or historical buildings or people walking.

11.2.36 Sensitivity to changes in transport conditions is generally focussed on vulnerable user groups who are less able to tolerate, adapt to or recover from changes. Table 11.1 summarises the broad criteria for identifying receptor sensitivity.

Table 11.1: Sensitivity Definition

Sensitivity	Description
High	Receptors of greatest sensitivity to traffic flows – schools, colleges, playgrounds, accident black spots (with reference to accident data), retirement homes, urban/residential roads without footways that are used by pedestrians.
Medium	Traffic flow sensitive receptors – congested junctions, doctors' surgeries, hospitals, shopping areas with roadside frontage, roads with regular pedestrian movement but with narrow / inadequate footways, unsegregated cycleways, community centres, parks, recreation facilities.
Low	Receptors with some sensitivity to traffic flow – places of worship, public open space, nature conservation areas, listed buildings, tourist attractions and residential areas with adequate footway provision.
Negligible	Receptors with low sensitivity to traffic flows and those sufficiently distant from affected roads and junctions.

11.2.37 Road links with descriptions of low or negligible sensitivity are considered against the Rule 1 threshold described above (> 30 % increase in traffic flow). Road links with descriptions of high or medium sensitivity are considered against the 'Rule 2' threshold described above (> 10 % increase in traffic flow). Where necessary,

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professional judgement has been applied in identifying the relevant category for each link.

Magnitude of Impact

11.2.38 The criteria for defining magnitude of impact is based upon advice contained within the IEMA RTA Guidelines, as shown in Table 11.2.

Table 11.2: Magnitude Definition

Sensitivity	Adverse/ *Beneficial*	Description
High	Adverse	Substantial or total loss of capability for movement along or across transport corridors, loss of access to key facilities and loss of road safety. Severe delays to travellers.
	Beneficial	Large scale improvement in the capability for movement along and across transport corridors, major improvement in access to key facilities, in road safety and in delays to travellers.
Medium	Adverse	Moderate loss of capability for movement along or across transport corridors, loss of access to key facilities and loss of road safety. Severe delays to travellers.
	Beneficial	Moderate improvement in the capability for movement along and across transport corridors, major improvement in access to key facilities, in road safety and in delays to travellers.
Low	Adverse	Some measurable loss of capability for movement along and across transport corridors, some measurable loss of access to key facilities and some measurable loss of road safety. Some measurable increase in delays to travellers.
	Beneficial	Some measurable increase in the capability for movement along and across transport corridors, some measurable increase in access to key facilities and some measurable increase in road safety. Some measurable increase in delays to travellers. Reduced risk of negative impacts occurring.
Negligible	Adverse	Very minor loss of capability for movement along and across transport corridors, very minor loss of access to key facilities and very minor loss of road safety. Very minor increase in delays to travellers.
	Beneficial	Very minor increase in capability for movement along and across transport corridors, very minor increase in access to key facilities and very minor increase in road safety. Very minor decreases in delays to travellers.
No Change	n/a	No loss of capability for movement along and across transport corridors, no change of access to key facilities and road safety. No delays to travellers.

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Significance of Effects

11.2.39 The significance of the effect upon traffic and transport is determined by correlating the magnitude of the impact and the sensitivity of the receptor. The particular method employed for this assessment is presented in Table 11.3.

11.2.40 Where a range of significance of effect is presented in Table 11.3, the final assessment for each effect is based upon expert judgement. For the purpose of this assessment, any effects with a significance level of minor or less are considered to be not significant in EIA terms.

Table 11.3: Level of Effect Matrix

Sensitivity of Receptor	Magnitude of Impact			
	Negligible	Low	Medium	High
Negligible	Negligible	Negligible or minor	Negligible or minor	Minor
Low	Negligible or minor	Negligible or minor	Minor	Minor or moderate
Medium	Negligible or minor	Minor	Moderate	Moderate or major
High	Minor	Minor or moderate	Moderate or major	Major

Consultation

11.2.41 The scope and nature of this ES Chapter reflects the advice provided by officers of the relevant highway authorities during the formal EIA Scoping process. Advice from Highways England (HE) is contained within a letter dated 4 March 2020 and advice from Nottinghamshire County Council (NCC) Highway is presented in a letter dated 4 March 2020. Both of these letters are contained within **Appendix 11-1**.

Limitations

11.2.42 For the purposes of this assessment, traffic surveys have been carried out at the following locations:

- The two ‘dumbbell’ roundabouts at the A453 / Barton Road / West Leake Lane junctions that form the eastern access to the Power Station site;
- The A453 Remembrance Way through lane in the section that runs between the roundabouts at Barton Road and West Leake Lane;

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- A453 Remembrance Way / Kegworth Road roundabouts that form the western access to the Power Station site and East Midlands Parkway Railway Station;
- The A453 Remembrance Way through lane in the section that runs between the roundabouts at Kegworth Road and East Midlands Parkway Railway Station; and
- The 'Crusader' roundabout (A453 Remembrance Way / Clifton Lane) situated some 3.5 miles to the north-east of the site.

11.2.43 The fully classified traffic turning surveys covered a 13-hour period between 06:00 and 19:00.

11.2.44 The surveys were carried out by an independent professional traffic surveying company on Tuesday 10 March 2020. The surveys were undertaken before traffic conditions were noticeably affected by the Government's recommendation (issued on 16 March 2020) for people to stay at home due to the Covid-19 outbreak.

11.2.45 The surveys are considered to represent typical traffic conditions and there are no significant limitations attached to the survey data.

11.3 Baseline

Highway Network

11.3.1 During both the construction and operational phases, vehicular access to the Proposed Development would be provided using the existing access road that is located to the east of the Site.

11.3.2 This eastern access road forms a priority junction with another internal road that provides a dedicated HGV access to the Power Station site. A security gate is in place at a point around 70 m south-east of this junction, at the boundary of the Power Station site.

11.3.3 Continuing south of the security gate, the road first forms a priority junction with Barton Lane and then forms a grade separated junction with the A453 Remembrance Way, through a set of 'dumb-bell' roundabouts that are located either side of the

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mainline carriageway. At this junction, both the eastbound and westbound lanes of the A453 Remembrance Way feature on and off slips.

11.3.4 Aside from the on and off slips, all roads on the route between the Site and the A453 Remembrance Way facilitate two-way flows and are derestricted, i.e. subject to a 60 mph speed limit.

11.3.5 No developments are in place on the route between the Site and the A453 Remembrance Way. The route does not feature footways and the level of pedestrian movements on the route is anticipated to be nominal.

11.3.6 Barton Lane runs in a south-west to north-east alignment and provides a route to the village of Thrumpton, which lies to the north of the Site. Barton Lane carries a single lane of traffic in each direction and also does not have footways. It is derestricted until it enters the built-up area, some 800 m from its junction with the Power Station access road, where the speed limit reduces to 30 mph. Barton Lane does not have footways and pedestrian activity on this road is anticipated to be nominal.

11.3.7 The only trips generated by the Proposed Development that could potentially use Barton Lane would be Refuse Collection Vehicles (RCVs) making kerb-side collections in the village of Thrumpton. Given the modest size of this village, development related traffic movements along Barton Lane are anticipated to be nominal.

11.3.8 A shared footpath / cycle path is in place from a point close to where the access road forms a junction with Barton Lane. The footway / cycleway is located on the northern side of the A453, which runs in a north-east to south-west alignment, connecting with the roundabout that is adjacent to the access on the western side of the Power Station site.

11.3.9 The A453 Remembrance Way extends south-west where it forms part of Junction 24 of the M1 motorway; this is known as the Kegworth Interchange.

11.3.10 At a point around 5 km north-east of the Site, A453 Remembrance Way forms a four-armed roundabout junction with Green Street (A453) and the access to the Clifton South Park and Ride Site. This roundabout is known as Mill Hill Roundabout.

11.3.11 At a point around 1 km north-east of the Mill Hill Roundabout, the A453 Remembrance Way forms a further 4 arm roundabout with Clifton Lane and Hartness Road, both of which route into existing built-up residential areas. This roundabout is known as The Crusader Roundabout.

11.3.12 Beyond this, to the north-east of the Site, the A453 Remembrance Way intersects the Nottingham Ring Road at a section called the Clifton Boulevard (A52).

Receptors

11.3.13 Receptors to be considered within the impact assessment have been selected based upon the access routes to be taken by vehicle movements generated by the Proposed Development. Table 11.4 presents the sensitivity for each receptor group.

Table 11.4: Sensitivity of Receptors

Link No.	Link Description	Sensitivity	Qualification
1	A453 between M1 and Western Access	Negligible	No developments served from this road. A combined footway / cycleway is in place on the northern side of the carriageway, but pedestrian and cycle movements are anticipated to be low. No highly sensitive receptors.
2	A453 between Western and Eastern Access	Negligible	No developments served from this road. A combined footway / cycleway is in place on the northern side of the carriageway but is set well back from the carriageway. Pedestrian and cycle movements are anticipated to be low. No highly sensitive receptors.
3	A453 east of Eastern Access	Negligible	No developments served from this road and no footway / cycleway in place on this section. No highly sensitive receptors.
4	A453 south of Crusader Roundabout	Low	Several developments (petrol filling station and fast food outlets) are served directly from this road and there are housing estates located either side of the carriageway, although these are set well back from the carriageway. Footways and a cycleway are in place on the northern side of the carriageway and so there is potential for some pedestrian / cycle movements, but these are not anticipated to be significantly high in volume. No highly sensitive receptors.
5	A453 north of Crusader Roundabout	Negligible	No developments served directly from this road. A combined footway / cycleway is in place on the northern side of the carriageway, but pedestrian and cycle movements are anticipated to be low. No highly sensitive receptors.
6	Eastern Site Access Road, north of Barton Lane	Negligible	Lies within the Power Station boundary and is not part of the public highway. No footways in place and no developments served from this road. Low number of pedestrian movements anticipated. No highly sensitive receptors present.

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Link No.	Link Description	Sensitivity	Qualification
7	Hartness Road, north of Crusader Roundabout	Low	Many residential and some commercial properties are served directly from this road. Adequate footways are in place on both sides of the carriageway and there are no highly sensitive receptors present.
8	Clifton Lane, south of Crusader Roundabout	Low	No developments served directly from this road. A combined footway / cycleway is in place on the eastern side of the carriageway. No highly sensitive receptors.

11.3.14 On the basis that all of the above links have a sensitivity which is either 'Negligible' or 'Low', all links are assessed against the 'Rule 1' threshold described earlier (> 30 % increase in traffic flow).

Traffic Flow

2020 Observed Flows

11.3.15 Table 11.5 summarises the 2020 14-hour weekday observed two-way traffic flows.

Table 11.5: Summary of 2020 Surveyed 14-hour Weekday Traffic Flows

Link	Site Description	2020 Flows (vehicles)	
		Vehicles	HGVs
1	A453 between M1 and Western Access	35,397	3,327
2	A453 between Western and Eastern Access	34,904	3,316
3	A453 east of Eastern Access	31,456	3,008
4	A453 south of Crusader Roundabout	31,107	3,006
5	A453 north of Crusader Roundabout	37,350	3,242
6	Eastern Site Access Road, north of Barton Lane	209	39
7	Hartness Road, north of Crusader Roundabout	2,019	70
8	Clifton Lane, south of Crusader Roundabout	7,731	301

11.3.16 Review of this traffic flow information identifies that maximum two-way flows are noted as occurring on the A453 north of the Crusader Roundabout, where flows are in the order of 37,350 two-way vehicle movements during the 14-hour weekday period.

11.3.17 The Proposed Development has been assessed against the following two baseline scenarios:

- **Baseline 1**, the scenario when the Power Station is still in operation; and
- **Baseline 2**, the scenario when the Power Station has ceased operation.

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11.3.18 The assessment compares the traffic-related environmental impacts of the Proposed Development as measured against the following anticipated future baseline scenarios:

- **Construction Phase (2023)** using 'Baseline 1' Scenario: Background network traffic (including trips generated by the Power Station) + growth + trips associated with any committed developments;
- **Operational Phase (2025)** using 'Baseline 1' Scenario: Background network traffic (including trips generated by the Power Station) + growth + trips associated with any committed developments; and
- **Operational Phase (2030)** using 'Baseline 2' Scenario: Background network traffic (excluding trips generated by the Power Station) + growth + trips associated with any committed developments.

11.3.19 The scenarios consider those relevant cumulative / committed developments that are likely to affect the future baseline traffic conditions. The following schemes were agreed with relevant highway authorities' officers through the formal EIA Scoping process:

- The approved but as-yet unoccupied employment units at the SEGRO East Midlands Gateway Logistics Park, located to the north of East Midlands Airport;
- The employment development at the former Hardstaffs site, located along Gotham Road; and
- The Redhill and River Soar main construction compounds associated with HS2 Phase 2b rail link.

11.3.20 The method of accounting traffic from these committed developments is set out in detail in the TA.

11.3.21 The likely level of trip generation of the Proposed Development has been forecast using a 'first principles' approach, which is based on the future operation of the Proposed Development. The method of deriving the trip generation is set out in detail in the TA and summarised in Table 11.6.

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Table 11.6: Summary of Daily Trip Generation during Weekdays

Trip Element	Trips (two-way)
HGV Trips	
Import of Waste	236
Import of Consumables	2
Export of Ash and Recovered Metals	71
Total HGV Movements	309
Car Trips	
Shift Staff	64
Day Staff	26
Visitors	10
Total Car Trips	100
Total Trips	
Total Trips	409

11.3.22 Table 11.6 shows that the Proposed Development is forecast to generate around 409 two-way trips per weekday, on average.

11.3.23 The TA also sets out the methodology that has been used to forecast the distribution of car and HGV trips generated by the Proposed Development, respectively. This is summarised in Table 11.7.

Table 11.7 Summary of Distribution of Car and HGV Trips

Route	Car	HGV
A453, south-west to M1 Motorway	42 %	81 %
A453, north-east towards Nottingham	41 %	19 %
West Leake Lane	17 %	0 %
Total	100 %	100 %

11.3.24 The vast majority of vehicle movements associated with the Proposed Development would occur during weekdays over the 14-hour period between 06:00 and 20:00. The effects have been assessed during the weekday over this 14-hour period during both the construction and operational phases.

11.3.25 Detailed junction capacity assessments, which form the basis for assessing driver delay, have been undertaken for the weekday peak hours. These peak hours have been confirmed through the traffic surveys (see Paragraphs 11.2.42 to 11.2.45) as follows:

- AM peak hour, 07:30 to 08:30; and
- PM peak hours of 16:15 to 17:15.

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11.3.26 Detailed junction assessments have been undertaken at the two ‘dumb-bell’ roundabouts at the A453 / Barton Road / West Leake Lane junctions that form the eastern access to the Power Station site.

2023 Baseline 1, Proposed Development in Construction Period and Power Station in Operation

11.3.27 Baseline 14-hour traffic flows derived for the 2023 assessment during the construction phase are presented in Table 11.8.

Table 11.8: Summary of 2023 Baseline 1 Traffic Flows, Construction Phase

Link	Site Description	2023 Flows (vehicles)	
		Vehicles	HGVs
1	A453 between M1 and Western Access	37,428	3,578
2	A453 between Western and Eastern Access	36,984	3,567
3	A453 east of Eastern Access	33,283	3,244
4	A453 south of Crusader Roundabout	32,926	3,242
5	A453 north of Crusader Roundabout	39,311	3,484
6	Eastern Site Access Road, north of Barton Lane	214	40
7	Hartness Road, north of Crusader Roundabout	2,064	72
8	Clifton Lane, south of Crusader Roundabout	7,906	308

2025 Baseline 1, Proposed Development in Operational Phase and Power Station in Operation

11.3.28 Under Baseline 1, both the Power Station and the Proposed Development would only operate in tandem for a 9-month period before the Power Station closes in September 2025. This would mean that any identified effects occurring during both the operation of the Power Station and the Proposed Development would be temporary in duration.

11.3.29 Baseline 1 14-hour traffic flows derived for the 2025 assessment during the operational phase are presented in Table 11.9.

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Table 11.9: Summary of 2025 Baseline 1 Traffic Flows, Operational Phase

Link	Site Description	2025 Flows (vehicles)	
		Vehicles	HGVs
1	A453 between M1 and Western Access	37,957	3,628
2	A453 between Western and Eastern Access	37,505	3,617
3	A453 east of Eastern Access	33,754	3,289
4	A453 south of Crusader Roundabout	33,391	3,287
5	A453 north of Crusader Roundabout	39,869	3,532
6	Eastern Site Access Road, north of Barton Lane	217	40
7	Hartness Road, north of Crusader Roundabout	2,095	73
8	Clifton Lane, south of Crusader Roundabout	8,021	312

2030 Baseline 2, Proposed Development in Operational Phase without Power Station Operating

11.3.30 Baseline 2 assumes that the Power Station is not operating; however, the following development / infrastructure would remain:

- Uniper Engineering Services offices;
- National Grid substations and power lines,
- gas turbine generating facility;
- railway sidings;
- gypsum and limestone storage buildings and their conveyor links to the sidings; and;
- other lesser elements of infrastructure such as internal roads linking the preceding elements.

11.3.31 Consequently, the trip generating potential of the Power Station site under Baseline 2 is lower than that of Baseline 1.

11.3.32 Traffic flows derived for the 2030 assessment during the operational phase are presented in Table 11.10.

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Table 11.10: Summary of 2030 Baseline 2 Traffic Flows, Operational Phase

Link	Site Description	2030 Flows (vehicles)	
		Vehicles	HGVs
1	A453 between M1 and Western Access	38,926	3,749
2	A453 between Western and Eastern Access	38,687	3,740
3	A453 east of Eastern Access	34,800	3,400
4	A453 south of Crusader Roundabout	34,424	3,398
5	A453 north of Crusader Roundabout	41,147	3,652
6	Eastern Site Access Road, north of Barton Lane	225	42
7	Hartness Road, north of Crusader Roundabout	2,174	75
8	Clifton Lane, south of Crusader Roundabout	8,325	324

11.4 Assessment of Effects

Incorporated Mitigation

11.4.1 The Proposed Development has been designed with features that would encourage the use of non-car modes of transport. These include the provision of:

- secure cycle parking for bicycles;
- staff shower, changing and locker facilities; and
- staff food preparation areas to encourage staff to remain on-site during working hours.

11.4.2 Sustainable transport could be further encouraged through the implementation of a Travel Plan, which can be secured though a suitably worded planning condition.

11.4.3 To manage traffic during the construction period, a Construction Traffic Management Plan (CTMP) could also be prepared to ensure that suitable mitigation measures are adopted to manage any adverse effects of construction. This can be secured though a suitably worded planning condition.

Construction Phase

Assessment of Effects against Current Baseline

11.4.4 The trip generation that is forecast during the construction phase is described in detail in the TA. Table 11.11 presents the predicted changes in vehicle movements, in terms of overall vehicle movements and HGV movements, based on the trip generation rates during the peak year of construction works.

11.4.5 The number of trips generated at the site would vary throughout the construction period. The total volume of construction-related vehicles at the site is anticipated to peak in month 21 (October 2023), with 361 vehicles which equates to 722 two-way trips.

11.4.6 The travel times for construction staff would depend upon the core hours which would be determined by the appointed contractor. As set out in the TA, construction work could occur 24 hours per day, 365 days of the year (subject to noise restrictions during the daytime, evening and night-time periods) and so there is a likelihood that construction-related trips would be spread out over throughout each day; however, it is considered that the majority of construction trips would be likely to occur during the 14-hour assessment period.

Table 11.11: 2023 Assessment for Construction Period (Baseline 1)

Link	Site Description	2023 Baseline Flows (vehicles)		Development Trips		% Increase	
		Vehicles	HGVs	Vehicles	HGVs	Vehicles	HGVs
1	A453 between M1 and Western Access	37,428	3,578	650	128	2 %	4 %
2	A453 between Western and Eastern Access	36,984	3,567	650	128	2 %	4 %
3	A453 east of Eastern Access	33,283	3,244	72	14	0 %	0 %
4	A453 south of Crusader Roundabout	32,926	3,242	72	14	0 %	0 %
5	A453 north of Crusader Roundabout	39,311	3,484	72	14	0 %	0 %
6	Eastern Site Access Road, north of Barton Lane	214	40	722	142	338 %	359 %
7	Hartness Road, north of Crusader Roundabout	2,064	72	0	0	0 %	0 %
8	Clifton Lane, south of Crusader Roundabout	7,906	308	0	0	0 %	0 %

11.4.7 Table 11.11 shows that during the construction phase, the changes in overall daily vehicle demands during construction of the Proposed Development are well below the IEMA Rule 1 30 % threshold on all links apart from Link 6, the Eastern Site Access Road, north of Barton Lane.

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11.4.8 In accordance with the IEMA RTA Guidelines, the sensitivity of receptors along all links (apart from Link 6) is considered to be low or negligible and the magnitude of impact is deemed to be negligible. There would therefore be a negligible or minor level of effect, which is not significant in EIA terms. On this basis no further assessment of construction traffic impacts is considered necessary on these links.

11.4.9 The construction-related environmental transport effects on Link 6 (i.e. the relevant effects of driver delay and hazardous loads defined earlier) are given more detailed consideration later in this Chapter in the subsections below.

Operational Phase

2025 Assessment of Effects during Operational Phase (Baseline 1)

11.4.10 The trip generation that is forecast during the operational phase is described in detail in the TA. Table 11.12 presents the predicted changes in vehicle movements, in terms of overall vehicle movements and HGV movements, based on the trip generation rates during the operational phase. This has been undertaken for 2025, the opening year, using Baseline 1 which assumes the Power Station is in operation.

Table 11.12: 2025 Assessment for Operational Phase (Baseline 1)

Link	Site Description	2025 Baseline Flows (vehicles)		Development Trips		% Increase	
		Vehicles	HGVs	Vehicles	HGVs	Vehicles	HGVs
1	A453 between M1 and Western Access	37,957	3,628	294	252	1 %	7 %
2	A453 between Western and Eastern Access	37,505	3,617	294	252	1 %	7 %
3	A453 east of Eastern Access	33,754	3,289	99	58	0 %	2 %
4	A453 south of Crusader Roundabout	33,391	3,287	99	58	0 %	2 %
5	A453 north of Crusader Roundabout	39,869	3,532	99	58	0 %	2 %
6	Power Station Access Road, north of Barton Lane	217	40	409	309	189 %	771 %
7	Hartness Road, north of Crusader Roundabout	2,095	73	0	0	0 %	0 %

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Link	Site Description	2025 Baseline Flows (vehicles)		Development Trips		% Increase	
		Vehicles	HGVs	Vehicles	HGVs	Vehicles	HGVs
8	Clifton Lane, south of Crusader Roundabout	8,021	312	0	0	0 %	0 %

11.4.11 Table 11.12 shows that during the operational phase in 2025, the changes in overall daily vehicle demands of the Proposed Development are well below the IEMA Rule 1 30 % threshold on all links apart from Link 6, the Eastern Site Access Road, north of Barton Lane.

11.4.12 In accordance with the IEMA RTA Guidelines, the sensitivity of receptors along all links (apart from Link 6) is considered to be low or negligible and the magnitude of impact is deemed to be negligible. There would therefore be a negligible or minor level of effect, which is not significant in EIA terms.

11.4.13 On this basis no further assessment of operational traffic impacts is considered necessary on these links.

11.4.14 The operation-related environmental transport effects on Link 6 (i.e. the relevant effects of driver delay and hazardous loads defined earlier) are given more detailed consideration later on in this Chapter in the subsections below.

2030 Assessment of Effects during Operational Phase (Baseline 2)

11.4.15 The trip generation that is forecast during the operational phase is described in detail in the TA. Table 11.13 presents the predicted changes in vehicle movements, in terms of overall vehicle movements and HGV movements, based on the trip generation rates during the operational phase. This has been undertaken for 2030, 10 years after the submission of the planning application for Baseline 2, which assumes the Power Station has ceased operating.

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Table 11.13: 2030 Assessment for Operational Phase (Baseline 2)

Link	Site Description	2030 Flows (vehicles)		Development Trips		% Increase	
		Vehicles	HGVs	Vehicles	HGVs	Vehicles	HGVs
1	A453 between M1 and Western Access	38,926	3,749	294	252	1 %	7 %
2	A453 between Western and Eastern Access	38,687	3,740	294	252	1 %	7 %
3	A453 east of Eastern Access	34,800	3,400	99	58	0 %	2 %
4	A453 south of Crusader Roundabout	34,424	3,398	99	58	0 %	2 %
5	A453 north of Crusader Roundabout	41,147	3,652	99	58	0 %	2 %
6	Power Station Access Road, north of Barton Lane	225	42	409	309	182 %	743 %
7	Hartness Road, north of Crusader Roundabout	2,174	75	0	0	0 %	0 %
8	Clifton Lane, south of Crusader Roundabout	8,325	324	0	0	0 %	0 %

11.4.16 Table 11.13 shows that during the operational phase in 2030, the changes in overall daily vehicle demands of the Proposed Development are well below the IEMA Rule 1 30 % threshold on all links apart from Link 6, the Eastern Site Access Road, north of Barton Lane.

11.4.17 On this basis no further assessment of operational traffic impacts is considered necessary on these links.

11.4.18 The operation-related environmental transport effects on Link 6 (i.e. the relevant effects of driver delay and hazardous loads defined earlier) are given more detailed consideration in the subsections below.

Driver Delay

11.4.19 Any significant effects of delay to other road users are typically made most apparent during the weekday peak hours, when congestion may occur. The TA includes detailed capacity assessments of the key junctions in the study area during the worst-case, weekday peak hours, and concludes that the impact of the increased traffic flows is negligible upon junction performance and driver delay.

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11.4.20 The sensitivity of receptors along Link 6 are considered to be negligible.

11.4.21 Based on the junction capacity assessment results set out in the TA, the impact of traffic from the Proposed Development is nominal and so the magnitude of impact upon driver delay is deemed to be negligible. The effect on driver delay along the links considered would therefore be of negligible or minor significance and is consequently not significant in EIA terms.

11.4.22 In the scoping advice received from NCC, officers requested that for junctions which would experience an increase in 30 or more two-way trips in an hour, an assessment should be considered.

11.4.23 During the construction period, the maximum level of trip generation is forecast to be 722 two-way trips per day. Construction work could occur 24 hours per day, 365 days of the year, and so there is a likelihood that an element of the construction-related trips would be spread out over the day. Notwithstanding this, there is a likelihood that some junctions maintained by NCC could experience an increase in trips greater than 30 vehicles per hour during certain months in the construction period.

11.4.24 Construction-related traffic could be managed through implementation of a CTMP and construction working hours will mean that staff would generally travel to and from the Site outside of the normal highway peak hours, when there is typically more spare capacity on the highway network. This would mitigate against the likelihood of incidents of delay caused by construction vehicles. Additionally, any incidents of driver delay caused by construction traffic would be temporary in nature.

11.4.25 The hourly profile of construction related traffic movements is unknown and would be likely to change throughout the construction programme. On this basis, it is not possible to accurately undertake detailed junction capacity assessments on junctions which could experience an increase in 30 trips per hour and so no assessments have been undertaken.

11.4.26 During the operational phase, the hourly trip generation forecasts demonstrate that the hourly 30 two-way trip threshold is exceeded at the eastern site access junction in the following hours:

- 06:00–07:00;
- 07:00–08:00;

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- 10:00–11:00;
- 11:00–12:00;
- 13:00–14:00; and
- 14:00–15:00.

11.4.27 The operation of the junctions that comprise the route between the A453 and the eastern Site access have been assessed during the network AM (07:30–08:30) and PM (16:15–17:15) peak hours. These assessments represent the worst case in terms of background traffic demands during the operation phase, and thus assess the highest level of driver delay. The results of these assessments are contained within Section 8 of the TA.

11.4.28 The assessment results show that during times when the junctions are experiencing the highest demands, the junctions that comprise the Eastern access on the A543 work well with significant spare capacity and without any excessive driver delay.

11.4.29 During the non-peak hour periods that the 30-vehicle threshold is exceeded, the background (i.e. non-development-related) traffic flows will be lower than during the peak hours. Given this, it is considered that the junctions would continue to operate well within their capacity and drivers would not therefore experience any material change in driver delay compared to the peak hours.

11.4.30 On this basis, the impacts of the development in terms of the effects of driver delay during the operation phase would be negligible and so taking account of NCC scoping advice, the effect on driver delay along the junctions considered would therefore be of negligible or minor significance and is consequently not significant in EIA terms.

Hazardous Loads

11.4.31 Some developments may involve transporting hazardous loads by road. The Proposed Development would not accept hazardous waste. However, some non-waste deliveries would be required that may be regarded as hazardous, such as removal of APCR and some reagent deliveries (depending on the concentration).

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11.4.32 All such hazardous material would be transported using specialist vehicles in accordance with the relevant health and safety regulations, governed by a process separate to planning.

11.4.33 The volume of deliveries is forecast to be less than 2 one-way movements per day and so the likelihood of an incident involving hazardous waste is considered to be insignificant.

11.4.34 In accordance with the IEMA RTA Guidelines, the sensitivity of receptors along Link 6 (Eastern Site Access) are considered to be negligible or low. The magnitude of impact upon hazardous loads is deemed to be negligible. The effect on hazardous loads along the links considered would therefore be of negligible or minor significance and is consequently not significant in EIA terms.

11.5 Mitigation

Construction Mitigation

11.5.1 Based on the above assessment, no mitigation measures beyond those suggested in the previous subsection (i.e. CTMP) are deemed necessary during the construction period.

Operational Mitigation

11.5.2 No further mitigation measures are deemed necessary during the operational periods.

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11.6 Residual Effects and Conclusions

11.6.1 It is concluded that the Proposed Development would not result in a significant impact on operational or environmental conditions over the local transport network and there is no requirement for off-site transport improvement / mitigation works.

11.6.2 The impact of trips generated by the Proposed Development, during both the construction and operational phases, has been assessed against anticipated future road conditions and with reference to appropriate guidance. It is concluded that in all scenarios the effects are considered to be not significant in EIA terms.

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CHAPTER 12.0 SOCIO-ECONOMICS

FIGURES (Volume 2 bound separately)

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12.0 SOCIO-ECONOMICS

12.1 Introduction

12.1.1 This Chapter of the Environmental Statement (ES) considers the likely effects of the East Midlands Energy Re-Generation (EMERGE) Centre (also referred to as the Proposed Development) on local socio-economic conditions. Socio-economic effects most commonly relate to the impact upon the human population living in the area surrounding a development site and the regional workforce.

12.1.2 The assessment includes the following:

- Identification of the socio-economic baseline in respect of key issues identified, focussing on the characteristics of the regional workforce. These characteristics can then be used as a measure for assessing future change; and
- Identification of the likely socio-economic effects, including direct, indirect and induced, that would arise from the construction and operation of the Proposed Development.

Context – Future Vision

12.1.3 A major future driver of the East Midland's economy, aimed at stimulating regional growth and regeneration, including creating circa 84,000 new jobs, is the East Midlands Development Corporation (EMDC), which is currently operating in shadow form after a Government allocation of funding.

12.1.4 As identified in Chapter 1.0 of this ES, the emerging EMDC has identified the Ratcliffe-on-Soar Power Station site (hereafter referred to as the Power Station site) as one of three strategically important locations for future economic growth in the East Midlands.

12.1.5 The vision for the Power Station site is to create an employment site based around modern industrial and manufacturing uses, underpinned by a sustainable energy theme. Whilst this vision is in its early stages, the Proposed Development is viewed as the catalyst, being the first new build on the redeveloped Power Station site, by virtue of generating low-carbon and partially renewable energy for the future industry and manufacturing uses.

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12.1.6 In short, EMDC recognises that the Power Station site is pivotal in delivering its aspirations and it offers the prime opportunity to develop a new regional economy based around an integrated energy solution spanning power, heat and transport.

12.1.7 The high-level Masterplan for the Power Station site is underpinned by the EMERGE ‘Energy Hub’, the first and most important component of which is the EMERGE Centre, a multifuel energy from waste (EfW) facility.

12.1.8 The EMERGE Centre is needed at many levels and its benefits would be widespread. It would simultaneously:

- Provide low carbon and partially renewable energy, both power and heat, to the future industry and manufacturing uses planned for the site;
- Help regenerate the Power Station site following the closure of the existing coal-fired Power Station and, due to the propitious timing, retain power sector skills and jobs on the site;
- Be the catalyst for the EMDC’s vision at the Power Station site by being the first new build on the redeveloped site;
- Deliver significant inward investment into Rushcliffe, Nottinghamshire and the wider region; and
- Deliver much needed sustainable waste management infrastructure within Nottinghamshire and the region.

12.1.9 Whilst the Proposed Development would clearly underpin the overall redevelopment of the Power Station site, on the basis that the future modern industrial and manufacturing uses are at this point in time unknown, this assessment is focused upon the Proposed Development in its own right.

Competence

12.1.10 The Socio-Economic Assessment was prepared by an Environmental Impact Assessment specialist with approximately seventeen years’ experience of working in assessing the environmental impact of industrial and energy sector developments and is a practitioner level member of IEMA. She has previously led on environmental assessments of new conventional power plant, offshore wind and biomass projects.

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12.2 Methodology and Scope of Assessment

Legislation and Guidance

12.2.1 Policy contained with the National Planning Policy Framework and the statutory Development Plan documents are set out in the Planning Statement (submitted as a separate standalone document) and have not been repeated here.

Other Policies / Strategies

12.2.2 The Local Enterprise partnership (LEP), Derby, Derbyshire, Nottingham and Nottinghamshire (D2N2), have set out a strategic economic plan / Vision 2030 [1] for the region to transform to a high value economy by 2030, with an increase in the number of higher paid jobs with increased skill levels.

12.2.3 Headline targets by 2030 included in the D2N2 vision include:

- Increasing overall value to economy by £9 billion to £70 billion;
- Raising weekly earnings by at least 40 %, and narrow wage disparities across the LEP; and
- Maintaining high and stable employment rates.

Guidance

12.2.4 There is no overarching guidance for the assessment of socio-economic effects; therefore, the methodology provided is based on environmental impact assessment principles. This considers the sensitivity of receptors to change and the magnitude of the change that each receptor would experience. Based upon this, a conclusion can be drawn as to whether the resultant effect is significant or not.

Assessment Methodology

12.2.5 The assessment considers the potential for the Proposed Development to affect local socio-economic conditions both during the construction phase and once it becomes operational. Due to their largely distinct nature, these two elements are considered

[1] *Derby, Derbyshire, Nottingham and Nottinghamshire, D2N2, 2019. Vision 2030.*

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under separate headings below. However, the methodology applied for determining effects is the same for both.

12.2.6 The assessment has been carried out by undertaking a desk-based study, including a review of key statistical information.

12.2.7 The Proposed Development has the potential to affect local socio-economic conditions via three types of effect, as follows:

- Direct economic effects: jobs and wealth that are wholly or largely related to either the construction or operation of the Proposed Development;
- Indirect economic effects: jobs and wealth generated in the economy via the supply chain of goods and services that support the direct activities; and
- Induced economic effects: jobs and wealth created by direct and indirect employees' spending.

The Study Area

12.2.8 The Study Area for the Assessment has been determined through the use of 2011 Census data to identify travel-to-work patterns. Data is available for Middle-layer Super Output Areas (MSOAs) that form part of the Census.

12.2.9 The Proposed Development is located within the MSOA Rushcliffe 014 which is centred on West Leake. Other MSOAs close to the Proposed Development are Leicestershire 002 and Erewash 014, centred on Kegworth and Long Eaton, respectively. Travel-to-work patterns for MSOA Rushcliffe 014 have been used. The area represents a similar non-urban location to that of the Proposed Development and encompasses the existing Power Station so is likely to give a reasonable indication as to where those employed at the Proposed Development would originate.

12.2.10 The online mapping resource Data Shine Commute [2] has been used to display and interrogate travel-to-work patterns for this MSOA Rushcliffe 014, and identifies all other MSOAs from where six or more people commuted to MSOA Rushcliffe 014 for work in 2011.

[2] *Data Shine Commute < http://commute.datashine.org.uk > [accessed 25 March 2020].*

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12.2.11 Figure 12.1 maps these MSOAs, with local authority boundaries superimposed. In selecting the appropriate study area there is a need to balance the extent of the geographic area with ensuring that the area also reflects a sufficient proportion of the working population commuting to MSOA Rushcliffe 014.

12.2.12 Figure 12.1 illustrates that those working in MSOA Rushcliffe 014 are distributed across a range of neighbouring MSOAs (154 MSOAs in total). It can be seen that the majority either live within Rushcliffe LA or in the adjacent parts of neighbouring local authorities.

12.2.13 If only MSOAs with greater than 25 people travelling to work in Rushcliffe 014 were considered (shaded yellow, orange and red) as the basis of the study area, this would represent only 56 % of people. If this area was increased to include MSOAs with greater than 15 people (shaded in green, yellow, orange and red), this would increase to 70 % of workers. If such a classification was used, 30 % of workers would not be represented by the selected study area. Additionally, this would lead to a relatively fragmented Study Area.

12.2.14 Due to wide geographic extent of workers travelling to Rushcliffe 014, the data was also represented on a local authority basis as shown in Figure 12.2.

12.2.15 Figure 12.2 illustrates the number of workers travelling from each LA to MSOA Rushcliffe 014. It was clear from taking into consideration the MSOA and LA data together that LAs with greater than a hundred and fifty workers commuting to MSOA Rushcliffe 014 was a more appropriate way of defining the Study Area. Although this extended the geographic extent, it allowed for a sufficient number of workers (85 %) to be covered within this Study Area. This was particularly important for areas such as Nottingham City, which has people from 34 individual MSOAs travelling to work in Rushcliffe 014.

12.2.16 As such, the Study Area for the assessment includes all of Rushcliffe, together with other LAs where more than a hundred and fifty people commuted to MSOA Rushcliffe 014 in 2011 as show in Table 12.1. The final Study Area is illustrated in Figure 12.2.

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Table 12.1: Identification of the Study Area

County / Unitary Authority	Local Authority	Number of people travelling to MSOA Rushcliffe 014
Study Area		
NCC	Rushcliffe	1,198 (36 %)
Nottingham City	Nottingham City	550 (17 %)
Leicestershire	Charnwood	402 (12 %)
Leicestershire	North West Leicestershire	264 (8 %)
NCC	Broxtowe	196 (6 %)
Derbyshire	Erewash	193 (6 %)
Excluded from Study Area		
Other	Other	496 (15 %)

12.2.17 The Study Area includes the local authorities identified in Table 12.1, representing 85 % of people travelling MSOA 014 for employment, but does not include the people travelling from "other" areas.

Receptors

12.2.18 The specific receptors that this assessment is concerned with are:

- Construction sector employment; and
- Rates of employment and gross value added (on-site and off-site), once the Proposed Development becomes operational.

12.2.19 Understanding the effects of the Proposed Development on these receptors enables a conclusion to be made as to the effects on the economy within the Study Area. It should be noted that in socio-economic assessment, both receptors and the effects of development upon them may be abstract and diffuse when contrasted with environmental receptors.

Additionality

12.2.20 For this assessment the concept of additionality refers to how the economy of the Study Area is likely to change because of the Proposed Development. In order to estimate the change in employment that would occur from the development, the

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Additionality Guide [3] has been followed. This includes a formula which takes into account the influence of 'leakage' (jobs taken up by people living outside the Study Area), 'displacement' (where a development would take employment/ market share from other businesses or organisations), and 'economic multipliers' (knock-on effects in the Study Area economy).

12.2.21 Table 12.2 shows the receptors and indicators that will be used to characterise the socio-economic baseline of the Study Area and to assess the effect of the Proposed Development.

Table 12.2: Receptors and Indicators to be Used in Baseline Characterisation

Receptor	Indicator
Economic Activity	GVA
Employment	Employees
Access to Employment Opportunities for Local Residents	Unemployment Rate
	Skills Profile

12.2.22 Understanding the effects of the Proposed Development on these receptors enables a conclusion to be made as to the effects on the economy within the Study Area.

Assessment of Significance / Assessment Criteria

12.2.23 The significance of changes to the receptors and indicators from the baseline due to the Proposed Development can be assessed in terms of the sensitivity and magnitude of change as explained below.

Sensitivity

12.2.24 The sensitivity of the receptors is determined based upon the importance attached to each receptor in policy, and the use of professional judgement relating to the scale of socio-economic challenges faced by each receptor (following analysis of the baseline). The criteria followed in determining receptor sensitivity are set out in Table 12.3. The criteria are indicative and the assessment includes a reasoned justification explaining the criterion allocated to each specific receptor.

[3] *Homes and Communities Agency, 4th edition 2014. Additionality Guide.*

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Table 12.3: Sensitivity Criteria

Sensitivity	Description
High	o Evidence of direct and significant socio-economic challenges relating to the receptor; and/or o Identification in policy as a key thematic or spatial priority.
Medium	o Some evidence of socio-economic challenges linked to the receptor, which may be direct or indirect; and/or o The receptor is identified in policy, but not as a key policy priority.
Low	o Little evidence of socio-economic challenges relating to the receptor; and/or o No identification in policy.
Negligible	o No socio-economic issues relating to the receptor; and/or o No particular economic weaknesses or challenges.

Magnitude of Change

12.2.25 The magnitude of change undergone by each receptor is determined by considering the likely deviation from baseline conditions. Magnitude criteria are set out indicatively in Table 12.4 below. Again, the assessment includes a reasoned justification explaining the criterion allocated to each specific receptor.

Table 12.4: Magnitude Criteria

Magnitude	Description
Large	A large change to existing conditions, in terms of either absolute or percentage change.
Medium	A moderate change to existing conditions, in terms of either absolute or percentage change.
Small	A limited change to existing conditions, in terms of either absolute or percentage change.
Negligible	No tangible change from baseline conditions.

Significance of Effect

12.2.26 As described above, once the sensitivity of the receptor and the magnitude of change have been identified, these are considered together to determine whether the resultant effect is significant or not. The level of effect that would occur is determined guided by the matrix shown in Table 12.5.

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Table 12.5: Criteria for Assessment of the Level of Socio-economic Effects

		High	Medium	Low	Negligible
Magnitude	**Large**	Substantial	Major	Moderate	Negligible
	Medium	Major	Moderate	Minor	Negligible
	Small	Moderate	Minor	Slight	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

12.2.27 For the purposes of this assessment, a major or substantial effect is considered to be significant. Where an effect is moderate, this may also be deemed significant following further consideration. A reasoned justification is provided as part of the assessment in relation to all judgements as to whether an effect is significant or not.

12.2.28 Less quantifiable socio-economic effects may also result from the Proposed Development. These effects may not easily be able to be linked to a specific receptor, or it may be difficult to quantify the likely change with any degree of certainty. In these cases, the likely effect is described textually, and a statement made as to whether that effect would be significant or not, based upon the professional judgement of the assessor.

Consultation

12.2.29 The scope of the Socio-Economic Assessment was set out in the Scoping Report submitted to Nottingham County Council (NCC) in February 2020 (refer to **Appendix 2-1**). The Scoping Opinion received from NCC in April 2020 (refer to **Appendix 2-2**) confirmed that the proposed scope was acceptable. No further post-scoping consultation has been carried out.

Limitations

12.2.30 The assessment and its conclusions are dependent upon the accuracy of third-party data. Economic data used to project the changes resulting from the Proposed Development is inevitably historic, and actual outcomes may vary from those stated due to wider economic fluctuations, or to changes in technology.

12.2.31 The data gathered reflects different points in time, with 2011 Census data typically being less current than NOMIS labour market statistics.

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12.3 Baseline

Data Collection

12.3.1 The Assessment utilises data gathered from various sources, including:

- 2011 Census [4] – provision of local population profiles;
- NOMIS [5] – Office for National Statistics (ONS) labour market statistics;
- Gross Value Added (GVA) – wealth from production of goods allowing comparison of regions of different sizes;
- ONS [6] – Mid-2018 Population Estimates; and
- County and local authority data.

12.3.2 In the following sections, the statistics are presented for the Study Area, as defined in Table 12.1, with statistics for Rushcliffe LA, Nottingham County Council area (NCC), Nottingham City Council, the East Midlands Region and either England, England and Wales or Great Britain, presented as comparators. It should be noted that both Rushcliffe and Nottingham City Council form part of the overall Study Area as described in Table 12.1.

Baseline Environment

Population

12.3.3 Mid-year population estimates for 2018 indicate that the Study Area had a population of 962,271 (percentage numbers are rounded, and do not necessarily add up to 100 %). The proportion of the population that was of working age was slightly higher than regional and national averages (Table 12.6).

[4] *UK Data Service Census Support. [online] https://borders.ukdataservice.ac.uk/easy_download.html [accessed 26 March 2020].*
[5] *NOMIS Labour Market Statistics: https://www.nomisweb.co.uk/reports/lmp/la/contents.aspx [accessed 26 March 2020].*
[6] *Source: Office for National Statistics licensed under the Open Government Licence. Mid-2018 Population Estimates for Middle Layer Super Output Areas in England and Wales by Single Year of Age and Sex [accessed 26 March 2020].*

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Table 12.6: Age Structure

Population	Study Area	Rushcliffe	Nottingham City	NCC	East Midlands	England & Wales
Total	962,271	117,671	331,069	823,126	4,804,149	59,115,809
0–19	23 %	23 %	26 %	22 %	23 %	24 %
20–64	60 %	56 %	63 %	57 %	57 %	58 %
65+	17 %	21 %	12 %	21 %	19 %	22 %

Employment

12.3.4 NOMIS travel-to-work data, based upon the 2011 Census, illustrates the employment levels for MSOA Rushcliffe 014. A total of 3,299 people had a place of work within the MSOA (including those commuting from outside). Employment within the MSOA is broken down in Table 12.7.

Table 12.7: Employment within MSOA Rushcliffe 014 (Census, 2011)

Location of Employees	Number of jobs	% of total jobs
People with place of work in MSOA Rushcliffe 014	3,299	100 %
People with place of work in MSOA Rushcliffe 014, that live in MSOA Rushcliffe 014	383	12 %
People with place of work in MSOA Rushcliffe 014, that live in Rushcliffe Borough	1,198	36 %
People with place of work in MSOA Rushcliffe 014, that live in NCC	1,789	54 %
People with a place of work in MSOA Rushcliffe 014, that live in the Study Area (reference Table 12.1)	2,803	85 %
People with a place of work in MSOA Rushcliffe 014, commuting from further afield (outside the study area)	496	15 %

12.3.5 Tables 12.8 to 12.13 present the key baseline employment data for the Study Area, compared to regional and national statistics taken from NOMIS (percentage numbers are rounded and do not necessarily add up to 100 %).

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Table 12.8: 2018 NOMIS Total Employee Jobs

Area	Total employee jobs
Study Area	505,000
Rushcliffe	52,000
Nottingham City	196,000
NCC	351,000

NOTE: Figures exclude the self-employed, those employed in farm-based agriculture, government-supported trainees, and HM forces.

Table 12.9: NOMIS Employment and Pay Data [7]

Area	Unemployment Rate	2019 Weekly Median Earnings
Study Area	4.1 %	£592.10
Rushcliffe	2.6 %	£699.40
Nottingham City	6.9 %	£480.10
NCC	4.3 %	£551.90
East Midlands	4.2 %	£547.40
Great Britain	3.9 %	£587.00

NOTE 1: Unemployment figures are based on NOMIS data covering the period October 2018–September 2019.
NOTE 2: Weekly median earnings figures are for place of residence. Figures are based on NOMIS data for 2019.

Table 12.10: NOMIS Qualification Level Data

Area	Qualification Level %					
	NVQ4	NVQ3	NVQ2	NVQ1	Other	None
Study Area	39.9 %	62.5 %	78.8 %	87.9 %	7.3 %	7.1 %
Rushcliffe	61.9 %	78.1 %	88.4 %	91.4 %	-	-
Nottingham City	35.8 %	56.5 %	69.8 %	80.5 %	9.4 %	10.1 %
NCC	32.6 %	53 %	71.8 %	84 %	7.6 %	8.4 %
East Midlands	33.2 %	54 %	72 %	84.1 %	7.8 %	8.1 %
Great Britain	39.3 %	57.8 %	74.9 %	85.4 %	6.8 %	7.8 %

NOTE 1: Percentage figures for NVQ levels are for that level and above, i.e. the NVQ1 figure includes the totals for NVQ2, 3 and 4.

[7] *ONS Crown Copyright Reserved [from NOMIS on 28 March 2020]*

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Table 12.11: NOMIS Employment Level by Industry (October 2018 – September 2019)

Industry	Study Area	Rushcliffe	Nottingham City	NCC	East Midlands	Great Britain
Mining and quarrying	0.6 %	0.3 %	0 %	0.1 %	0.2 %	0.2 %
Manufacturing	11.4 %	6 %	4.6 %	13.3 %	12.9 %	8.1 %
Electricity, gas, steam and air conditioning supply	1.1 %	0.7 %	2.3 %	0.8 %	0.8 %	0.5 %
Water supply; sewerage, waste management and remediation activities	0.6 %	0.3 %	0.4 %	0.8 %	0.7 %	0.7 %
Construction	5.1 %	4.8 %	2.6 %	6.3 %	4.4 %	4.7 %
Wholesale and retail trade; repair of motor vehicles and motorcycles	16.2 %	14.3 %	17.3 %	17.3 %	16.7 %	15.2 %
Transportation and storage	5.4 %	1.4 %	3.6 %	4.3 %	5.5 %	4.8 %
Accommodation and food service activities	6.9 %	7.1 %	6.1 %	7.3 %	7 %	7.6 %
Information and communication	4 %	7.1 %	5.1 %	3 %	2.9 %	4.2 %
Financial and insurance activities	1.4 %	1.1 %	2.6 %	1 %	1.7 %	3.5 %
Real estate activities	1.4 %	1.4 %	2 %	1.2 %	1.3 %	1.7 %
Professional, scientific and technical activities	7.7 %	10.7 %	6.6 %	6 %	6.4 %	8.7 %
Administrative and support service activities	8 %	6 %	9.2 %	8 %	9 %	9 %
Public administration and defence; compulsory social security	3 %	6 %	5.6 %	3 %	4 %	4 %
Education	11 %	14 %	11.2 %	9 %	9 %	9 %
Human health and social work activities	10 %	12 %	15.8 %	14 %	13 %	13 %
Arts, entertainment and recreation	3 %	4 %	2.6 %	3 %	3 %	3 %
Other service activities	2 %	2 %	2 %	2 %	2 %	2 %

Table 12.12: 2018 NOMIS Gross Value Added

Area	Gross Value Added (2018)	Gross Value Added per head (2018)
Study Area	£23,055 million	£23,959
Rushcliffe	£2,449 million	£20,812
Nottingham City	£9,658 million	£29,172
NCC	£15,184 million	£18,447
East Midlands	£108,966 million	£22,682
England	£1,643,271 million	£29,356

NOTE 1: Figures exclude the self-employed, those employed in farm-based agriculture, government-supported trainees, and HM forces.
NOTE 2. Gross Value Added is reported based on provisional figures for 2018.

Table 12.13: 2018 Employment by Occupation Data

Data (October 2018 – September 2019)	Study Area	Rushcliffe	Nottingham City	NCC	East Midlands	Great Britain
Managers, directors and senior officials	11.7 %	17.9 %	7.2 %	11.1 %	10.9 %	11.3 %
Professional occupations	22 %	35.1 %	18.8 %	19.7 %	18.3 %	21.2 %
Associate professional and technical	13.7 %	17.5 %	12.4 %	12.5 %	13.1 %	14.8 %
Administrative and secretarial	10.2 %	15 %	9 %	10.2 %	9.9 %	9.7 %
Skilled trades occupations	13 %	#	9.9 %	10.7 %	11.7 %	10 %
Caring, leisure and Other Service occupations	10.2 %	#	12.4 %	10.8 %	9.5 %	9 %
Sales and customer service occupations	8.9 %	#	8.4 %	6.9 %	7.1 %	7.3 %
Process plant and machine operatives	8 %	#	6.8 %	7.8 %	8.1 %	6.2 %
Elementary occupations	10.5 %	#	15 %	10.1 %	11.3 %	10.2 %

NOTE 1: Figures for Employment by Occupation are a percentage of those in employment, and are independent of the unemployment figure.
NOTE 2: # means dataset too small to produce reliable information.

12.3.6 NOMIS labour market profile data identifies that between October 2018 and September 2019, unemployment within the Study Area was slightly lower than the figure for NCC and the East Midlands region, but higher than for Great Britain.

12.3.7 NOMIS data identifies that in 2019, median earnings within the Study Area were higher than regional and national averages. The 2011 Census data for qualifications

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also indicates that qualification levels within the whole of the Study Area are generally higher than those observed regionally and nationally. However, the Study Area will receive an uplift due to the significantly larger averages in both earnings and qualifications for employment in the Rushcliffe LA area.

12.3.8 NOMIS data regarding Gross Value Added (GVA) provides provisional GVA figures for the Study Area compared regionally and nationally. The data indicates that GVA is lower than the national average, but plays a significant contribution to the overall GVA for the region.

12.3.9 With regards to employment breakdown by industry, 2018/19 NOMIS data for the Study Area can be compared with regional and national data for the same year. Employment levels in mining and quarrying; manufacturing; electricity, gas, steam and air conditioning supply; and education were above regional and national averages. Conversely, employment levels in financial and insurance activities, and human health and social work activities were all notably below regional and national averages.

Future Baseline

12.3.10 It should also be noted that the current coal-fired Power Station is currently due to cease generating in 2025, with decommissioning expected to follow. It is noted that not all structures at the current Power Station will be decommissioned, hence some existing employment will be retained. However, the full socio-economic effects that derive from the operation of the current Power Station are unlikely to continue in the medium to long term.

12.3.11 Although the Proposed Development is intended to be a catalyst for the redevelopment of the Power Station site, this assessment only considers the effects of the Proposed Development (not decommissioning, or other future development).

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12.4 Assessment of Effects

Construction Phase

Sensitivity of Receptor

12.4.1 The 2019 NOMIS data displayed in Section 12.3 shows that employment in the construction sector in the Study Area is similar to national averages, but lower than NCC levels. Construction employment was 5.1 %, compared to 6.3 % of total employment in Study Area and NCC, respectively.

12.4.2 Between October 2018 and September 2019, unemployment in the Study Area was slightly higher than national levels, and employment in the skilled trades was above regional and national averages (see Table 12.13).

12.4.3 Construction employment is dependent upon the availability of ongoing development opportunities due to construction employment being inherently temporary, lasting for only as long as that particular project (or specific aspect of that project) is under construction. Local planning policy supports the strengthening of economic provision across all employment sectors by providing suitable sites for new employment, which implies construction activity and associated construction employment. As such, sensitivity is considered medium.

Direct Effects

12.4.4 Direct effects relate primarily to jobs created wholly or largely related to construction of the Proposed Development.

12.4.5 The number of people on-site is likely to fluctuate depending upon the programming of particular work elements, and would be likely to comprise a mix of full-time and part-time contractors. The Applicant has confirmed that peak of up to approximately 600 people are likely to be on Site at any one time, with an average of approximately 300 staff employed on-site across the construction period as a whole. The staffing profile over the construction period is shown on Figure 4.12.

12.4.6 It is likely that elements of construction would be tendered in a series of sub-contractor packages, including for example ground works, steel works, etc. Local

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contractors may be able to fulfil the requirements of some of these packages. There is therefore scope for the employment of local people during the construction process (for example, those employed in skilled trades), and the provision of employment opportunities for those that are currently out of work. It is acknowledged, however, that some of the contractors and some of the workforce for more specialised elements of construction may potentially need to be drawn from outside the Study Area.

12.4.7 There would be an increase in construction employment during the construction phase, either via the creation of new jobs, or via the maintenance of existing employment.

12.4.8 In absolute terms, with, on average, approximately 300 workers on-site, and a peak employment level of approximately 600 people, this would represent a medium magnitude of change when considered against baseline construction employment levels. These figures are relatively small in percentage terms when considered against the whole of the Study Area (see Table 12.8), but nevertheless are large in absolute terms.

12.4.9 The effects of this on the Study Area overall would be moderate beneficial. The effects, which would be temporary, could be significant for individual businesses and workers, particularly for those which are locally based. Additionally, the generation of construction activity and employment associated with the Proposed Development has potential to lead to further opportunities for both businesses and individual workers, should further development in the Study Area be implemented subsequently (see Section 12.5 Cumulative Effects).

Indirect and Induced Effects

12.4.10 Indirect effects associated with the construction process would derive from supply chain employment. Construction materials and services would be bought-in by contractors. Some of these materials and services would be specialised, whilst others would be more generic. The various supply chains can only be determined by the relevant appointed contractors and therefore effects cannot be quantified at the time of writing. It should be recognised, however, that supply chain businesses will benefit from construction and demand for their goods or services is likely to support continued or additional employment.

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12.4.11 Induced effects would derive chiefly from the expenditure by those employed in construction. Some of this expenditure is likely to occur locally to the Site, or elsewhere in the Study Area. Any non-local workers whose home base is remote from the Site are likely to require accommodation during the week, and there would therefore be potential benefits to local hotels and guest houses.

12.4.12 There is a convention in economic terms that ten temporary jobs are equivalent to one FTE [8] job, based on the assumption that a permanent job lasts approximately ten years. It can then be assumed that ten worker-years on site are equivalent to one FTE job. Based on the forecasted average of 300 construction staff employed per day over the entire project, there would be an equivalent of 900 worker years during the three-year construction programme. This is the equivalent of 90 full time equivalent jobs associated with the direct construction employment.

12.4.13 The *Additionality Guide* suggests a composite multiplier of 2.7 (covering income and supply) is appropriate for construction employment. As such, it is estimated that approximately 153 [9] FTE jobs would be supported via the indirect or induced effects of the Proposed Development.

12.4.14 The magnitude of change deriving from indirect and induced construction employment cannot be stated with any certainty. The level of effect would range from being minor (across the entire Study Area) to major (and therefore significant) for some local businesses and some supply chain businesses, given the size and scale of the Proposed Development. These effects would be temporary, with the potential to lead to further opportunities for both businesses and individual workers. It should be noted that many supply chain businesses may be located outside the Study Area and that expenditure by construction workers may also take place there (including for example, online purchases, holiday expenditure, etc.). However, there is clear potential for some businesses within the Study Area to derive economic benefits from the Proposed Development during the construction stage.

[8] *Full time equivalent.*
[9] *For example, 90 direct FTE construction jobs multiplied by 2.7 gives 243, with the difference (i.e. 153) being the additional indirect or induced employment supported.*

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Operational Phase

Sensitivity of Receptor

12.4.15 Unemployment in the Study Area is slightly above national average, as set out in Section 12.3. Employment within the waste management sector was about the regional and national average in 2019. Within the Study Area, employment skewed towards higher skilled occupations and management occupations. However, there is clear disparity between the distribution of higher and lower skilled jobs within different parts of the Study Area, as shown in Table 12.14 which compares Rushcliffe local authority data with that of Nottingham City.

Table 12.14: 2018 Employment by Occupation Data – Comparison of Rushcliffe and Nottingham City Local Authorities in Study Area

Data (October 2018 – September 2019)	Study Area	Rushcliffe	Nottingham City
Managers, directors and senior officials	11.7 %	17.9 %	6.1 %
Professional occupations	22 %	35.1 %	18.9 %
Associate professional and technical	13.7 %	17.5 %	12.6 %
Administrative and secretarial	10.2 %	15 %	8.3 %
Skilled trades occupations	13 %	#	8.5 %
Caring, leisure and other service occupations	10.2 %	#	13.6 %
Sales and customer service occupations	8.9 %	#	10 %
Process plant and machine operatives	8 %	#	6.5 %
Elementary occupations	10.5 %	#	15.3 %

NOTE 1: Figures for Employment by Occupation are a percentage of those in employment, and are independent of the unemployment figure.
NOTE 2: # means dataset too small to produce reliable information

12.4.16 Local economic policies (refer to Section 12.1) recognise the need to have a skilled workforce to enable the region to compete economically at local and global scales. The economic plan of the LEP is to narrow wage disparities across the region and increase in the number of higher paid jobs with increased skill levels.

12.4.17 On this basis, the sensitivity of employment in the Study Area is considered to be high.

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Employment

12.4.18 The Proposed Development would result in the creation of approximately 45 FTE jobs. The occupational mix would be broadly as follows:

- Managers: 5;
- Engineers, Supervisors and Technicians: 20;
- Plant and Process Operatives: 13; and
- Administrative and Secretarial Occupations: 7.

12.4.19 The Applicant has confirmed that the gross income of those employed at the Proposed Development would be approximately £1.65 million per annum, and the net income (after deductions) would be approximately £1.3 million per annum.

Leakage

12.4.20 Approximately 85 % of those working within MSOA Rushcliffe 014 live within the Study Area, based upon commuting patterns identified in the 2011 census (as referenced in Section 12.3), and approximately 15 % of existing (in 2011) jobs are taken up by those living further afield. Based on this, the likely leakage of employment outside the Study Area is estimated at 15 %.

Displacement

12.4.21 It is possible that the Proposed Development would take trade from other businesses located within the Study Area. This could include the diversion of waste / RDF from other waste management facilities and hence could displace activity at these sites. However, any diversion from UK landfills would, given overall UK landfill inputs, result in minimal displacement. Any displacement of exported RDF from European facilities would not impact upon the UK economy. Further, it may well be replaced by waste presently going to landfill within Europe. As a consequence, displacement resulting from the Proposed Development is likely to be very low and has been estimated at no more than 5 %.

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Indirect and Induced Effects

12.4.22 During operation of the Proposed Development, a range of bought-in goods and services will be required providing continued or additional indirect employment by the suppliers of these goods and services (for example, during planned maintenance activities at the EMERGE Centre).

12.4.23 Other induced effects would derive from spending by those employed directly and indirectly at the Proposed Development, which would inevitably support employment (continued or additional) in relation to a further range of goods and services. The scale of this additional indirect and induced employment can be estimated via use of a multiplier. The *Additionality Guide* suggests a composite multiplier (covering income and supply) of 2.8 is appropriate for electricity production. As such, approximately 81 [10, 11] new or existing FTE jobs would be supported via the indirect or induced effects of the Proposed Development.

Additionality

12.4.24 Based on the above, the additionality deriving from the Proposed Development (i.e. how it would be likely to affect the economy of the Study Area once operational) can be estimated. Gross Value Added (GVA) has been estimated based on the income levels expected by the Proposed Development (set out above), and in relation to direct employment, works out at approximately £36,700 per job (excluding income tax and other deductions).[12] This is a significantly higher figure than the rate estimated for the Study Area, which is set out in Table 12.12.

12.4.25 Table 12.15 sets out the additionality calculation for the Proposed Development.

[10] *For example, 45 direct FTE jobs multiplied by 2.8 gives 126, with the difference (i.e. 81) being the additional indirect or induced employment supported.*

[11] *The figure of 81 additional FTE jobs is absolute and excludes the effects of leakage or displacement.*

[12] *£1,650,000.00 estimated gross income of employees, divided by 45 FTE jobs. This provides a worst case salary of £36,666.*

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Table 12.15: Additionality

	FTE Employment	Gross Value Added
A. Direct Employment	45	£1,650,000
B. Leakage (outside Study Area)	15 %	n/a
C. Gross Direct Effect (A - B)	38.3 (38–39 jobs)	£1,404,333
D. Displacement [13]	5 %	n/a
E. Net Direct Effect (C - D)	36.39 (36–37 jobs)	£1,334,300
F. Multiplier	2.8	n/a
G. Total Net Effect (E × F)	101.88 (101–102 jobs)	£3,735,600

12.4.26 As the Site is an undeveloped plot, it is considered that it does not currently support any specific employment and the loss of this land to accommodate the Proposed Development is unlikely to affect the employment levels of the relevant landowner. As such, the effects of the Proposed Development are not considered against any corresponding loss of employment at the Site.

12.4.27 As discussed in Section 12.3, it is expected that the current coal-fired Power Station will close in 2025. However, this is not a result of the Proposed Development. Importantly, the Proposed Development may provide continuity of employment for some staff at the current Power Station given the potential areas of cross-over in skill sets related to running and maintaining power generating installations.

12.4.28 The Proposed Development would result in the direct creation of approximately 45 FTE jobs. When leakage and displacement is taken into account, the Proposed Development is likely to support approximately 101–102 jobs within the Study Area. The net GVA to the economy of the Study Area by the Proposed Development would be in the region of £3.7 million annually. These figures are relatively small in percentage terms when considered against the whole of the Study Area, but nevertheless are relatively large in absolute terms, reducing unemployment in the area as well as providing a range of jobs with differing skills sets. As such, there would be a medium magnitude of change from the baseline for both employment and Gross Value Added reported in Section 12.3. This would result in a major beneficial effect to the economy of the Study Area, which would be significant.

[13] *Displacement is estimated at 5 %, as discussed above.*

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Wider Socio-Economic Effects

12.4.29 The net export capacity of the Proposed Development would be 43.4 MW. As such, up to 342,000 [14] MW-hours of electricity would be exported per annum. This is sufficient to meet the needs of approximately 90,000 homes. Approximately 50 % of the energy generated would be from the biogenic fraction of the residual waste treated at the Site and as such would be classified as renewable energy. This would clearly have a beneficial effect in terms of the transition to a low carbon economy, the development of renewable energy sources, and the recovery of waste.

Non-Domestic Business Rate Retention

12.4.30 The Proposed Development would be liable for non-domestic (business) rates which would be paid to NCCA. Government policy allows for business rate retention for local authorities who support the development of renewable energy projects. Where RDF comprises biomass, or is otherwise biodegradable, this is recognised as a source of renewable energy. As noted above, approximately 50 % of the residual waste treated would come from renewable sources, and as such, the same proportion of the energy generated is likely to be subject to business rate relief (which would need to be determined via a detailed assessment). On this basis, the Proposed Development would provide a financial benefit to Rushcliffe Borough Council.

District Heating and Heat Off-Take

12.4.31 In addition to the production of electricity, the Proposed Development would also be CHP ready and capable of providing heat in the form of steam (or possibly hot water) for use by local heat users. The short to medium term objective is that the Proposed Development could serve a Site heat network, and potentially also (via heat exchangers) a cooling network.

[14] *Based on the EfW operating 7884 hours per year.*

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12.5 Cumulative Effects

12.5.1 In terms of cumulative socio-economic impacts that could potentially arise due to the Proposed Development, only one scheme, HS2b, has been identified (refer to Chapter 2.0 for further details).

12.5.2 The indicative construction programme for HS2b indicates that construction work near to the Proposed Development is due to begin Quarter 3 and 4 of 2025. This is 9 months after the Proposed Development is anticipated to be fully completed and operational.

12.5.3 Due to the disparate timescales between the two projects, no direct cumulative effects are expected during construction. However, the consecutive potential construction activity at more than one site locally may lead to increased opportunities for local contractors, and hence for local employees, which could be beneficial.

12.6 Mitigation

12.6.1 The effect on both construction employment and permanent (non-construction) employment within the Study Area would be beneficial and no specific mitigation measures are deemed necessary.

12.6.2 Nevertheless, there are enhancement measures that could be used to increase the positive aspects and potential supply chain benefits to local businesses, such as:

- Use of labour agreements to maximise the proportion of local construction workers;
- A recruitment/training programme with a focus on the closest jobcentres; and
- Local procurement of products and services where possible.

12.6.3 The Applicant's award winning onsite training and apprenticeship skills centre (the Uniper Engineering Academy) is located at the Power Station. The Applicant would engage with NCC, Rushcliffe LA, D2N2 People and Skills Board and other relevant organisations, to develop and agree a plan to create and enhance opportunities for local people to acquire the skills needed to operate the plant and so be ready for employment during commissioning and operation.

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12.6.4 This particular measure would enhance the benefits of the Proposed Development, by increasing the skill base of the local labour force.

12.7 Residual Effects and Conclusions

12.7.1 The Proposed Development would have a moderate beneficial effect on construction employment within the Study Area. The effects, which would be temporary, could be significant for individual businesses and workers, particularly for those which are locally based. This would lead to a positive influence upon the continued viability of a range of contractor companies and their employees, as well of other businesses forming part of the supply chain. There may therefore be significant effects for specific businesses, and indeed for individuals employed in construction. Construction is a sector that is dependent upon the availability of continued opportunities to undertake built development, and the Proposed Development would provide such an opportunity. This will enable the retention and possible upgrading of skilled workers, within construction sector businesses.

12.7.2 Once operational, the Proposed Development would directly create approximately 45 jobs. A further 101–102 jobs are likely to be created or supported by indirect or induced expenditure (e.g. services bought-in to the Site, or spending outside the Site by employees). This would add an estimated £3.7 million to the economy of the Study Area each year. The effects of the Proposed Development would clearly be beneficial in generating employment within the Study Area, particularly as a range of different job types, at different skill levels, would be provided.

12.7.3 When considered in light of the planned decommissioning of the existing Power Station, there is clear scope to provide continued employment for some of the employees at the Power Station. When considered in the context of the wider Study Area economy, it is concluded that there would be a major beneficial and significant effect.

12.7.4 The job creation and increase in gross value added that would result from the Proposed Development, together with the training providing by the Applicant, would contribute to the achievement of both planning and economic policies.

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CHAPTER 13.0 ARCHAEOLOGY AND CULTURAL HERITAGE

FIGURES (Volume 2 bound separately)

APPENDICES (Volume 3 bound separately)

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13.0 ARCHAEOLOGY AND CULTURAL HERITAGE

13.1 Introduction

13.1.1 This Chapter provides an assessment of the effects of the Proposed Development upon archaeological and cultural heritage assets. This includes direct effects resulting from the construction of the Proposed Development and effects upon the setting of heritage assets which may arise during operation.

Proposed Development and Site Context

13.1.2 The Proposed Development is described in full in Chapter 4.0 of this Environmental Statement (ES). In summary, the Proposed Development is a multifuel energy recovery facility (ERF), recovering energy from waste material.

13.1.3 As described in greater detail in Chapter 1.0 of this ES the application site is located to the north of the Power Station site and includes a mixture of hardstanding and compacted stone. It is effectively level (30–38 m AOD) and bound to the north and east by the electrified Power Station security fence and to the south and west by a combination of Power Station related, large-scale developments, and a further open area formerly used by contractors. The Proposed Development is centred on SK 50430 30476.

13.1.4 The base geology is Branscombe Mudstone Formation of the Mercia Mudstone Group (red brown mudstone with thin intercalations of green grey, hard, dolomitic siltstone or sandstone). The Branscombe Mudstone Formation is known to contain abundant Gypsum that occurs as veins, nodules and thick beds. Two thick beds of gypsum (the Newark Gypsum and Tutbury Gypsum) are known to be present in the wider area and have been identified at the Site during previous investigation.[1] This is overlain by Hemington Member – Silt and Gravel. These superficial deposits formed up to three million years ago in the Quaternary Period. British Geological Survey (BGS) geological mapping[2] and information from historical site investigations[3] indicate that superficial deposits are absent across the Site.

[1] GEL (2007) Ground Investigation Ratcliffe Power Station. Unpublished geotechnical report.
[2] BGS (2020). *Available at: http://mapapps.bgs.ac.uk/geologyofbritain/home.html*
[3] GEL (2007)

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Competence

13.1.5 AOC Archaeology Group is a Registered Organisation of the Chartered Institute for Archaeologists (CIfA). This status ensures that there is regular monitoring and approval by external peers of our internal systems, standards and skills development.

13.1.6 AOC Archaeology Group conforms to the standards of professional conduct outlined in the CIfA Code of Conduct [4], the CIfA Standard and Guidance for Historic Environment Desk Based Assessment [5] and the CIfA Standard and Guidance for Commissioning Work or Providing Consultancy Advice on the Historic Environment.[6]

13.1.7 AOC is ISO 9001:2015 accredited, in recognition of the Company's Quality Management System.

13.2 Methodology and Scope of Assessment

Legislation

13.2.1 Policy contained within the National Planning Policy Framework (NPPF) and the statutory Development Plan documents (i.e. those prepared by Nottinghamshire and Nottingham and Rushcliffe) are set out in the Planning Statement (submitted as a separate standalone document) and have not been repeated here.

Guidance

National Planning Practice Guidance

13.2.2 In March 2014, the Department for Communities and Local Government [7] launched the planning practice guidance [8] as a web-based resource which is regularly updated

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[4] *CIfA (2014). Chartered Institute for Archaeologists' (CIfA) Code of Conduct https://www.archaeologists.net/sites/default/files/CodesofConduct.pdf (Accessed 09/03/2020)*
[5] *CIfA (2017). Standard and guidance for historic environment desk-based assessment The Chartered Institute for Archaeologists http://www.archaeologists.net/sites/default/files/CIfAS%26GDBA_3.pdf (09/03/2020)*
[6] *CIfA (2014). Standard and guidance for Commissioning Work or Providing Consultancy Advice on the Historic Environment. The Chartered Institute for Archaeologists http://www.archaeologists.net/sites/default/files/CIfAS&GCommissioning_1.pdf (Accessed 09/03/2020)*
[7] *Department for Communities and Local Government is now the Ministry for Housing, Communities and Local Government. Accessed (19/03/2020)*
[8] MHCLG, (2014, updated 2019*). Guidance, Historic Environment https://www.gov.uk/guidance/conserving-and-enhancing-the-historic-environment) Accessed (19/03/2020)*

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/ revised. Section 18a of the guidance is concerned with ‘Conserving and Enhancing the Historic Environment’. The Guidance notes that: *“Conservation is an active process of maintenance and managing change. It requires a flexible and thoughtful approach to get the best out of assets as diverse as listed buildings to as yet undiscovered, undesignated buried remains of archaeological interest.”* [9] Elements of the planning practice guidance particularly relevant to this assessment are discussed further under Assessment Methodology subsection below.

Good Practice Advice Note 3, Second Edition: Setting

13.2.3 In December 2017, Historic England (HE) published a guidance document on setting as part of their Good Practice Advice Notes intended to explain how to apply the policies contained in the NPPF. This document states: *“Setting is not itself a heritage asset, nor a heritage designation, although land comprising a setting may itself be designated. Its importance lies in what it contributes to the significance of the heritage asset or to the ability to appreciate that significance.”* [10]

13.2.4 The guidance sets out the ways in which setting may contribute to the value of a heritage asset. It advocates a five-stage approach, comprising:

- the identification of the heritage assets;
- an assessment of the contribution of setting to the asset’s value;
- an assessment of potential effects upon the setting (and thus the value of the asset) by a proposed development/change;
- an exploration of potential enhancement and / or mitigation measures; and
- to make, document and monitor the outcomes of the decision made.[11]

13.2.5 This guidance provides a checklist of potential attributes of setting which may contribute to or make appreciable the value of the asset in question. HE acknowledges that the checklist is non-exhaustive and that not all attributes will apply in all cases.

13.2.6 This assessment has regard to this checklist but, in the interests of proportionality, only discusses attributes of setting where these are found to contribute to the value of an asset. Similarly, in many cases effects upon setting are ‘less than substantial’

[9] *PPG Paragraph 002 Reference ID 18a-002-20190723 Accessed (19/03/2020)*
[10] *Historic England (2017). Good Practice Advice Note 3, Second Edition: Setting, 4.*
[11] *Historic England (2017). Good Practice Advice Note 3: Setting, 8.*

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and are not significant. As such, it is not always necessary or appropriate to propose mitigation or enhancement measures as outlined by this approach. Where relevant, mitigation and enhancement measures are identified as part of this assessment.

13.2.7 The final bullet point set out in the HE guidance above does not apply to this assessment as the monitoring of decision outcomes can only be undertaken once a planning decision has been made.

Assessment Methodology

13.2.8 The primary source of information relating to the presence and significance of known, non-designated historic / archaeological remains in the area is Nottinghamshire County Council's (NCC) Historic Environment Record (HER). An extract was received from the HER in February 2020. Up-to-date information on Scheduled Monuments, Listed Buildings and Registered Parks and Gardens (RPGs) was obtained from HE in February 2020, together with GIS data recording their locations and extent. Information on the boundaries of Conservation Areas were obtained from Erewash Borough Council, Rushcliffe Borough Council and North West Leicestershire District Council.

13.2.9 All heritage assets, whether designated or not, within a distance of up to 1 km from the boundary of the Site, have been identified and these are recorded in **Appendix 13-1**: Site Gazetteer. The locations of all assets are illustrated on Figures 13.1 and 13.2. All designated assets, including Scheduled Monuments, Listed Buildings, Conservation Areas and Registered Parks and Gardens, at distances up to 3 km from the Site, were identified and mapped. Those heritage assets that might be subject to effects upon their setting have been identified via scoping and with reference to Zone of Theoretical Visibility (ZTV) mapping and site visits.

Assessment of Significance / Assessment Criteria

13.2.10 This subsection sets out the methodology for assessing effects upon heritage assets; both direct physical and setting effects. It takes account of the NPPF [12], its practice

[12] MHCLG (2019). *National Planning Policy Framework*

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guide [13] and Historic England's Good Practice Advice Note 3: the setting of heritage assets.[14]

Assessing Cultural Value (Significance) & Importance

13.2.11 The definition of cultural significance is readily accepted by heritage professionals both in the UK and internationally and was first fully outlined in the Burra Charter, Article One, which identifies that 'cultural significance' or 'cultural heritage value' means aesthetic, historic, scientific, social or spiritual value for past, present or future generations.[15] This definition has since been adopted by heritage organisations around the world, including HE. The NPPF defines 'cultural significance' as: *"The value of a heritage asset to this and future generations because of its heritage interest. That interest may be archaeological, architectural, artistic or historic. Significance derives not only from a heritage asset's physical presence, but also from its setting."* [16]

13.2.12 All heritage assets have some value; however, some assets are judged to be more important than others. The level of that importance is, from a cultural resource management perspective, determined by establishing the asset's capacity to inform present or future generations about the past. In the case of many heritage assets their importance has already been established through the designation (i.e. scheduling, listing and register) processes applied by HE.

13.2.13 The criteria used to establish importance in this assessment are presented in Table 13.1 and are drawn from the Department of Media, Culture and Sports (DMCS) publication, Principles for Selection of Listed Buildings [17], and the Scheduled Monuments Policy Statements [18] published by the same body, which outline the criteria for designating heritage assets.

[13] MHCLG, (2014, updated 2019). *Guidance, Historic Environment*
[14] Historic England (2017) *The Setting of Heritage Assets Historic Environment Good Practice Advice in Planning: 3 (2nd Edition)* https://historicengland.org.uk/images-books/publications/gpa3-setting-of-heritage-assets/heag180-gpa3-setting-heritage-assets/
[15] International Council on Monuments and Sites (2013). *Burra Charter* Article 1.2.
[16] MHCLG (2019). *National Planning Policy Framework, p71.*
[17] DMCS (2018). *Principles for Selection of Listed Buildings.*
[18] DMCS (2013). *Scheduled Monuments Policy Statements*.

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Table 13.1: Criteria for Establishing Importance

Importance	Criteria
International and National	World Heritage Sites; Scheduled Monuments (Actual and Potential); Grade I and II* Listed Buildings; Grade I and II* Registered Parks and Gardens; Registered Battlefields; Fine, little-altered examples of some particular period, style or type.
Regional	Grade II Listed Buildings; Grade II Registered Parks and Gardens; Conservation Areas; Major examples of some period, style or type, which may have been altered; Asset types which would normally be considered of national importance that have been partially damaged (such that cultural heritage value has been reduced).
Local	Locally Listed Heritage Assets; Lesser examples of any period, style or type, as originally constructed or altered, and simple, traditional sites, which group well with other significant remains, or are part of a planned group such as an estate or an industrial complex; Asset types which would normally be considered of regional importance that have been partially damaged or asset types which would normally be considered of national importance that have been largely damaged (such that their cultural heritage value has been reduced).
Negligible	Relatively numerous types of remains; Findspots or artefacts that have no definite archaeological remains known in their context; Asset types which would normally be considered of local importance that have been largely damaged (such that their cultural heritage value has been reduced).

Methodology for Assessing Direct Physical Effects

13.2.14 A direct effect by a development can potentially result in an irreversible loss of information content and therefore cultural heritage value. The potential magnitude of change upon heritage assets caused by the Proposed Development has been rated using the classifications and criteria outlined in Table 13.2.

Table 13.2 Criteria for Establishing Magnitude of Physical Change

Magnitude of Change	Criteria
High	Major loss of information content resulting from total or large-scale removal of deposits from a site. Major alteration of a monument's baseline condition.
Medium	Moderate loss of information content resulting from partial removal of deposits from a site. Moderate alteration of a monument's baseline condition.
Low	Minor detectable changes leading to the loss of information content. Minor alterations to the baseline condition of a monument.
Marginal	Very slight or barely measurable loss of information content. Loss of a small percentage of the area of a site's peripheral deposits. Very slight alterations to a monument.
None	No physical change anticipated.

13.2.15 The predicted significance of a direct effect upon an asset is determined by considering its importance in conjunction with the magnitude of change, see Table 13.3.

Table 13.3: Significance Level of Direct Effects on Heritage Assets

Magnitude of Change	Importance of Asset			
	Negligible	**Local**	**Regional**	**National and International**
High	Minor	Moderate	Moderate–Major	Major
Medium	Negligible–Minor	Minor–Moderate	Moderate	Moderate–Major
Low	Negligible	Minor	Minor–Moderate	Moderate
Marginal	Negligible	Negligible	Minor	Minor–Moderate
None	None	None	None	None
The levels of effect recorded in grey highlighted cells are those considered to be 'significant' in EIA terms				

Methodology for Assessing Indirect Effects Upon Setting

Assessing Sensitivity of Assets to Changes to their Setting

13.2.16 Whilst determining the relative cultural value of a heritage asset is essential for establishing its importance, it is widely recognised [19, 20] that the importance of an asset is not the same as its sensitivity to changes to its setting. Thus, in determining

[19] Lambrick (2008). *Setting Standards: A Review prepared on behalf of the IFA*.
[20] Historic England (2017) *Good Practice Advise Note 3: Setting, 7, Paragraph 17.*

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effects upon the setting of assets by the Proposed Development, both importance and sensitivity to changes to setting need to be considered.

13.2.17 Setting is a key issue in the case of some, but by no means all assets. A nationally important asset does not necessarily have high sensitivity to changes to its setting (relative sensitivity); this may be because its value lies in its other characteristics and its setting is not a factor that contributes demonstrably to its value. An asset's sensitivity refers to its capacity to retain cultural heritage value in the face of changes to its setting. The ability of the setting to contribute to an understanding, appreciation and experience of the asset and its value also has a bearing on the sensitivity of that asset to changes to its setting. Assets with high sensitivity will be vulnerable to changes that affect their settings, and even slight changes may reduce their value or the ability of setting to contribute to the understanding, appreciation and experience of the asset. Less sensitive assets will be able to accommodate greater changes to their settings without significant reduction in their value and, despite such changes, the relationship between the asset and its setting will still be legible.

13.2.18 The criteria for establishing an asset's relative sensitivity are outlined in Table 13.4.

Table 13.4: Criteria for Establishing Relative Sensitivity

Sensitivity	Definition
High	An asset whose setting contributes significantly to an observer's understanding, appreciation and experience of it and its value should be thought of as having High Sensitivity to changes to its setting. This is particularly relevant for assets whose settings, or elements thereof, contribute directly to their value (e.g. form part of their Evidential and Aesthetic Value [21]). For example, an asset which retains an overtly intended or authentic relationship with its setting and the surrounding landscape. These may in particular be assets such as ritual monuments that have constructed sightlines to and/or from them, or structures intended to be visually dominant within a wide landscape area e.g. castles, tower houses, prominent forts, etc. An asset, the current understanding, appreciation and experience of which, relies heavily on its modern setting. In particular an asset whose setting is an important factor in the retention of its cultural value.
Medium	An asset whose setting contributes moderately to an observer's understanding, appreciation and experience of it and its value should be thought of as having Medium Sensitivity to changes to its setting. This could be an asset for which setting makes a contribution to value, but whereby its value is derived mainly from its physical evidential values. This could for example include assets which had an overtly intended authentic relationship with their setting and the surrounding landscape but where that relationship (and therefore the ability of the assets' surroundings to contribute to an understanding, appreciation and experience of them and their value) has been moderately compromised either by previous modern intrusion in their setting or the landscape, or where the asset itself is in such a state of disrepair that the relationship with setting cannot be fully determined.

[21] Historic England (2008). *Conservation Principles, 28–29.*

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Sensitivity	Definition
	An asset, the current understanding, appreciation and experience of which, relies partially on its modern setting regardless of whether or not this was intended by the original constructors or authentic users of the asset. An asset whose setting is a contributing factor to the retention of its cultural value.
Low	An asset whose setting makes some contribution to an observer's understanding, appreciation and experience of it and its value should generally be thought of as having Low Sensitivity to changes to its setting. This may be an asset whose value is mainly derived from its physical evidential values and whereby changes to its setting will not materially diminish our understanding, appreciation and experience of it or its value. This could for example include assets which had an overtly intended authentic relationship with their setting and the surrounding landscape, but where that relationship (and therefore the ability of the assets' surroundings to contribute to an understanding, appreciation and experience of them and their value) has been significantly compromised either by previous modern intrusion to its setting or landscape, or where the asset itself is in such a state of disrepair that the relationship with setting cannot be determined.
Marginal	An asset whose setting makes minimal contribution to an observer's understanding, appreciation and experience of it and its value should generally be thought of as having Marginal Sensitivity to changes to its setting. This may include assets for which the authentic relationship with their surrounding has been lost, possibly having been compromised by previous modern intrusion, but who still retain cultural value in their physical evidential value and possibly wider historical and communal values.

13.2.19 The determination of an asset's sensitivity is first and foremost reliant upon the determination of its setting. The criteria set out in Table 13.4 is intended as a guide. Assessments of individual assets are informed by knowledge of the asset itself, of the asset type if applicable, and by site visits to establish the current setting of the assets. This allows for the use of professional judgement and each asset is assessed on an individual basis. It should be noted that individual assets may fall into a number of the sensitivity categories presented above, e.g. a country house may have a high sensitivity to alterations within its own landscaped park or garden, but its sensitivity to changes in the wider landscape may be less.

13.2.20 In establishing the relative sensitivity of an asset to changes to its setting, the setting must first be identified. This assessment outlines a range of factors, through qualitative written narrative, which will be considered when establishing the setting of an asset and therefore determining its sensitivity. The factors will be assessed from known records and in the field. In defining these criteria, emphasis has been placed on establishing the current setting of each asset, how this contributes to the value of the asset and how the Proposed Development would affect it.

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Assessing Magnitude of Change

13.2.21 Determining the magnitude of change caused by the Proposed Development requires an identification of the change to the setting of any given asset and, in particular, changes to those elements of the setting that inform its cultural value. Table 13.5 outlines the main factors affecting magnitude of change.

Table 13.5: Factors Affecting Magnitude of Change

Site Details	Importance of detail for assessing magnitude of change
(1) Proximity to centre of development	Increasing distance of an asset from the Proposed Development will, in most cases, diminish the effects on its setting.
(2) Visibility of development (based visualisations where appropriate)	The proportion of the development that is likely to be intervisible with the asset will usually directly affect the magnitude of change on its setting.
(3) Complexity of landscape	The more visually complex a landscape is, the less prominent the new development may appear within it. This is because where a landscape is visually complex the eye can be distracted by other features and will not focus exclusively on the new development. Visual complexity describes the extent to which a landscape varies visually and the extent to which there are various land types, land uses, and built features producing variety in the landscape.
(4) Visual obstructions	This refers to the existence of features (e.g. tree belts, forestry, landscaping or built features) that could partially or wholly obscure the development from view.

13.2.22 It is acknowledged that Table 13.5 primarily deals with visual factors affecting setting. Whilst the importance of visual elements of settings, e.g. views, intervisibility, prominence etc, are clear, it is also acknowledged that there are other, non-visual factors which could potentially result in setting effects. Such factors could be other sensory factors, e.g. noise or smell, or could be associative. In coming to a conclusion about magnitude of change upon setting, this assessment makes reference to traffic, lighting and landscape and visual assessments, undertaken for this ES, if appropriate.

13.2.23 Once the above has been considered, the prediction of magnitude of change in setting is based upon the criteria set out in Table 13.6. In applying these criteria, particular consideration is given to the relationship of the Proposed Development to those elements of setting which have been qualitatively defined as most important in contributing to the value of the heritage asset and the ability to understand, appreciate and experience it and its value.

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Table 13.6 Criteria for Classifying Magnitude of Change in Setting

Magnitude	Criteria
High	Direct and substantial visual impact on a key sightline to or from an asset; Direct and substantial visual impact on a key 'designed-in' view or vista from an asset; Direct severance of the relationship between an asset and its setting; Major imposition within a Cultural Landscape; A change that alters the setting of an asset such that it threatens the protection of the asset and the understanding of its cultural value.
Medium	Oblique visual impact on an axis adjacent to a key sightline to or from an asset, but where the key sightline of the asset is not obscured; Oblique visual impact on a key 'designed-in' view or vista from an asset; Partial severance of the relationship between an asset and its setting; Notable, but not major, imposition within a Cultural Landscape; Notable alteration to the setting of an asset but not directly affecting those elements of the setting which contribute most to the understanding of the cultural value of the asset; A change that alters the setting of an asset such that the understanding of the asset and its cultural value is marginally diminished.
Low	Peripheral change in a view affecting a significant sightline or key 'designed in' view or vista to or from an asset; Minor imposition within a Cultural Landscape; A perceptible change that alters the setting of an asset beyond those elements of the setting which directly contribute to the understanding of the cultural value of the asset, and where those changes do not materially affect an observer's ability to understand, appreciate and experience the asset or its value.
Marginal	All other changes to setting.
None	No setting changes.

Assessing Level of Effect on Setting

13.2.24 The effect resulting from changes in the setting of cultural heritage assets is judged to be the interaction of the asset's sensitivity (Table 13.4) and the magnitude of the change (Table 13.6) and also takes into consideration the importance of the asset (Table 13.1). In order to provide a level of consistency the assessment of sensitivity, the prediction of magnitude of change and the assessment of level of effect have been guided by pre-defined criteria. A qualitative descriptive narrative is also provided for each asset to summarise and explain each of the professional value judgements that have been made in reaching a judgement on sensitivity of the asset and the magnitude of change.

13.2.25 The interactions that guide the determination of level of effect on settings of the assets in question is shown in Table 13.7.

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Table 13.7: Significance Level of Indirect Effect on the Setting of Cultural Heritage Assets

Magnitude of Change	Relative Sensitivity			
	Marginal	**Low**	**Medium**	**High**
High	Minor	Minor–Moderate	Moderate	Major
Medium	Negligible	Minor	Minor–Moderate	Moderate
Low	Neutral	Negligible	Minor	Minor–Moderate
Marginal	Neutral	Neutral	Negligible	Minor
None	None	None	None	None
The levels of effect recorded in grey highlighted cells are 'significant'.				

Harm

13.2.26 The PPG requires assessments to clearly state whether harm to a designated heritage asset is substantial or less than substantial, and therefore identify the NPPF policy test to be applied. There would be no direct physical effects upon designated heritage assets as a result of the Proposed Development. As such, any discussion of harm in this assessment will relate to effects on the setting of designated heritage assets.

13.2.27 The NPPG notes that 'substantial' harm is a 'high test' and that as such it is unlikely to result in many cases. What matters in establishing whether harm is 'substantial' or not, relates to whether a change would seriously adversely affect those attributes or elements of a designated asset that contribute to, or give it, its value.

13.2.28 In terms of effects upon the setting of designated heritage assets, it is considered that only those effects identified as 'significant' in this assessment have the potential to be of 'substantial' harm. Where no significant effect is found, the harm is considered to be 'less than substantial'. This is because, as set out earlier in this methodology, effects only reach the significance threshold if their relative sensitivity to changes in setting is at the higher end of scale, or if the magnitude of change is at the higher end of the scale.

13.2.29 For many designated assets, setting may not contribute to their value or contribution to value may be limited. For these assets, even high magnitude changes to setting are unlikely to have adverse effects on the overall value of the designated asset. As set out in Table 13.6, lower ratings of magnitude of change tend to relate to notable

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or perceptible changes to setting, but where these changes do not necessarily obscure or damage elements of setting or relationships which directly contribute to the value of assets. As such, effects that are not significant will result in 'less than substantial' harm. Where there are no effects or effects are deemed to be Neutral or None, there will be no harm.

13.2.30 Where significant effects are found, a detailed assessment of the level of harm will be made. Whilst non-significant effects will cause 'less than substantial' harm, the reverse is not always true. That is, the assessment of an effect as being 'significant' does not necessarily mean that the harm to the asset is 'substantial'. The assessment of level of harm, where required, will be a qualitative one, and will largely depend upon whether the effects predicted would result in a major impediment to the ability to understand or appreciate the heritage asset in question by reducing or removing its information content and therefore reducing its cultural value.

Cumulative Effects

13.2.31 The assessment of cumulative effects will be undertaken in a similar manner to that of the potential effects but will take into consideration other developments as agreed with the planning authority, including those which are operational, under construction, consented or proposed. Cumulative effects relating to cultural heritage are for the most part limited to effects upon the settings of heritage assets.

13.2.32 Those heritage assets which are included in the detailed setting assessment, under operational effects for the Proposed Development, will also be considered when assessing the potential for cumulative effects. However, only those assets that are judged to have the potential to be subject to significant cumulative effects will be included in the detailed cumulative assessment provided. In assessing cumulative effects operational, under construction, consented and Proposed Developments will be considered. While all of these developments and development proposals will be considered, only those specific developments which would contribute to, or have the possibility to contribute to, cumulative effects on specific heritage assets will be discussed in detail in the text.

13.2.33 The cumulative assessment will have regard to the guidance on cumulative impacts upon heritage assets as set out in *Environmental Impact Assessment Handbook*

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V5 [22], and will utilise the criteria for assessing setting impacts as set out above. The assessment of cumulative effects will consider whether there would be an increased impact, either additive or synergistic, upon the setting of heritage assets as a result of adding the Proposed Development to a baseline, which may include operational, under construction, consented or Proposed Developments as agreed with the planning authority.

Scope of Assessment

13.2.34 This assessment considers the potential for direct physical effect upon archaeological remains as a result of the Proposed Development. This has been done through desk-based assessment, geoarchaeological deposit modelling and a walkover survey with the aim of identifying potential effects upon known heritage assets. The archaeological potential of the Site, that is the potential for buried archaeological remains to survive on Site and thus potentially be affected by the Proposed Development, is also assessed.

13.2.35 The assessment also considers the potential for setting effects upon designated heritage assets within 3 km of the Site boundary to be affected by the Proposed Development.

Consultation

13.2.36 A Scoping Report was submitted to NCC on 14 February 2020 and a Scoping Opinion was received on 6 April 2020.

13.2.37 A summary of relevant points made within the Scoping Opinion is given in Table 13.8, which also identifies where these points are addressed in this Chapter.

[22] *SNH & HES 2018 Environmental Impact Assessment Handbook V5. Available at: https://www.nature.scot/handbook-environmental-impact-assessment-guidance-competent-authorities-consultees-and-others*

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Table 13.8: Summary of Issues Raised During Consultation

Consultee	Comment	Response to Consultation
NCC Senior Practitioner Archaeology	I recommend that the applicants undertake geotechnical works to assess levels of made ground, previous ground disturbance and to model subsurface deposits, including the presence/absence of natural deposits. Such work would also help clarify the potential for contamination. I would recommend that geotechnical work should be undertaken in conjunction with appropriate expert geoarchaeological advice.	Review of previous geotechnical reports has been undertaken by a geoarchaeologist. Where relevant, borehole data from the Site and surrounding area has been used to create a deposit model for the Site. Levels of previous ground disturbance have been established and archaeological potential assessed accordingly. This assessment is presented in Paragraphs 13.3.60 to 13.3.72.

Limitations

13.2.38 This assessment is based upon data obtained from publicly accessible archives, as described in Section 13.3.2, a walkover survey and site visits to assets which could potentially be subject to setting effects. HER Data was received from NCC and downloaded from the HE website in February 2020. The assessment does not contain records added after this date.

13.2.39 The walkover survey was undertaken on 11 March 2020; the setting assessment was conducted on 10, 11 and 12 March 2020. The strategy for assessing heritage assets on private property involved establishing a viewpoint from the closest public footpath or road. It should be noted that the site walkover and the setting assessment site visits were undertaken in late winter with varying levels of tree coverage.

13.2.40 In its Scoping Opinion (letter dated 6 April 2020) NCC suggested that geotechnical investigation may be used to demonstrate absence of archaeology. As is described in greater detail within this Chapter, this assessment has identified a low potential for previously unrecorded finds and deposits of all periods to exist within the Site. In addition, landscaping works in the north and central parts of the Site have likely removed or heavily truncated any archaeological remains or deposits in these areas and thus potential is limited to the south of the Site, where pockets of less disturbed material may survive buried beneath later levelling deposits. Chapter 9 of this ES advises that further geotechnical works be undertaken as a condition of planning consent to provide more information about ground conditions underlying the Site. These geotechnical works provide the appropriate opportunity to undertake further

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archaeological investigation. This would enable identification and preservation by record of any unrecorded archaeological remains.

13.3 Baseline

Introduction

13.3.1 The baseline aims to characterise the Site and surrounding area to identify any known assets which could be directly physically impacted upon by the Proposed Development and to assess the potential for hitherto unknown buried remains to survive on the Site. The establishment of the baseline also helps in identifying the character and context of the landscape in which the designated assets are located, and thus informs the setting assessment.

Data Collection

13.3.2 The following data sources have informed the preparation of the assessment:

- Historic England: For National Heritage List for England data (NHLE) and Aerial Photography;
- National Map Library, National Library of Scotland (NLS), Promap: For old Ordnance Survey maps (1st & 2nd Edition, small- and large-scale) and pre-Ordnance Survey historical maps;
- Nottinghamshire County Council: For Historic Environment Record data;
- Nottinghamshire Archives, Archive, Castle Meadow Rd, Nottingham NG2 1AG: For archival records and historical maps relating to the Site;
- The Genealogist Online: For historic Tithe maps and apportionments; and
- Environment Agency (EA): For LIDAR data.

13.3.3 Data from these sources has been used to identify:

- All heritage assets and events within a distance of up to 1 km from the edge of the boundary of the Site (see Figure 13.1), including:
  - o Scheduled Monuments;
  - o Listed Buildings;
  - o Conservation Areas;
  - o Gardens and Designed Landscapes;
  - o Non-designated heritage assets; and

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   - Events records, indicating the location and results of previous archaeological investigations.
- Designated heritage assets up to 3 km from the Site (see Figure 13.2), including:
   - Scheduled Monuments;
   - Listed Buildings;
   - Conservation Areas; and
   - Gardens and Designed Landscapes.

13.3.4 All heritage assets and archaeological events identified in this assessment are shown on Figures 13.1 and 13.2 and listed in the Site Gazetteer in **Appendix 13-1**. It should be noted that numbering in the gazetteer is not consecutive due to removal of assets recorded under a previous iteration of the Study Areas. No Registered Battlefields or World Heritage Sites have been identified within the Study Areas and as such further consideration of effects upon them is scoped out of this assessment.

Current Baseline Context

13.3.5 The Site includes the area of the Proposed Development and a small rectangular area immediately to the south where a substation is proposed. The Site covers an area of circa (c.) 4 ha. The Site is located to the north of the Power Station site and is currently covered in hardstanding and compacted stone. It is bound to the north and east by the electrified Power Station site security fence and to the south and west by a combination of Power Station related, large-scale developments, and a further open area formerly used by contractors. The Proposed Development would be located within the Nottinghamshire Wolds Regional Character Area, and within Policy Area NW02: East Leake Rolling Farmland (adjacent to the boundary with Policy Area NW01: Gotham and West Leake Hills and Scarps). The presence of the existing Power Station is recognised as an influence on the landscape.[23]

13.3.6 Data for designated heritage assets was downloaded from HE in February 2020 and designated heritage assets within 3 km of the Site have been identified (Figure 13.2 and **Appendix 13-1**). No designated assets are located within the Site.

[23] TEP, (2009). *Greater Nottingham Landscape Character Assessment.*

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13.3.7 Seven Scheduled Monuments are located within the 3 km Study Area. These are:

- The Roman Site on Red Hill (Site 44), c.575 m west of the Proposed Development;
- Moated Site south-east of Sawley Locks (Site 103), c.2.48 km west of the Site;
- Site revealed by aerial photography, south-east of Dunster Barn (Site 104), c.2.42 km west south-west of the Site;
- Roman villa and enclosures north of Ratcliffe Lane (Site 105), c.2.27 km west south-west of the Site;
- Roman fort 200 yds (182 m) E of All Saints' Church (Site 106), c.2.9 km west north-west of the Site;
- The Dovecote at Manor Farm (Site 107), c.2.78 km north-east of the Site; and
- A Romano-British nucleated enclosed settlement and Roman villa complex at Glebe Farm (Site 108), c.2.28 km north-east of the Site.

13.3.8 Fifty-eight Listed Buildings are located within the 3 km Study Area. The majority are Grade II Listed and full details of these are available within the Site Gazetteer in **Appendix 13-1**. There are six Grade I and II* Listed Buildings within the 3 km Study Area, including:

- Church of All Saints, Thrumpton, Grade II* Listed Building (Site 45), c.780 m north of the Site;
- Thrumpton Hall, Grade I Listed Building (Site 70), c.740 m north of the Site;
- Church of St. Winifrid, Kingston on Soar, Grade I Listed Building (Site 98), c.2.64 km south of the Site;
- Church of the Holy Trinity, Ratcliffe on Soar, Grade I Listed Building (Site 99), c.1.72 km south-west of the Site;
- Church of St. George, Barton in Fabis, Grade I Listed Building (Site 100), c.2.80 km north-east of the Site; and
- Church of St. Lawrence, Gotham, Grade I Listed Building (Site 101), c.2.97 km east of the Site.

13.3.9 Four Conservation Areas lay completely, or partially, within the 3 km Study area. These are:

- Thrumpton Conservation Area (Site 109), c.200 m north of the Site, lies completely within the 3 km Study Area and contains 21 Listed Buildings as well as seven non-designated buildings (Sites 77–83) and a non-designated park (Site 88). The designated assets within the Thrumpton Conservation Area

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include the Grade I Listed Thrumpton Hall (Site 70), the Grade II* Listed Church of All Saints (Site 45) and nineteen Grade II Listed Buildings (Sites 42, 49, 57–69 and 71–74);

- Long Eaton Sheet Stores Conservation Area (Site 110), c.2.07 km north-west of the Site, lies completely within the 3 km Study Area and contains one Grade II Listed Building (Long Eaton Canal Bridge, Site 122);
- Long Eaton Town Centre Conservation Area (Site 149), c.2.84 km north north-west of the Site, lies partially within the 3 km Study Area; and
- Sawley Conservation Area (Site 150), c.2.85 km west north-west of the Site, lies partially within the 3 km Study Area and contains the Roman fort 200 yds East of All Saints' Church Scheduled Monument (Site 106).

13.3.10 One Registered Park and Garden (RPG) lies within the 3 km Study Area. This is:

- Grade II Listed Kingston Park Pleasure Gardens (Site 102), c.2.18 km south of the Site, lies completely within the 3 km Study Area. The RPG contains the Grade II Listed Kingston Hall (Site 132) and three other associated Grade II Listed Buildings (Sites 127, 131 and 138).

13.3.11 Most of the remaining Listed Buildings, outside of the Conservation Areas and Registered Parks and Gardens, are in, or close to, the villages and small towns within the 3 km Study Area. These settlements include:

- Ratcliffe on Soar, located c.1.44 km south-west of the Site, which contains the Grade I Listed Church of the Holy Trinity (Site 99) and the Grade II Listed Manor Farmhouse (Site 111);
- Kingston on Soar, located c.2.62 km south of the Site, which contains the Grade I Listed Church of St Winifrid (Site 98), eleven Grade II Listed Buildings (Sites 126, 128–130, 133–137, 139 and 141) in the village and the Grade II listed Kingston Fields Farmhouse and Workshop (Site 140) outside the village;
- Gotham, located 2.64 km east of the Site, which contains the Grade I Listed Church of St Lawrence (Site 101) and four Grade II Listed Buildings (Sites 142–145); and
- Barton in Fabis, located c.2.80 km north of the Site, which contains the Grade I Listed Church of St. George (Site 100), the Dovecote at Manor Farm Scheduled Monument (Site 107) and six Grade II Listed Buildings (Sites 113–117).

13.3.12 The remaining five Grade II Listed Buildings include the Red Hill Tunnels South Portal (Site 87), the Packhorse Bridge over Red Hill Lock (Site 112), Cranfleet Lock (Site 119), a Canal Bridge (Site 120) and the Tamworth Road Bridge (Site 121).

13.3.13 Data regarding heritage assets was obtained from NCC, which holds the HER for Nottinghamshire, in February 2020. The data extract included point records, locating more discrete features such as find spots and polygon records highlighting features such as Scheduled Monuments. There was some duplication of records encountered within the HER extract and numerous point records for different phases of activity encountered on excavations. Where possible these duplicated, or closely associated records, were combined under one Site No. for the benefit of this report. In total forty-nine non-designated assets were identified within the 1 km Study Area. Taken together these entries record assets and artefacts dating from the prehistoric period to the 20th century. No heritage assets are recorded by the HER within the boundaries of the Site, but one modern non-designated asset was identified within the northern site boundary from OS mapping. The HER includes ten records relating to previous archaeological works (events) within the 1 km Study Area.

13.3.14 The HER data indicates that the Site lies in an area which shows signs of occupation from the prehistoric period onwards. A significant number of recorded assets are associated with the Red Hill Roman Scheduled Monument (Site 44). The medieval and post medieval agrarian landscape, and later industrial development including the canals and railways are also well evidenced within the data.

13.3.15 No World Heritage Sites or Registered Historic Battlefields fall within 3 km of the Site.

13.3.16 The British Geological Survey GeoIndex[24] shows that the Cropwell Bishop Formation of the Mercia Mudstone Group underlies the area. The BGS report[25] describes the Cropwell Bishop Formation as red brown, rarely grey-green, blocky mudstone with impersistent thin beds of strong grey-green siltstone and fine-grained sandstone. The formation is indicated to contain abundant gypsum that occurs as nodules, lenticular masses and locally as thick beds. The BGS indicate that drift deposits are not present across the Site. Small areas of Head and Glacial Till (Boulder Clay) are shown north of the Power Station site. Alluvium is shown to be

[24] BGS (2020). *Available at:* http://mapapps.bgs.ac.uk/geologyofbritain/home.html
[25] BGS (2002). *Geological Assessment for Power Station Site* (unpublished grey literature report)

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present along the River Soar and River Trent to the west and north and to extend both sides of the A453.

13.3.17 Various historical ground investigation reports and boreholes logs are available for the Site and immediately surrounding area. These investigations have been used to produce a deposit model of the Site. This shows that the Site is underlain by Made Ground which average at less than 1.5 m in thickness excepting in the south of the Site where deposits of up to 3 m thickness are modelled. The Made Ground is underlain by weathered deposits of Mercia Mudstone. Most boreholes record the Mudstone as Clay in its upper reaches immediately below the Made Ground and indicate that it is weathered. The weathered Clay/Mudstone extends to an average of 6 m below ground level where stronger less weathered Mudstone is recorded.

Prehistoric (pre AD 43)

13.3.18 The HER records nine assets that are, or include features, of prehistoric date within the 1 km Study Area. Most are findspots or artefact scatters and include the discovery of microliths and a flint knife (Site 3), two flint handaxes (Site 4), a Mesolithic flint scraper (Site 7), a Neolithic macehead (Site 8), an Iron Age Shield Boss (Site 17), a holed axehead (Site 20) and a Palaeolithic axehead (Site 24) from the area around the Red Hill Scheduled Monument (Site 44) and within the Thrumpton Conservation Area (Site 109). Previous geoarchaeological work in the wider area [26] has demonstrated the great mobility of the rivers in the Trent and Soar confluence zone with numerous sites sealed beneath alluvium. There are no superficial deposits recorded within the Site and thus it is likely that the Site was located above the floodplain during the prehistoric period and may have been an attractive area for settlement, located above the low lying wetland of the floodplains of the Trent and Soar.

13.3.19 Iron Age features including gullies and pits, as well as Iron Age finds, were recorded during archaeological investigations by Greenfield during a 1963 excavation (Site 11 and 15). These, and other undocumented, investigations have led to the identification of an Iron Age Settlement on Red Hill (Site 56).

[26] Brown, A.G. Challis, K, and Howard, A.J (2004) Predictive Modelling of Multi-period Geoarchaeological and Resources at a River Confluence. Unpublished project report for the Aggregate Fund Sustainability Levy.

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13.3.20 Red Hill is situated on high ground to the south-east of the confluence of the River Soar and the River Trent. It seems likely that the asset, due to its commanding views of the surrounding area and proximity to the rivers, was considered important during the Iron Age. The presence of a later Roman religious centre on the hill may also indicate that there was an earlier ritual site at this location. The levelling of the Site is likely to have removed any deposits of prehistoric date within the north and centre of the Site. It is possible that pockets of undisturbed prehistoric material may survive buried beneath Made Ground in the south of the Site. The potential for prehistoric remains to survive on the Site is low but cannot be discounted.

Roman (AD 43 – AD 410)

13.3.21 The HER records several assets that are, or include features, of Roman date within the 1 km Study Area. There are also five Scheduled Monuments (Sites 44, 104, 105, 106 and 108), thought to date to the Roman period within the 3 km Study Area.

13.3.22 The findspots identified in the HER include Roman pottery sherds (Sites 13, 16 and 22), Roman coins (Site 18), a stone quern (Site 21), a cremation (Site 27) and assorted finds scatters (Sites 28 and 29). These finds are concentrated, for the most part, on or around the Red Hill Scheduled Monument (Site 44).

13.3.23 The Red Hill Scheduled Monument (Site 44) occupies a sub-rectangular parcel of land with a smaller square annex. Red Hill is situated on high ground to the south-east of the confluence of the River Soar and the River Trent. It seems likely that this confluence was considered sacred during the Iron Age and was chosen for the site of a shrine, which was later adopted by the Romans for a temple. It is c.575 m west of the Site. There have been several archaeological investigations conducted on or around the Scheduled Monument on Red Hill. Excavations by Houldsworth on the site in the 1950s uncovered a Roman building which had been identified from aerial photographs. Pottery from the 2nd to 4th centuries AD, a lead tablet and a 1st century AD burial were associated with the building (Site 10). Red Hill was further excavated by E. Greenfield in the summer of 1963 in advance of building works connected with the Power Station (Sites 11–12 and 14–15). These excavations identified finds, structural evidence and inhumations dating from between the 2nd and 5th centuries. The structures identified during these investigations have been interpreted as belonging to a shrine or temple complex. The principal evidence for this is several lead curse tablets, as the structural evidence is fragmentary and incoherent. It is

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clear, however, that this site comprised a complex of buildings, one of which appears to have been high status (sometimes described as a villa).[27] Palfreyman and Ebbins[28] have also highlighted the important role of the Red Hill site in the distribution of commodities and raw materials including iron, lead, coal, pottery, gypsum and salt. Work in the past few years has begun to suggest that the shrine may have encouraged the growth of a small Roman town to the south and west of the Scheduled area.[29]

13.3.24 The Roman finds, features and interventions on and around the Red Hill Scheduled Monument lie in close proximity to the Site; however, a number of other Roman Scheduled Monuments are also located within the 3 km Study Area. These are briefly outlined below.

13.3.25 The Roman Fort east of All Saints Church in Sawley, Scheduled Monument (Site 106) is a roughly rectangular parcel of arable land c.2.9 km north-west of the Site. The earthworks forming the monument were barely visible during the setting assessment site visits, possibly due to the localised flooding in the area. The Roman Villa and enclosures north of Ratcliffe Lane Scheduled Monument (Site 105) is a sub-triangular parcel of land c.2.27 km west south-west of the Site and is not visible within an arable field system and survives only as buried archaeological remains. The adjacent site revealed by aerial photography Scheduled Monument (Site 104) is a sub-rectangular parcel of land, c.2.42 km west south-west of the Site, and was also not visible within a pastoral field. The Romano-British nucleated enclosed settlement and Roman villa complex at Glebe Farm Scheduled Monument (Site 108) is within an irregular parcel of land c.2.28 km north-east of the Site, fitting the modern field boundaries, within worked arable farmland.

13.3.26 Overall, the Red Hill Roman finds and features *"appear to demonstrate a widespread settlement, metalworking and probably commercial activity on a scale far greater than that of a rural settlement. Taken together with the temple and so-called "villa" on the same site, it is evident that Red Hill was a major urban-type settlement at the junction of a communication system with a possible waterfront on the River Soar,*

[27] East Midlands Archaeological Research Framework (2006). *Resource Assessment of Roman Nottinghamshire, 7.* https://www2.le.ac.uk/services/ulas/images/east-mid-research-framework/25nottrom.pdf (viewed 16/03/2020).
[28] Palfreyman, A. and Ebbins, S. *(2003),* Redhill Iron Age and Romano-British site, Nottinghamshire: A new assessment, *Transactions of the Thoroton Society* 107,17–40.
[29] Krawiec, K (2007) *Red Hill Marina, Ratcliffe on Soar An Archaeological Evaluation Fieldwork summary 2007.* Unpublished Birmingham archaeology report.

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close to the confluence with the Trent" [30]. Archaeological evaluation at Redhill Marina south-west of the Site indicated survival of paleochannels and potential waterlogged deposits buried beneath alluvium close to the river channel edge. Extensive Roman remains including human remains were encountered on drier elevated ground to the east and likely associated with the Scheduled Red Hill site to the north. Archaeological deposits at Redhill Marina were generally found overlying natural sand and gravel river terrace deposits at depths of no more than 1 m below ground level. A review of geotechnical data from within the Site indicates that superficial deposits are absent and that the north and central parts of the Site have been truncated to depths of greater than 1 m. It is thus likely that any Roman material that may have survived in the north and centre of the Site has been removed or heavily truncated. However, given the proximity of the Site to the remains at Red Hill and the wider Roman activity known in the area, it is judged that the potential for Roman remains to survive in the south of the Site is low but cannot be discounted.

Early Historic and Medieval (AD 410 – AD 1600)

13.3.27 There is only one individual Early Historic asset recorded within the 1 km Study Area. Pottery thought to date to the early medieval period was identified during Houldsworth's excavation on Red Hill (Site 10). Within the 3 km Study Area cremations dating 5th to 6th century have been discovered within Kingston on Soar [31], but generally the evidence for this period is sparse. The potential for Early Historic remains to survive on the Site is, therefore, judged to be low.

13.3.28 The medieval remains within the 3 km Study Area can be characterised by the churches, within their associated villages, and the broader development of the arable landscape they lay within. All the rural settlements within the 3 km Study Area (Barton in Fabis, Kingston on Soar, Gotham, Ratcliffe on Soar and Thrumpton) contain surviving medieval structures and have documentary evidence for their medieval origins. Only two of these settlements lay within the 1 km study area and shall be discussed first.

[30] East Midlands Archaeological Research Framework (2006). *Resource Assessment of Roman Nottinghamshire, 4.* https://www2.le.ac.uk/services/ulas/images/east-mid-research-framework/25nottrom.pdf (viewed 16/03/2020)
[31] East Midlands Archaeological Research Framework (2006). *Anglo Saxon Nottinghamshire, 5.* *https://www2.le.ac.uk/services/ulas/images/east-mid-research-framework/30nottas.pdf* (viewed 17/03/2020)

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13.3.29 The nearest settlement to the Site is Thrumpton. Thrumpton was known as Turmodeston [32] (Turmod likely being the name of an old owner of the land) in the Domesday Book, within the Hundred of Rushcliffe and the county of Nottinghamshire. The land was recorded as being owned by Roger of Bully, William Peverell and Hugh of Grandesmil and had a recorded population of fifteen households in 1086.[33]

13.3.30 The first mention of the church in Thrumpton (Site 45) is in 1210 when *"Reginald Basset and Richard Puterell [Powdrell] released all their Right and Claim to the Ad vowson of the Church of Thurmodeston [Thrumpton] by Fine, 12 Joh. to Ranulph, Prior of Norton [Cheshire], and his Successors"*.[34] The Grade II* Listed Church of All Saints in Thrumpton (Site 45) and the Grade II Listed 13th century font in the graveyard (Site 57), are the only surviving designated assets which date to the medieval period within the village. Elements of the current church date from the 13th to 15th centuries, despite the church having undergone extensive renovation in 1871.

13.3.31 The second nearest settlement to the Site is that of Ratcliffe on Soar. Ratcliffe on Soar was known as Radeclive (Red Hill or Bank) [35] in the Domesday Book and was within the Hundred of Rushcliffe and the county of Nottinghamshire. The land was recorded as being owned by Saewin of Kingston and had a recorded population of thirteen households in 1086.[36]

13.3.32 The only surviving medieval heritage asset within Ratcliffe on Soar is the Grade I Listed Church of the Holy Trinity (Site 99). Elements of this church are known to date to the 12th century (parts of the chancel) whilst the tower and nave were added in the 13th century. Expansion and alterations continued in the 15th and 16th centuries but by the 18th century the church was reported to be in a very poor state of repair. Many elements of the earlier church were altered, concealed or replaced during renovation works in the 19th century. The earliest documentary reference to the church is the first record of patronage when Roger de Laci, Constable of Nottingham, confirmed

[32] Thoroton, Robert. "*Parishes: Thrumpton." Thoroton's History of Nottinghamshire: Volume 1, Republished With Large Additions By John Throsby. Ed. John Throsby. Nottingham: J Throsby, 1790. 30-36*. British History Online. http://www.british-history.ac.uk/thoroton-notts/vol1/pp30-36 (viewed 17/03/2020).
[33] Open Domesday (2020). https://opendomesday.org/place/SK5031/thrumpton/ *(Viewed 17/03/2020)*
[34] Thoroton, Robert. "*Parishes: Thrumpton." Thoroton's History of Nottinghamshire: Volume 1, Republished With Large Additions By John Throsby. Ed. John Throsby. Nottingham: J Throsby, 1790. 30-36*. British History Online. http://www.british-history.ac.uk/thoroton-notts/vol1/pp30-36 (viewed 17/03/2020).
[35] *Thoroton, Robert. "Parishes: Ratcliffe-on-Sore." Thoroton's History of Nottinghamshire: Volume 1, Republished With Large Additions By John Throsby. Ed. John Throsby. Nottingham: J Throsby, 1790. 24-30. British History.* http://www.british-history.ac.uk/thoroton-notts/vol1/pp24-30 (viewed 17/03/2020)
[36] Open Domesday (2020). https://opendomesday.org/place/SK4928/ratcliffe-on-soar/ *(Viewed 17/03/2020)*

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the gift of the advowson to the Abbot and Augustine Convent of the Blessed Mary in Norton (near Chester) in 1211. Reference was made to his father indicating that patronage had been in the Laci family for some time.[37]

13.3.33 There are also non-designated heritage assets dating to the medieval period within the 1 km Study Area. These include the coping stones of a medieval well in Thrumpton (Sites 9 and 43), the location of a potential moated manor site visible on aerial photography (Sites 19 and 53), which are located immediately south-east of the Site, and ridge and furrow near Red Hill farm (Site 25). The HER indicates that the location of remains of the moated site (Sites 19 and 53) was deeply excavated and now lies within the bounds of the Power Station site.

13.3.34 Within the 3 km Study Area, the villages of Barton in Fabis, Kingston on Soar and Gotham all also each contain a Grade I Listed Building dating to the medieval period. In the case of Barton in Fabis it is the Church of St. George (Site 100) which retains elements dating from the 14th to 16th centuries despite extensive restoration and repair in the 19th century. Kingston on Soar is centred on the Church of St. Winifrid (Site 98) which retains elements of the Babington family chancel and aisle dating to c.1540 within a structure which was largely rebuilt in the 19th century. Gotham is home to the Church of St. Lawrence (Site 101) which retains elements dating from the 13th to 15th centuries despite renovations and repairs in the 18th and 19th centuries.

13.3.35 There is also a Scheduled moated site (Site 103), c.2.48 km west of the Site, which is assumed to belong to the medieval period, due to its type, but no further details were recorded.

13.3.36 Saxton's 1576 map (viewed but not reproduced here due to copyright restrictions) depicts the layout of the River Trent and River Soar with the surrounding settlements all clearly depicted (Radelyf, Kynston, Thrumpton, Goteham, Barton, Sawley and Long Eaton). This map does not, however, show any detail of roads or land use within the area beyond the artistic depiction of what appear to be church towers, in some of the settlements.

[37] *Thoroton, Robert. "Parishes: Ratcliffe-on-Sore." Thoroton's History of Nottinghamshire: Volume 1, Republished With Large Additions By John Throsby. Ed. John Throsby. Nottingham: J Throsby, 1790. 24-30. British History. http://www.british-history.ac.uk/thoroton-notts/vol1/pp24-30* (viewed 17/03/2020)

13.3.37 The proximity of a moated site (Sites 19 and 53), c.25 m south-east of the south-eastern corner of the Site, indicates potential but it is also likely that any archaeological remains directly associated with this asset were destroyed during works associated with the construction of the Power Station. The majority of the other medieval heritage assets identified in the Study Area relate to the villages that themselves were within a predominantly agrarian landscape. Any superficial medieval agricultural remains will likely have been removed when the Site was levelled in the late 1960s. There is a low potential for medieval remains to survive in the south of the Site.

Post-Medieval and Modern (AD 1600 – Present)

13.3.38 The 1767 Bowens Map of Nottinghamshire (viewed but not reproduced here due to copyright restrictions) depicts very little change from the earlier 1576 map apart from some changes to the place names. This map depicts Ratclif upon Soar with Kingston Chapel, Gotham, Trumpington and chapel (Thrumpton), and Barton in the Beans (Barton in Fabis) and Sawley. Again, there is very little detail of land use on this map, but the presence of the chapels/churches appears to be acknowledged in the case of Thrumpton and Kingston.

13.3.39 The Ratcliffe on Soar Parish Tithe Map of 1850 (viewed but not reproduced here due to copyright restrictions) indicates that the Site was within arable fields at the time. The Site overlay fields (numbered 7, 8, 27 and 28 on the Tithe Map). The tithe map award details that these fields were occupied by William Parr and named Wood Hill (tithe map no.7), Far Hill (tithe map no.8), New Fields (tithe map no.27) and Grass Gossy Close (tithe map no.28). In the wider area the map shows systems of small subdivided fields close to the road between Ratcliffe on Soar and Thrumpton, in contrast to much larger fields on the hills. The railway line is also depicted in the western part of the tithe map (but there is no clear indication of the Redhill Tunnel), as is the layout of Ratcliffe on Soar including its Grade I Listed church (Site 99) and the early 18th century Grade II Listed Manor Farmhouse (Site 111). To the north of Ratcliffe is a depiction on the map which may relate to the Pound Lock and Packhorse Bridge (Site 112) which were constructed in late 18th / early 19th century. Winking Hill Farm (Site 84), a non-designated asset, is also visible on this map.

13.3.40 The earliest edition of the OS map which covers this area was published in 1884 (Figure 13.3). The only change within the immediate vicinity of the Site is the

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appearance of Drypot Barn at the eastern end of the field that had been called Grass Gossy Close on the tithe map of 1850. The surrounding area is, however, now mapped for the first time in detail. To the west the Redhill Tunnel (Sites 26, 42 and 87), originally constructed in 1839 for the railway line, is now clearly depicted. Within the 1 km Study Area many of the buildings depicted on the tithe map are now annotated. Non-designated assets such as disused gypsum mines (Sites 41 and 54) are also depicted (although Site 41 is annotated as being disused and Site 54 is within a field containing the annotation “Old Shafts”). However, no shafts or mining activity were shown within the Site itself, despite the Tutbury seam outcropping nearby.

13.3.41 To the north of the Site is the Thrumpton Conservation Area. Most of the assets which contribute to its status and character were developed during the post-medieval period and are depicted on the 1884 OS map. The layout of the Grade I Listed Thrumpton Hall (Site 70), with its late 18th century west gate piers (Site 71), late 18th century icehouse (Site 49), 19th century western gateway (Site 69) and 19th century eastern gateway (Site 68) within Thrumpton Park (Site 88) is clearly visible. The present Thrumpton Hall dates from 1607 but incorporates elements of an earlier manor house. A priest’s hole at the foot of a secret staircase built into the thickness of a chimney breast survives from the earliest house and was used by the Roman Catholic Powdrill family to conceal Father Garnett, a leading figure in the 1605 Gunpowder Plot. The Powdrill’s involvement in the affair eventually led to the confiscation of their estate which was passed to the Pigot family. The new owners carried out lavish and extensive alterations to the Hall during the 1660s, including the addition of a magnificent carved wooden staircase. The expense incurred by these improvements eventually resulted in Gervase Pigot II (to whom there is a monument at All Saints Church dated 1669) being forced to mortgage the estate, and in 1694 John Emmerton foreclosed it and took possession. Soon after, Emmerton enclosed the park, clearing the buildings of the original village and building a new group of houses around the existing Church of All Saints. He also carried out extensive tree planting in the grounds of the Hall.[38] Many of the Grade II Listed Buildings visible on the OS map within the village of Thrumpton originally date to the 18th century, typically having undergone modifications in to the 19th century (Sites 58–67). There are also a number of non-designated heritage assets including buildings (Sites 78, 80, 81 and 83), a fishpond (Site 51), a flood defence bank (Site

[38] Rushcliffe Borough Council (2010). *Thrumpton Conservation Area Appraisal and Management Plan.*

50) and a gravel pit (Site 52) within the Conservation Area which date to this period and are visible on the OS map. To the north-west of the Conservation Area, Cranfleet Lock (Site 119) and the Canal Bridge (Site 120), both built 1797, are also depicted.

13.3.42 Within the wider 3 km Study Area there are numerous designated assets depicted on the 1884 OS map. To the north and north-west the layout of the Long Eaton Town Centre Conservation Area (Site 149), the Long Eaton Sheet Stores Conservation Area (Site 110), the layout of the Sawley Conservation Area (Site 150), the Grade II Listed Long Eaton Canal Bridge (Site 122) and the Grade II Listed Tamworth Road Bridge (Site 121), built 1837–1838, are all visible. To the south the layout of the village of Kingston on Soar with its 18th and 19th century Grade II Listed Buildings (Sites 126, 128–130, 133–134, 136–137, 139 and 141) as well as the isolated Kingston Manor Farm (Site 140) are also visible. The Kingston Park and Pleasure Grounds Grade II Registered Park and Garden (Site 102) appears to have been much more expansive in 1884 than it is currently. The layout of the mid-19th century Kingston Hall (Site 132) and its associated structures (Sites 127, 131 and 138) within the park appear to be the same as the present-day arrangement. To the east the layout of the Grade II Listed 17th century Manor House (Site 145) and other Grade II Listed 19th century buildings (Sites 142-144) within Gotham village are all visible on the 1884 OS map. To the north-east the arrangement of the 17th to 19th century Grade II Listed Buildings (113–117) within Barton in Fabis is also visible, as is the location of the 17th century Dovecote at Manor Farm Scheduled Monument (Site 107).

13.3.43 The OS map of 1921 (Figure 13.4) shows no change to the arrangement of the field systems in the immediate vicinity of the Site. In the wider 3 km Study Area there is also little change to the layout of the rural settlements and field systems, except for some new urban expansion to the south of Long Eaton and to the north-east of Sawley (settlement called New Sawley). The Grade II Listed K6 type telephone box in Kingston on Soar (Site 135) would have been built but is not depicted on the maps.

13.3.44 There continues to be no significant change within the Site, as visible in the RAF aerial photograph of 1945, until the 1960s when the Rattcliffe on Soar Power Station was built. The Power Station was constructed between 1963 and 1967 and designed by Godfrey Rossant & J.W. Gebarowicz of Building Design Partnership.[39] The first OS map to show the Power Station is dated 1969. Eight cooling towers are located

[39] Clarke, J 2013 *'High Merit': existing English post-war coal and oil-fired power stations in context* Historic England Report Available at https://research.historicengland.org.uk/Report.aspx?i=15846

on the west part of the Power Station and lagoons are shown just to the north of them. The A456 Remembrance Way was also built at the time to create better transport links in the area. The expansion of the Ratcliffe Junction to the East Midlands Parkway Train Station is the other significant change within the 1 km Study Area. These changes are all visible on the 1972–1973 OS map (Figure 13.5) which also shows that the Site lies just beyond the boundary of the Power Station where it is shown as an open area. In contrast to the surrounding landscape to the north, no contours are shown within the Site indicating that it had been levelled by this time. Within the wider 3 km Study Area the urban expansion on New Sawley up to the bounds of historic Sawley and further infilling in Long Eaton represent the only major changes to settlement layouts. The war memorial within Barton in Fabis (Site 118) was constructed during this period but is not visible on the 1972–1973 OS map.

13.3.45 The OS map of 1982–1983 (Figure 13.6) shows that the northern part of the Site was occupied by a Sports Ground which appears to have an associated small building (Site 151). A drawing dated 1991 shows the Site was used as a temporary laydown area during the construction of the Flue Gas Desulphurisation (FGD) plant.[40] The eastern and northern area was used as a car park. Small buildings including a workshop and a store are shown. Electricity cables are shown running east-west in the northern part of the Site, and running along the boundary with the gypsum store. Another cable feeds to the workshop in the south-centre of the Site from the south. At the end of the FGD project a landscaping scheme was agreed as a means of utilising the excavated spoil from the construction and removing the need for this material to be sent offsite for disposal. A drawing dated 1998 shows two football pitches in the centre of the site, with a cricket square between them.[41] The OS map of 2000 shows cut slopes on the north and east boundaries of the Site. The rest of the Site is shown to be featureless, except for a fenceline that runs across the sport field area. The 2004 OS map shows that the car park had been constructed. The sports field is not marked as such and the fenceline that ran across it on the 2000 map is not shown.

13.3.46 AOC understands that the Sports Ground was removed and resurfaced around 2008 to support the construction of Selective Catalytic Reduction (SCR) plant for the

[40] ARUP 2007a
[41] ARUP 2007a *Preliminary geotechnical desk study for the proposed biomass Plant* Unpublished file note

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Power Station.[42] There is little other significant change to report in the wider 3 km Study Area which appears, for the most part, unchanged to the present day.

13.3.47 Overall, the historic mapping shows that the Site lay within arable field systems for most of the post-medieval period. The area remained undeveloped until the construction of the coal-fired Power Station in the 1960s. The Site lay within land that was landscaped to the north for use as a laydown area during various phases of construction within the Power Station site. The Site was subsequently used for deposition of material excavated during the FGD plant construction and was levelled and used as a sports field in the late 20th century.

13.3.48 Given the above, there is judged to be a low potential for post-medieval remains to survive in the south of the Site. There is a high potential for modern remains and deposits to survive across the Site. These would mostly be associated with the construction of the Power Station and materials required for the Sports Ground that occupied the area from the 1980s until c.2008.

Aerial Photographic Evidence

13.3.49 Aerial photographic evidence covering the Study Area was recovered from two principle sources. These included RAF aerial photographs taken in 1945 which were viewed at the Nottinghamshire Archive and further photographs dating from between 1977 and 2006, held by the Historic England Archives.

13.3.50 An RAF aerial photograph of 1945 shows the layout of the field systems in the area to the north-east of Ratcliffe on Soar. This photograph does not quite show the full extent of the Site, but the surrounding area appears unchanged from the earlier mapping.

13.3.51 A 1977 aerial photograph shows that a cricket pitch, with associated pavilion (Site 151) is present within the Site. This pitch looks identical in layout to the Sports Ground mapped on the 1982–1983 OS map. Very little detail of the surrounding area can be seen on this aerial photograph.

[42] *Kieran Irwin, Lead Engineer Uniper pers comm 31-03-2020.*

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13.3.52 A 2006 aerial photograph shows that most of the area covered by the Site is part of a fallow (appears brown) field with a small area of car parking towards the southern edge. There is no sign of the Sports Ground visible on the 1982–1983 OS map.

13.3.53 It is thus evident from aerial photographs that the Site was largely used for agricultural purposes until the 1960s and does not appear to have been developed in the modern era with the exception of the Sports Ground in the 1980s and car park and hardstanding areas now present on the site.

13.3.54 No anomalies were visible on the aerial photographs that were thought to represent below surface archaeology.

LIDAR & Infrared Evidence

13.3.55 LIDAR data, held by the Environment Agency (EA), provides high-resolution digital terrain and surface modelling, providing valley floor physiography / geomorphology, as well as details of archaeological sites to supplement aerial photographic evidence. LIDAR imagery (1 m interval) was downloaded from the EA Website and viewed (March 2020). No additional sites or features were noted.

Site Walkover

13.3.56 A walkover survey of the Site was undertaken on 11 March 2020. The weather conditions were clear and dry. It was possible to access most of the area due to it being occupied by an empty contractor's car park and a large area of hard standing.

13.3.57 The southernmost portion of the area is occupied by a fenced off car park, which was in use at the time of the survey (**Appendix 13-2**, Plate 13.1). The central part of the area was occupied by a fenced contractor's car park (**Appendix 13-2**, Plate 13.2), bound by an access road on the northern and eastern sides, which was empty at the time of the survey. The northern part of the area was occupied by a wire fenced area of hardstanding which contained areas of puddles due to the slightly uneven ground and poor drainage. This area also was used to store a few plastic traffic barriers, iron sleepers and some storage containers but, for the most part, was empty and seemed to only see occasionally use (**Appendix 13-2**, Plate 13.3).

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13.3.58 The northern, north-eastern and eastern boundaries of the Site are marked by an electrified fence. The area is bound to the west, south-west and south by infrastructure and buildings belonging to the existing Power Station.

13.3.59 No previously unidentified heritage assets were identified during the walkover survey.

Deposit Modelling

13.3.60 The term 'deposit modelling' describes any method used to provide visual representations of the spatial and stratigraphic relationships between sediments and provides an effective strategy for investigating the subsurface stratigraphy and the potential for the preservation of associated paleoenvironmental and archaeological remains.[43], [44] Given that the Site is known to have been subject to previous development it was considered appropriate to create a deposit model for the Site in order to better understand how previous development might have affected the archaeological potential of underlying deposits. Deposit modelling for the Site was undertaken using ArcGIS and RockWorks 17 geological utilities software.

13.3.61 Various historical ground investigation reports are available for the Site and surrounding area. The earlier ground investigations provide only very brief descriptions and are not recorded to modern standards and thus are not suitable for deposit modelling. However, where relevant these records have been used in forming wider conclusions about archaeological potential within the Site.

13.3.62 The deposit model was based on 29 data points comprising existing borehole records held by the BGS and geotechnical and geoarchaeological site investigations. Seven borehole records were derived from a ground investigation survey specific to the Site[45] with the remaining derived from a surrounding Study Area shown on Figure 13.7. Boreholes from within the Site are prefixed 'BH' as shown on Figure 13.7. A review of boreholes logs from geotechnical investigations undertaken in advance of construction of the FGD plant west of the Site was also undertaken. The

[43] Carey, C Howard, A J Knight, D Corcoran J and Heathcote, J 2018 'Deposit modelling: an introduction' In Carey, C Howard, A J Knight, D Corcoran J and Heathcote, J (eds.) *Deposit Modelling and Archaeology* Exeter, UK: Short Run Press.
[44] Historic England 2020 *Deposit Modelling and Archaeology. Guidance for Mapping Buried Deposits*. https://historicengland.org.uk/images-books/publications/deposit-modelling-and-archaeology/heag272-deposit-modelling-and-archaeology.
[45] Geotechnical Engineering limited 2007 *Ground Investigation Ractcliffe Power Station Proposed Biomass Site.* Unpublished Geotechnical report.

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geotechnical records used from the FGD works comprised a sample of 20 boreholes sunk during geotechnical works undertaken by Soil Mechanics Limited. Detailed borehole logs were available for the area of the FGD Plant, but no location plan was available. Only local grid co-ordinates were provided within each log and thus they were located by plotting the layout pattern of the local grid against borehole locations recorded by BGS. Boreholes from the Soil Mechanics Limited geotechnical works are prefixed 'FGD' on Figure 13.7. A further two borehole logs hosted online by the BGS were also reviewed and inputted into the deposit model. These boreholes are prefixed 'SE' on Figure 13.7.

13.3.63 The recorded borehole data were grouped into a set of stratigraphic units in order to map the key deposits across the Site. The sedimentary units were classified into three groupings: Mercia Mudstone, Clay and Made Ground. The lithology of the Clay varies in the borehole descriptions and an initial attempt was made to separate organic silty clays from the non-humose weathered Clays derived from mudstone; however, there were insufficient data points of the silty clay to accurately map or project these variable lithologies in detail. It was therefore decided to create a simpler model based on three units while recognising the variability in the Clay. The transition between the weathered Clay unit into the Mercia Mudstone is gradual and thus their distinction within the model is by nature somewhat artificial and this has been considered in interpreting the model and evaluating paleoenvironmental potential.

13.3.64 The data were modelled using an inverse distance weighting algorithm within RockWorks and used to create thickness plots and elevation plans (Figures 13.12 to 13.14). It is recognised that the reliability of the model is dependent upon the data upon which it is founded. The borehole and test-pit logs used for the model have been interpreted by a geoarchaeologist but still rely upon the accuracy of the original observations and have also been derived from three separate data sets. The Site Investigation works were undertaken to investigate sedimentary properties and land contamination and were not monitored by an archaeologist. The Site has a complex modern industrial past and the remains of deposits and structures relating to its former uses may survive below the surface in some areas of the Site. For the purposes of the modelling presented here, the attribution of 'Made Ground' has been used to infer disturbance. While on some sites 'Made Ground' deposits encountered by geotechnical engineers can include earlier archaeological deposits of interest, the deposits described as Made Ground within the Site generally contain modern materials such as concrete, brick, glass, wire and asbestos. Given the absence of development within the Site until the second half of the 20th century we can assume that these modern artefacts are derived from the cut and fill levelling that occurred across the Site and are unlikely to contain undisturbed deposits of archaeological interest. Furthermore, while the data are relatively well distributed over the Study Area there is a much denser concentration of data west of the Site where geotechnical works for the FGD plant were concentrated and as such the reliability of the model is generally greater in this area. The modelling also extrapolates and smooths between the data sets and as such the modelled levels of stratigraphic contexts vary slightly from the levels recorded in each individual test pit/borehole log as can be seen in Figures 13.9 and 13.10.

13.3.65 Ground investigations undertaken in 1963 provide limited data regarding the nature of below ground deposits but a contour plan provides very useful information regarding ground levels. The contours from 1963 show that the previous ground surface fell fairly rapidly from 42.7 m AOD in the north-east of the Site to 37.2 m AOD in the south-west of the Site.[46]

13.3.66 The ground level recorded at FGD89_5 in 1989 in the north-west of the Site was recorded at 40.6 m AOD. The ground level recorded at BH1 in the north-east of the Site in 2007 was recorded at 37.96 m AOD. This indicates a reduction in ground level of approximately 2.5 m in the north of the Site since 1989. A topographic survey of the Site undertaken by Malcolm Hughes Chartered Surveyors in October 2019 reveals the Site to be level at an average elevation of 38.25 m AOD. This change in ground level indicates that cut earthworks were undertaken across the Site after 1963 and again after 1989. The maximum total cut height is about 5 m in the north-east of the Site; the cut height is more typically 1 m to 2 m across much of the central part of the Site and in the south of the Site the existing ground surface level is higher than recorded in both 1963 and 1989 indicating that this part of the Site has been built up.

13.3.67 Two-dimensional strip logs were created for each of the data point boreholes within the Site. Strip logs of the deposits encountered in each borehole within the Site are presented in Figure 13.8. Given the relatively shallow nature of the deposits encountered a Vertical Exaggeration Factor of ×10 has been applied for purposes of graphical presentation. Two-dimensional projected north-west to south-east aligned

[46] *ARUP 2007b Ratcliffe On Soar Power Station Proposed Biomass Plant Immediate Feedback following Ground Investigation* *<u>Unpublished file note</u>*

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stratigraphic profiles were also generated using RockWorks for the boreholes across the Site and a Vertical Exaggeration factor of ×10 was also applied to the projected sections (Figures 13.9 and 13.10). Two projected profiles have been created to reflect the change in ground level that appears to have occurred between 1989 and 2007. This is demonstrated on Figure 13.10 which excludes the boreholes derived from the 1989 dataset and thus more accurately reflects the modern level ground surface. Figure 13.9 shows a slope in ground surface from north-west to south-east indicating that further levelling occurred after the 1989 site investigations and is consistent with later evidence for the use of the Site as a sports field and car park. The differences between Figures 13.9 and 13.10 also demonstrate the difference in the ways in which the datasets were recorded with bands of Gypsum noted as separate lithologies within 1989 dataset whereas Gypsum was recorded as veins within the Mudstone in the 2007 dataset and recorded as part of the Mudstone lithology.

13.3.68 As shown within the logs (Figure 13.8) all boreholes encountered Mercia Mudstone deposits. The Mudstone is typically described as moderately weak red-brown Mudstone with laminations and veins of Gypsum. The Gypsum is recorded as a separate lithology in the 1989 dataset which notes a thick seam of Gypsum extending across the Study Area as modelled in Figure 13.9. The 2007 dataset, however, describes the Gypsum occurring as nodules within the Mudstone which are noted as ranging in thickness from 1 m (BH2) to 3.3 m (BH5).

13.3.69 Clay was encountered in the majority of boreholes but was absent from FGD89_5 and BH1. It was described as stiffer at its base where it is formed of weathered Mudstone, generally becoming softer upwards. It is typically described as a fissured red-brown locally mottled blue grey or black sandy clay. BH2 contained some black organic fragments which may be indicative of localised preservation of material of paleoenvironmental interest. Within BH6 the Clay is described as containing patches of darker brown and black material which, again, may indicate higher organic content although no organics are noted within the logs. The clay varies in thickness from 2.2 m to 6 m and is thickest at BH6 and BH7 in the south of the Site, following an apparent dip in the Mudstone surface and where the upper levels of the Clay have not been previously cut by earthworks.

13.3.70 All boreholes encountered Made Ground deposits. The depth of the Made Ground is typically less than 1.5 m, although BH1 located in the north of the Site recorded Made

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Ground deposits to a depth of 2.2 m. The Made Ground is variable in nature but is typically described as a red-brown clay derived from Mercia Mudstone soils containing varying quantities of coarse particles including fragments of brick and concrete as well as ash deposits. Weed cloth was recorded at a depth of 0.4 m below ground level on logs from BH4, BH5 and BH6 and interpreted as being related to the former sports fields.

13.3.71 The level ground surface at 38 m AOD is modelled on Figure 13.11 with a slight rise shown in the north of the Site reflecting the higher ground level in 1989 modelled around FGD1989_5 at the north of the Site boundary. The natural fall in ground surface is reflected more accurately in Figure 13.12 and Figure 13.3 which show the modelled elevation of the surface of the Clay and Mudstone respectively and show that these natural geological deposits fall in a roughly north-west to south-east direction. The natural fall in the underlying geology is also reflected to some degree in the thickness of the Made Ground across the Site (Figure 13.4) which is at its thickest in the south-east corner of the Site where greater depths of Made Ground have been deposited in order to level off the Site. There is a somewhat anomalous area of deeper Made Ground modelled in the north of the Site around BH1 which is recorded as being located on the edge of a small shallow depression and where depths of Made Ground up to 2.2 m thick were recorded. The reason for the deep Made Ground in this area is not clear but borehole logs record concrete fragments between 1.93 m and 2.2 m[47] and thus it is assumed that this is modern Made Ground.

13.3.72 The results of the deposit modelling at the Site in conjunction with other studies carried out in the surrounding landscape has highlighted that the deposits encountered within the Site are broadly characteristic of their location reflecting landscaping activities associated with the adjacent existing Power Station. Of particular note and interest is a dip in the Mudstone surface in the east of the Site and associated thicker deposits of Clay which are indicative that the south of the Site may preserve relatively undisturbed deposits. The presence of organic fragments within the Clay at BH2 are indicative of the possibility of encountering paleoenvironmental material suitable for dating within the Site. However, the observed organic fragments were noted in only one borehole which was located in the centre of the Site and may have been subject to disturbance and thus of less

[47] *GEL (2007)*

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interest for resolving wider questions regarding the deposits in the south of the Site. The general absence of organic material across the borehole logs studies suggests that paleoenvironmental potential within the Site is very limited.

Future Baseline

13.3.73 The future baseline as discussed here assumes that large elements of the existing coal-fired Power Station and related components have been removed. However, the following development / infrastructure would remain: the Uniper Engineering Services offices; the National Grid substations and power lines, the gas turbine generating facility; the railway sidings; the gypsum and limestone storage buildings and their conveyor links to the sidings; and other lesser elements of infrastructure such as internal roads linking the preceding elements.

13.3.74 There would be no material change to the historic environment baseline from that set out above. The archaeological potential of the Site would remain as identified above. The removal of elements of the Power Station would remove notable built elements, largely to the south and west of the Site. This removal would likely make the Proposed Development more visible from certain of the designated heritage assets within the Study Areas, particularly those located to the south and west of the Site. This increased visibility will be considered when assessing the effects of the Proposed Development against the future baseline, below.

13.4 Assessment of Effects

Construction Phase

Assessment of Effects against Current Baseline

13.4.1 Effects on heritage assets during the Construction Phase predominantly relate to direct physical effects on heritage assets. While there may be potential for some effects upon the setting of designated heritage assets during the Construction Phase, these would be limited to views of construction vehicles and plant for a limited duration and would therefore be temporary. Further, any effects upon setting resulting from the Construction Phase would not exceed those predicted for the Operational Phase. As such, the potential for effects on the settings of heritage assets is discussed within the Operational Phase assessment.

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Direct Effects: Known Remains

13.4.2 Potential effects on known buried archaeological remains which may survive relate to the possibility of disturbing, removing or destroying in situ remains and artefacts during ground-breaking works (including excavation and other works associated with construction). Only one non-designated asset was identified within the Site. This asset was a modern sports field (Site 151), with an associated building, visible on the 1982–1983 OS map. The sports field had been removed by the time of the publication of the OS map of 2000. Due to its late date and limited duration this asset has no cultural heritage value. There are no known remains with cultural heritage value which would be impacted.

Direct Effects: Unknown Remains

13.4.3 The Proposed Development has the potential to result in high magnitude of change to any hitherto unknown archaeological remains which may be present on the Site, as ground-breaking and construction works could potentially result in their total loss. Study of previous ground investigation reports and deposit modelling has revealed that the Site was landscaped prior to and after 1989. The ground level in the north of the Site was reduced by up to 5 m prior to 1989 and thus any archaeological deposits within this part of the Site would have been removed. Ground level was reduced by approximately 1 m in the centre of the Site which would likely have truncated archaeological remains. In the south of the Site the ground level was built up by approximately 1 m. Subsequent landscaping projects involved importation of waste material from the construction and subsequent landscaping of the Site. It is possible that levelling deposits in the south of the Site may seal archaeological remains that may have survived here prior to landscaping.

13.4.4 This assessment has established that the Site lay in undeveloped, agrarian land between two settlements; Ratcliffe on Soar (centred Site 45) to the south and Thrumpton (centred Site 70) to the north until the 1960s. The assets found in the immediate vicinity of the Site relate to the 19th century agricultural landscape and gypsum mines (Site 54); a potential medieval moated site (Sites 19 and 53) and a findspot of Roman pottery (Site 22). There is, however, significant evidence of occupation in earlier periods, and Roman remains are recorded to the west of the Site at the nearby Red Hill Scheduled Monument (Site 44). Overall, there is judged to be a low potential for archaeological remains from all periods to survive within the

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Site due to the high levels of previous ground disturbance. Any survival of archaeological deposits will likely be restricted to the southern half of the Site where previous disturbance has been less extensive.

13.4.5 The level of effect, in EIA terms, would be dependent upon the importance of any remains encountered. If remains of Local, Regional or National importance are present on Site, high magnitude changes would have the potential result in significant levels of effect. If remains of Negligible importance are present, high magnitude changes would not result in levels of effect which are significant in EIA terms. Section 13.6 sets out measures to ensure that any effects on hitherto unknown buried archaeological remains which may survive on the Site are mitigated.

Operational Phase

Assessment of Effects against Current Baseline

13.4.6 Effects on heritage assets resulting from the presence of the Proposed Development are likely to be limited to effects on the settings of heritage assets.

13.4.7 As the Proposed Development would be located adjacent to the existing railway line and in an area already characterised by the Power Station, it is considered that it would not give rise to any significant adverse effects on settings with regards to odour and noise. Thus, this assessment focuses on visual changes to the settings of heritage assets.

13.4.8 All effects on the settings of heritage assets identified in this assessment are judged to be adverse effects on cultural heritage value. No beneficial effects have been found and as such the effects discussed below should be read as adverse.

13.4.9 A full assessment was undertaken, using GIS analysis, desk-based survey of assets, a ZTV, site visits / area visits and Google Maps. Two ZTV were utilised, one for the proposed stack and one for the proposed boiler house. These ZTV used an EA 2 m Digital Surface Model (DSM) LIDAR data, which takes account of the presence of screening features in the landscape, such as buildings and vegetation. It was based upon an amended surface model, reflecting the future baseline scenario where many structures at the existing Power Station are no longer present. This ZTV indicated that most of the heritage assets identified within 3 km of the Site would have views

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of the Proposed Development, except for those within the village of Gotham (as a result the heritage assets within Gotham village were not visited as part of the survey). Site visits concluded that most of the designated assets in the wider 3 km Study Area would have limited visibility (less limited for assets to the west and south) of the Proposed Development due to topography, intervening built structures (including the Power Station) and vegetation. Whilst glimpses of the Proposed Development are possible for many of these assets, particularly with regard to the presence of the new stack, the Proposed Development would be seen at a distance and beyond other built features, or as part of a view already containing the Power Station. As such, effects are likely to be non-material in that they would not result in a change to the setting of the assets such that there would be a reduction in the cultural value. The predicted magnitude of change and level of effect is set out for each asset, or where relevant group of assets, below.

13.4.10 All heritage assets are listed in the gazetteer in **Appendix 13-1** and Figure 13.2 shows all designated heritage assets (Scheduled Monuments, Listed Buildings, Registered Parks and Gardens and Conservation Areas) located within 3 km of the Site.

13.4.11 The Red Hill Scheduled Monument (Site 44) lies 575 m to the west of the Site. The ZTV indicates that both the proposed stack and the proposed boiler house would be likely visible from this asset and this is represented on Figure 5.4b, VP2 i-iii which was taken from a location immediately west of the Scheduled area. The immediate setting for this asset is the Red Hill itself (with an area of mature trees to the north and arable land to the centre and south) with the River Soar to the west (with its marina), further agricultural land to the south and north and the Power Station to the east. The view of the Power Station is unobstructed, and it is expected that there will be a clear view of the Proposed Development from most of the asset (**Appendix 13-2**, Plate 13.4). This asset was Scheduled due to the archaeological potential of buried remains within it and as such has a high sensitivity to changes in its immediate environment. As the asset is associated with ritual activity, which may have attributed some importance to the views from the hill, it could have been judged to have high sensitivity to changes within its wider environment. However, the current setting, which includes the Power Station in a close and prominent position, and the lack of any upstanding remains, means that it is difficult to understand and experience the relationship of the asset to its former setting. Beyond its topographic position the current setting contributes little to the value of the asset and its main value lies in the

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evidential value of its buried remains. On this basis its sensitivity to changes in its wider environment is judged to be medium. The Proposed Development would represent a perceptible change to the wider setting of the asset, as shown on Figure 5.4b, VP2, iii, but would not materially alter the asset's setting such that the ability to understand, appreciate and experience it and its value would be reduced. The magnitude of change is considered low. Overall, there would be a minor level effect, which is **not significant** in EIA terms. Any harm to the asset would be considerably less than substantial in terms of the NPPF.

13.4.12 The Roman Villa and enclosures north of Ratcliffe Lane and the adjacent asset revealed by aerial photography, south-east of Dunster Barn Scheduled Monuments (Sites 104 and 105) lie c.2.27 km west south-west of the Site. The ZTV indicates that both the proposed stack and the proposed boiler house would likely be visible from these assets. Their immediate setting is within agricultural land which is bound by further field systems to the north, west and east and Ratcliffe Lane to the south. Overhead Power Lines (OHLs) were also visible within the fields to the south of these Scheduled Monuments. There was a slightly obstructed view of the current Power Station from these assets, due to intervening hedgerows and mature trees (**Appendix 13-2**, Plate 13.5). It is expected that there would be an obstructed view of the Proposed Development due to the above and the large intervening structures which form part of the existing Power Station. These assets are buried monuments and do not have a physical presence in the landscape and their relationship to their setting is not readily legible. As such their current setting contributes little to an understanding and experience of their value, the bulk of which is contained in their buried archaeological remains. They are thus judged to have a low sensitivity to changes beyond their immediate surroundings. While the Proposed Development would be perceptible from these assets, it would be located beyond their immediate setting and would not compromise the ability to understand, experience and appreciate the assets and their value. The magnitude of change is therefore considered low. Overall, there would be a negligible level effect, which is **not significant** in EIA terms. Any harm would be considerably less than substantial in terms of the NPPF.

13.4.13 The Roman Fort east of Sawley Church Scheduled Monument (Site 106), lies c.2.9 km north-west of the Site. The ZTV indicates that both the proposed stack and the proposed boiler house would be likely visible from this asset. Its immediate setting is within a publicly accessible grass field bound by the River Trent to the south, a church yard and historic core of Sawley to the west, further grass fields to the east and the modern development of Sawley town to the north. There was a slightly obstructed and distant view of the current Power Station from this asset, due to intervening hedgerows and mature trees (**Appendix 13-2**, Plate 13.6). It is expected that there would be an obstructed view of the Proposed Development due to the above and the large intervening structures which are part of the Power Station site. This asset is a buried monument and does not have a physical presence in the landscape; its relationship to its setting is not readily legible. As such its current setting contributes little to an understanding and experience of its value, the bulk of which is contained in the buried archaeological remains. As such, it is judged to have a low sensitivity to changes beyond its immediate surroundings. While the Proposed Development would be perceptible from the asset, it would be located beyond its immediate setting and would not compromise the ability to understand, experience and appreciate the asset and its value. The magnitude of change is considered low. Overall, there would be a negligible level effect, which is **not significant** in EIA terms. Any harm would be considerably less than substantial in terms of the NPPF.

13.4.14 The Moated Site south-east of Sawley Locks Scheduled Monument (Site 103) lies c.2.48 km west of the Site. The ZTV indicates that both the proposed stack and the proposed boiler house would likely be visible from this asset. This asset could not be directly accessed during the survey, as it is located on private land, but its immediate setting is within a series of agricultural fields with OHLs and a raised railway line immediately to its west. There was a slightly obstructed view of the current Power Station from this asset, due to intervening hedgerows and mature trees (**Appendix 13-2**, Plate 13.7). It is expected that there would be an obstructed view of the Proposed Development due to the above and the large intervening structures which are part of the Power Station site. This asset is a buried monument and does not have a physical presence in the landscape; its relationship to its setting is not readily legible. As such its current setting contributes little to an understanding and experience of its value, the bulk of which is contained in the buried archaeological remains. As such, it is judged to have a low sensitivity to changes beyond its immediate surroundings. While the Proposed Development would be perceptible from this asset, it would be located beyond its immediate setting and would not compromise the ability to understand, experience and appreciate the asset and its value. The magnitude of change is considered low. Overall, there would be a negligible level effect, which is **not significant** in EIA terms. Any harm would be considerably less than substantial in terms of the NPPF.

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13.4.15 The Romano-British nucleated enclosed settlement and Roman villa complex at Glebe Farm Scheduled Monument (Site 108) lies c.2.28 km north-east of the Site. The ZTV indicates that the both proposed stack and the proposed boiler house could, potentially, be visible from this asset. This asset could not be directly accessed during the survey, as it is located on private land, but its immediate setting is within agricultural land, with the Glebe Farm complex to its south-western edge and the modern A456 to the north. There was an obstructed view of the current Power Station from this asset, due to intervening topography and vegetation, including distant mature trees (**Appendix 13-2**, Plate 13.8). It is expected that there would be a heavily obscured view of the Proposed Development due to the above and the backdrop of large structures which are part of the Power Station site. This asset is a buried monument and does not have a physical presence in the landscape; its relationship to its setting is not readily legible. As such its current setting contributes little to an understanding and experience of its value, the bulk of which is contained in the buried archaeological remains. As such, it is judged to have a low sensitivity to changes beyond its immediate surroundings. While the Proposed Development would be perceptible from this asset, it would be located beyond its immediate setting and would not compromise the ability to understand, experience and appreciate the asset and its value. The magnitude of change is considered low. Overall, there would be a negligible level effect, which is **not significant** in EIA terms. Any harm would be considerably less than substantial in terms of the NPPF.

13.4.16 The Dovecote at Manor Farm Scheduled Monument (Site 107) lies c.2.78 km north-east of the Site. The ZTV indicates that both the proposed stack and the proposed boiler house could, potentially, be visible from this asset. The immediate environment around the Dovecote is the Manor Farm complex of buildings (now in use as a café and restaurant) and car park. There was no visibility of the existing Power Station from this location and there will be no view of the Proposed Development (**Appendix 13-2**, Plate 13.9). As the asset is a building within the Manor Farm complex which has been modified but still retains elements of its original character, it is judged to have medium sensitivity to changes within its immediate surroundings, and low sensitivity to changes beyond its immediate surroundings. The magnitude of change is none; there would be **no effect** and no harm in terms of the NPPF.

13.4.17 The Thrumpton Conservation Area (Site 109) lies c.200 m (at its nearest point) to the north of the Site. As this Conservation Area is very large and encompasses a variety of Listed Buildings and character areas within a designed landscape, this

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assessment will break up the discussion into the following groups: Thrumpton Park, Thrumpton Hall and associated buildings, Thrumpton Village, The Church of All Saints Thrumpton and Eastern Thrumpton.

13.4.18 Thrumpton Park (Site 88) is not a designated asset but is part of a designed landscape associated with the Grade I Listed Thrumpton Hall (Site 70), within the Thrumpton Conservation Area (Site 109). The Grade II Listed North Portal to the Red Hill tunnels (Site 42) lies within its westernmost reaches. The ZTV indicates that the proposed stack could, potentially, be visible from these assets. The ZTV also indicates that the proposed boiler house would not be visible from these assets. The visibility to the existing Power Station is varied throughout the park with the least obstructed views being from atop the hills (**Appendix 13-2**, Plate 13.10), forming its southern boundary, and from the northern limits of the park adjacent to the River Trent (**Appendix 13-2**, Plate 13.11). Overall, however, the view of the Proposed Development would be heavily obscured by topography, mature trees and within the backdrop of the Power Station, from most parts of the Park. The Park is currently used as pastoral land for sheep grazing, with a cricket pitch towards the south-eastern end, and there is also some limited access for fishing along the bank of the River Trent. This part of the Conservation Area is assessed as having high sensitivity to changes within its immediate environment, e.g. the boundaries of the Conservation Area, due to it retaining large elements of its historic layout; but is of medium sensitivity to changes beyond these boundaries. Views of the Proposed Development would be fleeting as one moves throughout this part of the Conservation Area and largely obscured by mature vegetation both within the Conservation Area and on its boundaries. The Proposed Development would therefore be perceptible from some locations but would be located beyond those elements of setting which contribute to the value of the asset and an understanding and appreciation of it. The magnitude of change is therefore judged to be low. Overall, there would be a minor level effect, which is **not significant** in EIA terms. Any harm would be considerably less than substantial in terms of the NPPF.

13.4.19 Thrumpton Hall (Site 70) is a Grade I Listed Building with associated Grade II Listed structures. These include the west gate piers (Site 71), the icehouse (Site 49), the western gateway (Site 69) and the eastern gateway (Site 68). The other structures all post-date the Hall and were built as part of the Thrumpton Park designed landscape. The paths, gardens and terracing around the Hall are all part of the character to the Site. The ZTV indicates that the proposed stack could, potentially,

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be visible from these assets. The ZTV also indicates that the proposed boiler house would not be visible from these assets. The visibility of the Power Station from numerous viewpoints associated with these assets was very limited, with only occasional heavily obscured views of the tallest existing stack being possible (**Appendix 13-2**, Plate 13.12 and Plate 13.13). There would be no clear view of the Proposed Development, due to its smaller scale, and it would be completely obscured by topography and mature trees. The Grade I Listed Thrumpton Hall and its associated structures are assessed as having high sensitivity to changes within the Conservation Area, due to the retention of the 19th century layout and aesthetics, and medium sensitivity to changes beyond these boundaries. The lack of visibility of the Proposed Development means that the magnitude of change is none. There would be **no effect** and no harm in terms of the NPPF.

13.4.20 Thrumpton Village has a historic core which contains thirteen Grade II Listed Buildings (Sites 58–67 and 72–74) and seven non-designated buildings (Sites 77–83) along Church Lane. The ZTV indicates that the proposed stack could, potentially, be visible from these assets. The ZTV also indicates that the proposed boiler house would not be visible from these assets. The visibility of the existing Power Station from numerous locations (**Appendix 13-2**, Plate 13.14 and Plate 13.15) associated with the village was very limited, with only occasional heavily obscured views being possible of the tallest existing stack (at the southern end of the village). There would be no clear view of the Proposed Development which be completely obscured by intervening structures, local mature trees, and topography. The Grade II Listed Buildings in the village are within the Thrumpton Conservation Area and as such are assessed as having a high sensitivity to changes within their village and Conservation Area setting, due to the retention of the historic layout and structural elements within the village. The sensitivity to change outside their immediate setting is assessed as being medium, as the village lies within a predominantly rural landscape which somewhat enhances its setting. The lack of visibility of the Proposed Development means that the magnitude of change is none. There would be **no effect** and no harm in terms of the NPPF.

13.4.21 All Saints Church in Thrumpton (Site 45) is as Grade II* Listed Building and has an associated Grade II Listed font (Site 57) within its churchyard. The ZTV indicates that the proposed stack could, potentially, be visible from these assets. The ZTV also indicates that the proposed boiler house would not be visible from these assets. The visibility of the existing Power Station from a location just south of the church was

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very limited with only a heavily obscured view of the tallest existing stack being possible (**Appendix 13-2**, Plate 13.15). There would be no clear view to the Proposed Development which would be completely obscured by intervening structures, local mature trees, and topography. The Church has high sensitivity to change within its immediate churchyard and village setting as it is currently a dominant feature of a village which has retained large elements of its historic character. The sensitivity to change outside its immediate setting is assessed as being medium, as the Church lies within a predominantly rural landscape which is somewhat representative of its original setting. The magnitude of change is none. There would be **no effect** and no harm in terms of the NPPF.

13.4.22 The eastern part of the Thrumpton Conservation Area does not include any designated heritage assets but covers an area of houses, farm buildings and farmland to the east of the historic core of Thrumpton village and adjacent to Barton Lane. The ZTV indicates that the proposed stack could, potentially, be visible from some locations within this part of the Conservation Area. The ZTV also indicates that the proposed boiler house would not be visible from this location. The visibility to the Power Station is varied throughout this area with the least obstructed views being from the north-eastern limits of the Conservation Area adjacent to Barton Lane (**Appendix 13-2**, Plate 13.16). The view to the Proposed Development would be heavily obscured by intervening structures, local mature trees, topography and the backdrop of the Power Station. This part of the Conservation Area is assessed as having medium sensitivity to changes within its immediate environment, due to it retaining some elements of its historic layout, but low sensitivity to changes beyond its immediate surroundings. The Proposed Development would be perceptible from certain locations within this portion of the Conservation Area but would clearly be located, and separate from, those elements of setting in its immediate surroundings which contribute to its value. The Proposed Development would not obscure the relationship between this area and the rest of the Conservation Area. The magnitude of change is therefore considered to be low. Overall, there would be a negligible level effect, which is **not significant** in EIA terms. Any harm would be considerably less than substantial in terms of the NPPF.

13.4.23 The Long Eaton Town Centre Conservation Area (Site 149), c.2.84 km north north-west of the Site, lies partially within the 3 km Study Area. This area was designated to preserve the layout and character of the town centre. The ZTV indicates that both the proposed stack and the proposed boiler house could, potentially, be visible from

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some locations within this Conservation Area. The visibility to the Power Station from the southern end of the Conservation Area is extremely limited due to intervening buildings, topography and some mature trees (**Appendix 13-2**, Plate 13.17). The view of the Proposed Development would be heavily obscured by intervening buildings and topography (notably Red Hill) and probably only possible from upper floor windows of buildings within the Conservation Area. The Conservation Area has a high to medium sensitivity to change within its boundaries (as it already has undergone numerous modern alterations) and a low sensitivity to change beyond its boundaries. Given the distance to the Site and very limited visibility of the Proposed Development, which would only be fleeting visible from discreet locations, any perceptibility of the Proposed Development would not materially affect the ability to understand and experience the asset and its value. The magnitude of change is judged to be, at most, low. Overall, there would be a negligible level effect, which is **not significant** in EIA terms. Any harm would be less than substantial in terms of the NPPF.

13.4.24 The Long Eaton Sheet Stores Conservation Area (Site 110), c.2.07 km north-west of the Site, lies completely within the 3 km Study Area and contains one Grade II Listed Building (Long Eaton Canal Bridge, Site 122). This area could not be accessed during the survey due to it being an active and private industrial area. The ZTV indicates that both the proposed stack and the proposed boiler house could, potentially, be visible from some locations within this Conservation Area. The view to the Power Station from the publicly accessible south-eastern corner of the Conservation Area was relatively unobscured (**Appendix 13-2**, Plate 13.18). It is likely that within the Conservation Area the view of the Proposed Development would, at least, be partially obscured by intervening buildings and the embankment for the railway running along its southern edge. The Conservation Area has a medium sensitivity to change within its boundaries, which has retained its industrial character and some of the original 19th century structures, but a low sensitivity to changes in the wider environment. While the Proposed Development would be perceptible, it would not alter the ability to understand the industrial character of the Conservation Area or its value. The magnitude of change would be low. Overall, there would be a negligible level effect, which is **not significant** in EIA terms. Any harm would be considerably less than substantial in term of the NPPF.

13.4.25 The Sawley Conservation Area (Site 150), c.2.85 km west north-west of the Site, lies partially within the 3 km Study Area. This area was designated to protect the historic

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core of Sawley. All the designated buildings within Sawley lie outside of the 3 km Study Area. The ZTV indicates that both the proposed stack and the proposed boiler house would likely be visible from some locations within this Conservation Area. Figure 5.4g, VP 7, iii, taken from a location immediately south of the Conservation Area, indicates that the stack would be visible to the left of the Power Station as would the roofline of the proposed boiler house. The view to the Power Station from the eastern part of the Conservation Area was unobscured (**Appendix 13-2**, Plate 13.6). It is expected that there would be an obstructed view of the Proposed Development due to the above and the large structures which are part of the Power Station some of which would intervene in the view. The Conservation Area has high to medium sensitivity to change within its boundaries, as it has retained the layout of its historic core amongst a large number of more modern additions; but is considered to be of low sensitivity to changes in the wider environment. While the Proposed Development would be perceptible, it would not alter the ability to understand the character of the Conservation Area or its value. The magnitude of change is therefore considered to be low. Overall, there would be a negligible level effect, which is **not significant** in EIA terms. Any harm would be considerably less than substantial in terms of the NPPF.

13.4.26 Ratcliffe on Soar lies c.1.44 km to the south of the Site and contains the Grade I Listed Church of the Holy Trinity (Site 99) and the Grade II Listed Manor Farmhouse (Site 111). The ZTV indicates that both the proposed stack and the proposed boiler house would, potentially, be visible from these assets. Visibility to the Power Station is partially obscured by large mature trees (with no leaf cover), the landscaping for the A453 and intervening structures (**Appendix 13-2**, Plate 13.19). Ratcliffe on Soar has lost elements of its historic and rural character due to the proximity of large-scale modern development in the form of the A453, the Power Station and associated power lines. The view to the Proposed Development from the Listed Buildings therein would, therefore, be obscured by the above and Power Station structures. The Church and Manor Farm have medium sensitivity to change in their immediate environment and village setting and low sensitivity to change outside their immediate environment and in the wider landscape. The Proposed Development would be partially visible from these assets but would be located beyond their important village setting and therefore would not materially affect the ability to understand, appreciate or experience the assets and their value. The magnitude of change is therefore judged to be low, at worst. Overall, there would be a negligible level effect, which is

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not significant in EIA terms. Any harm would be considerably less than substantial in terms of the NPPF.

13.4.27 Barton in Fabis, located c.2.80 km north of the Site and contains the Grade I Listed Church of St. George (Site 100), the Dovecote at Manor Farm Scheduled Monument (Site 107) and six Grade II Listed Buildings (Sites 113–117). The ZTV indicates that both the proposed stack and the proposed boiler house could, potentially, be visible from these assets. Figure 5.4i, VP9, iii was taken from a location north-east of Barton in Fabis and likely represents the worst-case scenario of views from the village and the heritage assets therein. It indicates views of the proposed stack above an existing tree line with the proposed boiler house obscured beyond a wooded ridge. There was very limited visibility of the current Power Station from discreet locations within Barton in Fabis (**Appendix 13-2**, Plate 13.20) including from each of the assets located within the village. There would be no clear views to the Proposed Development from the designated assets, and it would be largely, if not completely obscured by intervening structures within the village, mature trees, and distant topography. Barton in Fabis has retained its historic core centred on the Grade I Listed Church and surrounded by Grade II Listed Buildings with some modern additions and the village forms the primary setting for these assets. As a result, the designated assets within the village have a high to medium sensitivity to changes in their village setting and the immediate environment, which has retained large elements of its rural character; being surrounded by arable farmland with the River Trent to the north-west. They have a low sensitivity to changes in the wider landscape beyond the elements of setting defined above as contributing to their value. The Proposed Development would not be visible from the ground, either from or with the assets, and therefore would not alter the village or immediate rural setting defined here as contributing to the value of the asset. However, as limited views from the assets cannot be ruled out, a precautionary marginal magnitude of change is predicted. Overall, there would be a neutral level effect, which is **not significant** in EIA terms. There would be no harm in terms of the NPPF.

13.4.28 Kingston on Soar, located c.2.62 km south of the Site, contains the Grade I Listed Church of St Winifrid (Site 98), eleven Grade II Listed Buildings (Sites 126, 128–130, 133–137, 139 and 141) in the village. The ZTV indicates that both the proposed stack and the proposed boiler house could, potentially, be visible from these assets. Figure 5.4e, VP5, iii was taken from a location on the northern edge of the village and represents the worst-case scenario in terms of views from the village. It indicates the

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proposed stack would be visible above tree cover, which would obscure the proposed boiler house. The designated assets within the western and central parts, typically on the southern side of the road, of the village (Sites 129, 130 and 134–136) would have heavily obscured views of the Proposed Development due to intervening buildings, mature trees and topography (**Appendix 13-2**, Plate 13.21). The designated assets along the northern edge of the village (Sites 128, 133, 137 and 139) would have clearer views of the Proposed Development (**Appendix 13-2**, Plate 13.22) but these would almost certainly be obscured by mature trees and other vegetation within their gardens, which could not be accessed. Visibility from these assets is likely to be similar to that shown in Figure 5.4e, VP5, iii. The designated assets within the eastern part of the village, including Sites 126 and 141, would have heavily obscured views of the Proposed Development due to intervening buildings and topography (see **Appendix 13-2**, Plate 13.24 for views towards the Site from Site 141). Further, the Grade I Listed Church of St. Winifrid (Site 98) (**Appendix 13-2**, Plate 13.23) has large mature trees forming the boundary of the churchyard. These are coniferous and would be in leaf year-round meaning that the Proposed Development would be heavily obscured in views from the church. The churchyard and character of the historic core of the village have been well maintained, with some modern additions, and as such they form an important setting for the designated assets therein. The assets are judged to have a high sensitivity to changes within their village setting. The village lies within a predominantly arable farmland landscape which contributes somewhat to the value of the assets, but it is judged that its sensitivity to change in the wider environment, which includes the railway line to the west and the Power Station, is medium. Although the views of the Proposed Development appear to be heavily obscured from the western and central parts of the village, including the Grade I Listed Church (Sites 98, 129, 130 and 134–136), limited views from the assets cannot be ruled out, a precautionary marginal magnitude of change is predicted. For these assets there would be neutral level effect, which is **not significant** in EIA terms, and would result in no harm in terms of the NPPF. The magnitude of change for the designated assets along the northern edge and in the eastern part of the village (Sites 126, 128, 133, 137, 139 and 141) would be low. There would be a minor level effect, which is **not significant** in EIA terms. Any harm to these assets would be considerably less than substantial in terms of the NPPF.

13.4.29 The Grade II Registered Kingston Park Pleasure Gardens (Site 102), c.2.18 km south of the Site, lies completely within the 3 km Study Area. The Park contains the

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Grade II Listed Kingston Hall (Site 132) and three other associated Grade II Listed Buildings (Sites 127, 131 and 138). The ZTV indicates that both the proposed stack and the proposed boiler house could, potentially, be visible from these assets. The Park and the Hall could not be accessed during the survey as they are located on private property. A location at the Lodge and Gateway (Site 131) established a clear view of the Power Station (**Appendix 13-2**, Plate 13.25) whilst a view was also possible from the footpath adjacent to the park in Kingston on Soar established that the Power Station was heavily obscured (**Appendix 13-2**, Plate 13.24). The number of mature trees and the boundary wall of the Park would suggest that views of the Proposed Development from within would be heavily obscured at best. The Hall, its associated buildings and the Park are all part of a designed landscape which has retained its layout from the 19th century. As such these assets have a high sensitivity to change within the Park boundaries. The surrounding rural landscape, village of Kingston on Soar and Kingston Farmhouse complex all contribute positively to the wider setting of the Park. The clear view of the Power Station from the Lodge and Gateway, however, makes a negative contribution. On the basis of the above it is judged that the Park and the assets therein have a medium sensitivity to changes in their wider landscape. The Proposed Development would be visible from the Lodge and Gateway but is likely to be largely if not completely obscured from views within the Park. The Proposed Development would not obscure the relationships between elements of the designed landscape nor will it materially alter the wider rural landscape such that the ability to understand, experience and appreciate the assets and their value would be diminished. The magnitude of change is therefore judged to be low. Overall, there would be a minor level effect, which is **not significant** in EIA terms. Any harm would be considerably less than substantial in terms of the NPPF.

13.4.30 The Grade II Listed Kingston Fields Farmhouse and Workshop (Site 140), is located c.2.5 km south-east of the Site. This asset could not be directly accessed during the survey as it is located within private property at the end of a private access road. The ZTV indicates that both the proposed stack and the proposed boiler house could, potentially, be visible from this asset. A viewpoint from the end of the private access road (**Appendix 13-2**, Plate 13.29) established that the Power Station was obscured by mature trees and distant topography. This asset is a complex of farm buildings which continue to fulfil their original and intended purpose within the field systems to the east of Kingston on Soar. The asset is judged to have a high sensitivity to changes within the farm complex, which has maintained its historic layout, and its

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immediate associated agricultural land. The Kingston Field Farmhouse and Workshop lie within a predominantly arable farmland landscape which contributes somewhat to the value of the asset, but it is judged that its sensitivity to change in the wider environment, which includes the Power Station, is low. The mature trees and distant topography would suggest that views of the Proposed Development from this asset would be heavily obscured at best. On this basis, and as the Proposed Development would be located beyond the farm complex and its associated agricultural land, the magnitude of change is judged to be low. Overall, there would be a negligible level effect, which is **not significant** in EIA terms. Any harm would be considerably less than substantial in terms of the NPPF.

13.4.31 The remaining five Grade II Listed Buildings include the Red Hill Tunnels South Portal (Site 87), the Packhorse Bridge over Red Hill Lock (Site112), Cranfleet Lock (Site 119), a Canal Bridge (Site 120) and the Tamworth Road Bridge (Site 121).

13.4.32 The Red Hill Tunnels South Portal (Site 87) lies c.750 m west of the Site. This asset could not be accessed during the survey due to it being part of an active railway line. The ZTV indicates that both the proposed stack and the proposed boiler house could, potentially, be visible from this asset. It is expected that there would be heavily obscured views of the Proposed Development due to the surrounding topography, landscaping associated with the railway and intervening large structures which are currently part of the Power Station. Views would like be similar to those depicted in Figure 5.4b, VP2, iii. This asset is an industrial and transportation/communication asset whose location relies upon its direct association with the railway line (and it is still fulfilling its original and intended use) which makes up its primary setting. The bulk of its value lies in its architectural and historic interest. On this basis it is judged to be of low sensitivity to change beyond the immediate rail line setting and within the wider landscape. The Proposed Development would be perceptible but would not obscure the relationship of the tunnel with the rest of the rail line and would not diminish the ability to understand or appreciate the asset and its value. The magnitude of change is therefore judged to be low. Overall, there would be a negligible level effect, which is **not significant** in EIA terms. Any harm would be considerably less than substantial in terms of the NPPF.

13.4.33 Packhorse Bridge over Red Hill Lock (Site 112) lies c.1.13 km west of the Site. The ZTV indicates that the proposed stack could, potentially, be visible from this asset. The ZTV also indicates that the proposed boiler house would not be visible from this

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asset. This bridge is still functional and is within the developed Redhill Marina along the River Soar. There are buildings associated with the Marina and agriculture in the immediate vicinity of the bridge. The Bridge and Lock have a medium sensitivity to change within their local riverine environment and they are still functional and serving a similar purpose to their original and intended use within the more modern development of the marina. It is this setting that contributes to the value of the asset and it is judged to be of a low sensitivity to change within its wider landscape. There are obstructed views of the existing Power Station from the bridge due to intervening topography and mature trees, as can be seen in Figure 5.4b, VP2, i-ii. It is likely that there would be an obscured view of the Proposed Development due to the intervening features described above. As views of the Proposed Development would be limited and as they would not alter important elements of the bridge's setting as outlined above, the magnitude of change is judged to be low. Overall, there would be a negligible level effect, which is **not significant** in EIA terms. Any harm in terms of the NPPF would be considerably less than substantial.

13.4.34 Cranfleet Lock (Site 119) lies c.970 m north of the Site. The ZTV indicates that both the proposed stack and the proposed boiler house could, potentially, be visible from this asset. Figure 5.4h, VP8, iii was taken from north-east of the Lock and indicates that, from this location, the proposed stack would be visible above the existing trees, while the proposed boiler house would be located behind a wooded ridge. The Lock is in working condition and forms part of the Erewash Cut canal. It is surrounded by arable land to the north and has clear views across the River Trent and in to Thrumpton Park to the south. The Lock has a medium sensitivity to change within its local canal environment. It continues to fulfil its original and intended purpose within the canal system adjacent to the River Trent and it is these setting relationships which contribute to its value. Its siting in the wider landscape would have been functional and related to the requirements of the canal and local topography. For this reason, it is judged to be of a low sensitivity to changes in the wider landscape. This asset has an obscured view of the Power Station due to intervening topography and vegetation including mature trees on the other side of the River Trent (**Appendix 13-2**, Plate 13.26). It is likely that the Proposed Development would be heavily obscured by these features. While the Proposed Development would be perceptible, it would be located clearly beyond those elements of setting defined above as contributing to the value of the asset and it would not obscure the relationships between the lock and the canal and river with which it is associated. It therefore would not materially diminish the ability to understand, experience and appreciate the asset and its value. The magnitude of change would be low. Overall, there would be a negligible level effect, which is **not significant** in EIA terms. Any harm would be considerably less than substantial in terms of the NPPF.

13.4.35 The Canal Bridge (Site 120) lies c.970 m north-west of the Site. The ZTV indicates that the proposed stack could, potentially, be visible from this asset. The ZTV also indicates that the proposed boiler house would not be visible from this asset. The Bridge is in working condition and provides access from a farm to the north to the island formed by the Erewash Cut and the River Trent. It is surrounded by arable land to the north and has clear views across the River Trent and in to Thrumpton Park to the south and continues to fulfil its original and intended purpose of providing access to grazing pasture on the island. The Bridge has a medium sensitivity to change within its local environment which comprises the Erewash Cut, the River Trent and the island and is sensitive to changes which would obscure these setting relationships. However, it siting is largely functional and related to fulfilling a transport and access need and based on topographical considerations; as such the wider landscape does not contribute significantly to its value and it is judged to be of low sensitivity to changes to its wider landscape setting. This asset has an obscured view of the Power Station due to intervening topography and vegetation including mature trees on the other side of the River Trent (**Appendix 13-2**, Plate 13.27). It is likely that the Proposed Development would be heavily obscured by the features described above. Views of the Proposed Development would be partially obscured and would not inhibit the ability to understand the function of the bridge or its relationship to the immediate elements of its setting which contribute to its value, the magnitude of change is judged to be low. Overall, there would be a negligible level effect, which is **not significant** in EIA terms. Any harm would be considerably less than substantial in terms of the NPPF.

13.4.36 The Tamworth Road Bridge (Site 121) lies c.2.72 km north-west of the Site. The ZTV indicates that both the proposed stack and the proposed boiler house could, potentially, be visible from this asset. The Bridge is in working condition and lies adjacent to a busy roundabout junction within the urban development of New Sawley. The Road Bridge is fulfilling its original and intended use within a heavily urbanised setting which has seen many alterations and additions since the bridge's construction in the 19^{th} century. Its setting, insofar as it contributes to its value, is largely limited to the related and adjacent transportation route and it has a low sensitivity to change in its wider environment. This asset has a heavily obscured view of the Power Station

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due to intervening urban development and distant topography and mature trees (**Appendix 13-2**, Plate 13.28). It is likely that the Proposed Development would be heavily obscured by the above noted features. Given the distance to the Proposed Development and the fact that it would not obscure the relationship of the bridge with its associated road network, the Proposed Development would not materially alter the ability to understand or appreciate the asset and its value. The magnitude of change would be low, at most. Overall, there would be a negligible level effect, which is **not significant** in EIA terms. Any harm would be considerably less than substantial in terms of the NPPF.

Assessment of Effects against Future Baseline

13.4.37 Whilst the Power Station structures remain present, these would remain very prominent features that would draw attention away from the Proposed Development, and indeed may screen views of it from some heritage assets as discussed above.

13.4.38 The sensitivity of the heritage assets to changes in their wider environments would be unchanged from those outlined above. However, the potential for the magnitude of change to be altered when considered against the future baseline needs to be considered, as removal of some of the Power Station structures could increase the visibility or prominence of the Proposed Development in some views. However, it is noted that from many of the assets considered, and as outlined above, mature vegetation and built structures in their vicinity obscure the Power Station and for these assets these screening features will also greatly obscure views of the Proposed Development. Even though the removal of many large structures will be a notable alteration to the wider setting of many assets and the Proposed Development may appear more prominent for this reason, this will not directly affect those elements of their settings which contribute most to the understanding of their cultural value as set out above. As such, overall, the magnitude of change will remain at most low for the heritage assets that have a view of the Proposed Development even when considered against the Future Baseline. These changes will not alter the level of effect so the effects will remain **not significant** in EIA terms and any harm will be considerably less than substantial in terms of the NPPF. Detailed consideration of the effects upon the setting of each of the assets is considered below.

13.4.39 The Scheduled Monuments within the Study Area (Sites 44, 103–108) all have low or medium sensitivity to change within their wider environment due to either being

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buried monuments, having inherent characteristics that contributed to their designation (the Dovecote, Site 107) or having large scale prominent modern development already making up part of their current settings (Roman Site on Red Hill, Site 44). It is likely that the views of the Proposed Development would be made more prominent by removal of large structures on the Power Station site when viewed from the Scheduled Monuments located to the west and north-west (Sites 44, 103–106); while the Proposed Development may appear more prominent from these assets, it would still be located beyond those elements of setting which contribute most to their value and an understanding an experience of those values. The Proposed Development would remain completely obscured from the Dovecote (Site 107) to the north-east and heavily obscured to the Romano-British nucleated enclosed settlement and Roman villa complex at Glebe Farm (Site 108), due to intervening topography and mature trees. The magnitude of change is considered to be none (for Site 107) or low (for Sites 44, 103–106 and 108). Overall, there would be a **no effect** on Site 107 and at most a minor level effects for the other Scheduled Monuments, which are **not significant** in EIA terms. There would be no harm to Site 107 and any harm to the other Scheduled Monuments would be considerably less than substantial.

13.4.40 The Thrumpton Conservation Area (Site 109) contains the Grade I Listed Thrumpton Hall (Site 70), the Grade II* Listed Church of All Saints (Site 45) and nineteen Grade II Listed Buildings (Sites 42, 49, 57–69 and 71–74) as well as non-designated assets including Thrumpton Park (Site 88) and buildings within the village (Sites 77–83). The area has a low to medium sensitivity to change within its wider environment as set out above. The removal of the largest elements of the Power Station would not increase the visibility of Proposed Development, which would not be seen from most, if not all, of the Conservation Area due to the intervening topography and mature trees. The magnitude of change would be none, or low (for those areas within the Conservation Area with a view Proposed Development). Overall, there would be negligible or minor level effects, which are **not significant** in EIA terms. Any harm would be considerably less than substantial in terms of the NPPF.

13.4.41 The Long Eaton Town Centre Conservation Area (Site 149) has a low sensitivity to changes within its wider environment. Even considering the removal of the largest elements of the Power Station structures, the Proposed Development would not be visible from most, if not all, of the Conservation Area due to the intervening urban development and distant topography. The magnitude of change is low, at most.

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Overall, there would be a negligible level effect, which is **not significant** in EIA terms. Any harm would be less than substantial in terms of the NPPF.

13.4.42 The Long Eaton Sheet Stores Conservation Area (Site 110) has a low sensitivity to changes within its wider environment. The removal of the largest elements of the Power Station structures would be likely to make the Proposed Development more visible from most, if not all, of the Conservation Area. However, the Proposed Development would still be located beyond the industrial setting of the asset and would not materially affect the ability to understand and appreciate the asset and its value. The magnitude of change would be low. Overall, there would be a negligible level effect, which is **not significant** in EIA terms. Any harm would be considerably less than substantial in terms of the NPPF.

13.4.43 The Sawley Conservation Area (Site 150) has a low sensitivity to changes within its wider environment. The removal of the largest elements of the Power Station structures would be likely to make the Proposed Development more visible from parts (especially to the east), of the Conservation Area. However, the Proposed Development would still be located beyond the elements of setting which contribute most to the value of the asset and it would not materially affect the ability to understand and appreciate the asset and its value. The magnitude of change would be low. Overall, there would be a negligible level effect, which is **not significant** in EIA terms. Any harm would be considerably less than substantial in terms of the NPPF.

13.4.44 The assets within Ratcliffe on Soar (centred on Site 99, the Church of the Holy Trinity) have a low sensitivity to change within their wider environment, beyond their village setting. The removal of the largest elements of the Power Station structures would likely make the Proposed Development more visible from some parts of the village. However, the Proposed Development would still be located beyond the elements of setting which contribute most to the value of the asset and it would not materially affect the ability to understand and appreciate the asset and their value. The magnitude of change would be at most low. Overall, there would be a negligible level effect, which is **not significant** in EIA terms. Any harm would be less than substantial in terms of the NPPF.

13.4.45 The designated assets within Barton in Fabis, include the Grade I Listed Church of St. George (Site 100), the Dovecote at Manor Farm Scheduled Monument (Site 107)

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and six Grade II Listed Buildings (Sites 113–117). These assets were assessed as having a low sensitivity to changes within their wider environment, beyond the village setting. Even with the removal of the largest elements of the Power Station structures, the Proposed Development would remain mostly invisible from all the assets within Barton in Fabis due to intervening structures within the village, mature trees, and distant topography. However, as limited views from the assets cannot be ruled out, a precautionary marginal magnitude of change is predicted. Overall, there would be a neutral level effect, which is **not significant** in EIA terms. There would be no harm to the assets in Barton in Fabis in terms of the NPPF.

13.4.46 The designated assets within Kingston on Soar include the Grade I Listed Church of St Winifrid (Site 98) and eleven Grade II Listed Buildings (Sites 126, 128–130, 133–137, 139 and 141). These assets were assessed as having a medium sensitivity to changes within their wider environment. The removal of the largest elements of the Power Station structures would likely make the Proposed Development more visible from some locations within the village (albeit, views would likely remain obscured). However, the Proposed Development would still be located beyond the elements of setting which contribute most to the value of these assets and it would not materially affect the ability to understand and appreciate the assets and their values. For the designated assets within the western and central parts of the village, including the Grade I Listed Church (Sites 98, 129, 130 and 134–136), the magnitude of change would be marginal. For the designated assets along the northern edge or within the eastern part of the village (Sites 126, 128, 133, 137 139 and 141) the magnitude of change would be low. Overall, there would be a neutral or a minor level effect upon these assets, which is **not significant** in EIA terms. Any harm would be considerably less than substantial in terms of the NPPF.

13.4.47 The Grade II Registered Kingston Park Pleasure Gardens (Site 102) contain the Grade II Listed Kingston Hall (Site 132) and three other associated Grade II Listed Buildings (Sites 127, 131 and 138). Overall, these assets have a medium sensitivity to changes in their wider environment. The removal of the largest elements of the Power Station structures would be likely to make the Proposed Development more visible from some locations within the park, especially the Lodge and Gateway (Site 131), but the number of mature trees and the boundary wall of the park suggest that views from within the Park would be heavily obscured at best. Further, the Proposed Development would still be located beyond the elements of setting which contribute most to the value of the assets and it would not materially affect the ability to

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understand and appreciate the assets and their value. The magnitude of change would be low. Overall, there would be a minor level effect, which is **not significant** in EIA terms. Any harm would be considerably less than substantial in terms of the NPPF.

13.4.48 The Grade II Listed Kingston Fields Farmhouse and Workshop (Site 140) has a low sensitivity to change in its wider environment, beyond its immediate associated agricultural setting. Even with the removal of the largest elements of the Power Station structures, the Proposed Development would be heavily obscured from the asset due to the intervening topography and mature trees. The magnitude of change is low. Overall, there would be a negligible level effect, which is **not significant** in EIA terms. Any harm would be considerably less than substantial in terms of the NPPF.

13.4.49 The remaining five Grade II Listed Buildings include the Red Hill Tunnels South Portal (Site 87), the Packhorse Bridge over Red Hill Lock (Site112), Cranfleet Lock (Site 119), a Canal Bridge (Site 120) and the Tamworth Road Bridge (Site 121).

13.4.50 The Red Hill Tunnels South Portal (Site 87) has a low sensitivity to change within its wider environment. The removal of the largest elements of the Power Station structures may make the Proposed Development more noticeable. Despite the possibility of increased visibility, the Proposed Development would still be located beyond the elements of setting which contribute most to the value of the asset and it would not materially affect the ability to understand and appreciate the asset and its value. The magnitude of change would be at most low. At most, there would be a negligible level effect, which is **not significant** in EIA terms. Any harm would be considerably less than substantial in terms of the NPPF.

13.4.51 The Packhorse Bridge over Red Hill Lock (Site112) has a low sensitivity to change within its wider environment. The removal of the largest elements of the Power Station structures may make the Proposed Development more visible though it would not change the extent to which the intervening topography would obscure the Proposed Development in the view. Despite the possibility of increased visibility or prominence, the Proposed Development would still be located beyond the elements of setting which contribute most to the value of the asset and it would not materially affect the ability to understand and appreciate the asset and its value. The magnitude of change is low. Overall, there would be a negligible level effect, which is **not**

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significant in EIA terms. Any harm would be less than substantial in terms of the NPPF.

13.4.52 Cranfleet Lock (Site 119) has a low sensitivity to change within its wider environment. Even with the removal of the largest elements of the Power Station structures, the Proposed Development would likely remain heavily obscured from the asset due to the intervening topography and mature trees. The magnitude of change is low. Overall, there would be a negligible level effect, which is **not significant** in EIA terms. Any harm would be considerably less than substantial in terms of the NPPF.

13.4.53 The Canal Bridge (Site 120) has a low sensitivity to change within its wider environment. Even with the removal of the largest elements of the Power Station structures, the Proposed Development would likely remain heavily obscured from the asset due to the intervening topography and mature trees. The magnitude of change is low. Overall, there would be a negligible level effect, which is **not significant** in EIA terms. Any harm would be considerably less than substantial in terms of the NPPF.

13.4.54 The Tamworth Road Bridge (Site 121) has a low sensitivity to change in its wider environment. Even with the removal of the largest elements of the Power Station structures, the Proposed Development would likely remain heavily obscured from the asset due to the intervening urban development, mature trees and distant topography. The magnitude of change is low. Overall, there would be a negligible level effect, which is **not significant** in EIA terms. Any harm would be considerably less than substantial in terms of the NPPF.

13.5 Cumulative Effects

13.5.1 The Proposed Development lies near part of the proposed High-Speed Rail Phase 2b (HS2b). The route of HS2b through the Ratcliffe on Soar to Long Eaton area would be approximately 9.2 km long and extend from the north-west of Kegworth in the south of the area and travel north through Redhill, Long Eaton and Toton, up to the B5010 Derby Road overbridge.[48] The key elements of this proposed scheme include:

[48] Department for Transport (2018) *High Speed Rail (Crewe to Manchester and West Midlands to Leeds) Working Draft Environmental Statement Volume 2: Community Area report LA05: Ratcliffe-on-Soar to Long Eaton.* https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/745213/HS2_Phase_2b_WDES_Volume_2_LA05_Radcliffe-on-Soar_to_Long_Eaton.pdf viewed (19/03/2020)

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- The route of HS2b, continuing from the Coleorton to Kegworth area (LA04) north-east towards the Stapleford to Nuthall area (LA06);
- East Midlands Hub station: an integrated station for HS2b and conventional lines; and
- Modifications to the existing conventional lines to accommodate HS2 and service the East Midlands Hub station.

13.5.2 Submission details for HS2b illustrate that construction works near to the Power Station are scheduled to begin in Quarters 3 and 4 of 2025.[49] This is nine months after the Proposed Development is anticipated to be fully completed and operational. It should be noted that the Bill seeking powers to construct and operate HS2b has not progressed through Parliament, a process anticipated to take place in 2021. As such, the scheme currently has no formal ‘consent’.

13.5.3 The potential for cumulative impacts upon heritage assets will consider the visibility of construction related activities on HS2b combined with the operational phase of the Proposed Development, including the expected removal of large elements of the Power Station, as set out in the future baseline. The operational phase of HS2b is only likely to have a neutral cumulative effect at best (possibly no effect on the settings of many distant assets) as the settings which already have a current view of an active railway line will then have a view of an active high-speed railway line. As outlined in Paragraph 13.2.31, only those assets that are judged to have the potential to be subject to significant cumulative effects will be included in the detailed cumulative assessment.

13.5.4 The western parts of Thrumpton Park (Site 88), within the Thrumpton Conservation Area (Site 109), would likely have clear and unobstructed views of construction activities relating to HS2b improvements from the northern portal of the Redhill Tunnel and to the north on the bridge over the River Trent. The designated heritage assets within the Conservation Area would likely have heavily obstructed views due to the mature trees within the park and intervening buildings within the village. As it is unlikely that the Proposed Development would be visible from many parts of the Conservation Area, the Proposed Development in combination with the HS2b construction works would have a limited cumulative impact. It is assessed that there may be a temporary low magnitude of change upon the parts of Conservation Area

[49] *ibid*

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(typically the western and northern parts of the non-designated park). For those parts of the Conservation Area noted above, there would be a minor cumulative level effect, which is **not significant** in EIA terms. Any harm would be less than substantial in terms of the NPPF.

13.5.5 The designated assets within Barton in Fabis, including the Grade I Listed Church of St. George (Site 100), the Dovecote at Manor Farm Scheduled Monument (Site 107) and six Grade II Listed Buildings (Sites 113–117) are unlikely to have clear views of construction work relating to the HS2b railway. As it is also unlikely that the Proposed Development would be clearly visible from many of the assets within Barton in Fabis, it is assessed that there will be **no cumulative effect**. There would be no harm in terms of the NPPF.

13.5.6 The designated assets within Ratcliffe on Soar, including the Grade I Listed Church of the Holy Trinity (Site 99) and the Grade II Listed Manor Farmhouse (Site 111) may have some views of HS2b construction works, particularly those relating to the Ratcliffe on Soar Viaduct. It is assessed that there may be a temporary increase in the level of impact on those parts of the village with a view to the Proposed Development. The magnitude of cumulative change would be low. For these assets, there would be a negligible cumulative level effect, which is **not significant** in EIA terms. Any harm would considerably less than substantial in terms of the NPPF.

13.5.7 The designated assets within Kingston on Soar including the Grade I Listed Church of St Winifrid (Site 98), eleven Grade II Listed Buildings (Sites 126, 128–130, 133–137, 139 and 141) in the village are likely to have some distant visibility to the HS2b construction works relating to the Ratcliffe on Soar Viaduct. It is assessed that there may be a temporary increase in the level of impact on those parts of the village with a view to the Proposed Development. The magnitude of cumulative change would be low. For the assets within the western and central parts of the village, including the Grade I Listed Church (Sites 98, 129, 130 and 134–36), there would be a minor cumulative level effect, which is **not significant** in EIA terms. For the assets along the northern edge and within the eastern part of the village (Sites 126, 128, 133, 137 139 and 141), there would also be a minor cumulative level effect, which is **not significant** in EIA terms. Any harm would be less than substantial in terms of the NPPF.

13.5.8 The Grade II Registered Kingston Park Pleasure Gardens (Site 102) contains the Grade II Listed Kingston Hall (Site 132) and three other associated Grade II Listed Buildings (Sites 127, 131 and 138). These assets are likely to have some distant visibility to the HS2b construction works relating to the Ratcliffe on Soar Viaduct. It is assessed that there may be a temporary increase in the level of impact on those parts of the Park with a view to the Proposed Development. The magnitude of cumulative change would be low. There would be a minor cumulative level effect, which is **not significant** in EIA terms. Any harm would be less than substantial in terms of the NPPF.

13.5.9 The Grade II Listed Kingston Fields Farmhouse and Workshop (Site 140) is likely to have some distant visibility to the HS2b construction works relating to the Ratcliffe on Soar Viaduct. It is assessed that there may be a temporary increase in the level of impact. The magnitude of cumulative change would be low and there would be a minor cumulative level effect, which is **not significant** in EIA terms. Any harm would be less than substantial in terms of the NPPF.

13.5.10 Cranfleet Lock (Site 119) is likely to have clear and unobstructed views of construction works relating to HS2b (the section between the Redhill Tunnel and the Long Eaton and Toton Viaduct). As it is likely that the Proposed Development will be heavily obscured from Cranfleet Lock, it is assessed that the magnitude of cumulative change will be low. Therefore, there would be a negligible cumulative level effect, which is **not significant** in EIA terms. Any harm would be less than substantial in terms of the NPPF.

13.5.11 The Canal Bridge (Site 120) is likely to have a clear and unobstructed view of construction works relating to HS2b (the section between the Redhill Tunnel and the Long Eaton and Toton Viaduct). As it is likely that the Proposed Development will be heavily obscured visible from the Canal Bridge, it is assessed that the magnitude of cumulative change will be low. Therefore, there would be a negligible cumulative level effect, which is **not significant** in EIA terms. Any harm would be less than substantial in terms of the NPPF.

13.5.12 Submission details of HS2b suggest that there may be direct impacts upon the Red Hill Scheduled Monument (Site 44), the South Portal of the Red Hill Tunnel (Site 87)

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and the North Portal of the Red Hill tunnel (Site 42).[50] These three sites were assessed as having negligible to minor level effects upon their setting as a result of the Proposed Development. Any cumulative impact upon their settings as a result of construction work relating to HS2b would be temporary and represent low to medium magnitude of change. This would result the cumulative level of effect of minor, or minor-moderate, which is **not significant** in EIA terms. Any harm resulting from cumulative effects upon setting would be less than substantial in terms of the NPPF.

13.6 Mitigation

Construction Mitigation

13.6.1 The NPPF [51] and associated guidance, as well as local planning policies, require a mitigation response that is designed to avoid, reduce or compensate for the adverse effects of the Proposed Development on heritage assets.

13.6.2 Chapter 9.0 of this ES advises that further geotechnical works are to be undertaken as a condition of planning consent, to provide more information about ground conditions underlying the Site. It is advised that any intrusive geotechnical investigations in the south of the Site are subject to archaeological monitoring and that results are reviewed by a geoarchaeologist to allow for the deposit model for the Site to be updated accordingly. If the results of geotechnical works confirm that modern Made Ground deposits extend across the Site, then no further archaeological works would be advised. If geotechnical works indicate potential for undisturbed deposits, it is advised that an archaeological evaluation is undertaken across a representative proportion of the southern half of the Site to establish the extent of any surviving archaeological remains that might be damaged during construction of the Proposed Development. It is recommended that this is secured as a condition of any planning consent. If significant remains are encountered, further works including full excavation, post-excavation analysis and publication may be required.

13.6.3 The exact scope of any further investigations and / or mitigation would need to be agreed with the Archaeological Officer for NCC.

[50] *ibid*
[51] *MHCLG (2019). National Planning Policy Framework.*

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13.6.4 At most, minor effects on the settings of heritage assets are expected during the construction phase. As these effects will be temporary and are not significant, no mitigation is deemed necessary.

Operational Mitigation

13.6.5 No additional direct effects upon archaeological remains are expected after construction of the Proposed Development. Therefore, no additional mitigation is required in relation to the operation of the Proposed Development in relation to direct physical impacts.

13.6.6 No effects greater than minor–moderate level (including those cumulative effects from the proposed HS2b construction phase) on the settings of heritage assets are expected. As these effects are not significant in EIA terms, no mitigation is deemed necessary.

13.7 Residual Effects and Conclusions

13.7.1 The assessment has identified a low potential for previously unrecorded finds and deposits of all periods to exist within the Site. Landscaping works in the north and central parts of the Site have likely removed or heavily truncated any archaeological remains or deposits in these areas and thus potential is limited to the south of the Site, where pockets of less disturbed material may survive buried beneath later levelling deposits. Chapter 9 of this ES advises that further geotechnical works be undertaken as a condition of planning consent to provide more information about ground conditions underlying the Site. It is advised that any intrusive geotechnical investigations in the south of the Site are subject to archaeological monitoring and that results are reviewed by a geoarchaeologist to allow for the deposit model for the Site to be updated accordingly. If the results of geotechnical works confirm that modern Made Ground deposits extend across the Site, then no further archaeological works would be advised. If geotechnical works indicate potential for undisturbed deposits, it is advised that an archaeological evaluation is undertaken across a representative proportion of the southern half of the Site to establish the extent of any surviving archaeological remains that might be damaged during construction of the Proposed Development. It is recommended that this is secured as a condition of planning. This would enable identification and preservation by record of any unrecorded archaeological remains. The presence of ash within BH7

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indicates the potential for ground contamination within the south of the Site and therefore any such work should be undertaken in accordance with prevailing legislative requirements [52] and guidance.[53]

13.7.2 Following the completion of the aforementioned evaluation, residual effects upon the potential assets within the Site would be offset.

13.7.3 This assessment has identified negligible through to minor–moderate effects on the settings of designated and non-designated heritage assets within the Study Area, resulting either from the Proposed Development on its own or from cumulative effects.

13.7.4 Within the current baseline many of the assets would have obstructed views of the Proposed Development due to vegetation, intervening buildings and topography, or, where there are views towards the Site, the visual horizon already contained a variety of prominent structures in the form of the Power Station, which the Proposed Development will blend into, or be obscured by. Within the future baseline those designated assets that would have a clearer view of the Proposed Development, due to the removal of existing Power Station structures, would not have the elements of their setting which contribute to their value being compromised.

13.7.5 Overall, non-significant effects resulting in less than substantial harm is expected to designated heritage assets as such no mitigation is deemed necessary. Residual effects upon the setting of designated heritage assets will therefore remain unchanged from those set out under operational phase effects as noted above.

[52] *HSE 1991 Protection of Workers and the General Public During the Development of Contaminated Land. HMSO, London.*
[53] *CIRIA 1996 A Guide for Safe Working on Contaminated Sites. Report 132, CIRIA, London.*

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CHAPTER 14.0 CUMULATIVE EFFECTS

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14.0 CUMULATIVE EFFECTS

14.1 Introduction

14.1.1 This Chapter provides an assessment of the likely significant cumulative effects of the Proposed Development during its construction and operation. It has been prepared by a Chartered Member of the Royal Town Planning Institute with over twelve years' post qualification experience.

14.2 Methodology and Scope of Assessment

Legislation and Guidance

14.2.1 The Town and Country (Environmental Impact Assessment) Regulations 2017 [1] (hereafter referred to as the 'EIA Regulations') require that a description of the likely significant effects of the development on the environment should be included in the Environmental Statement (ES), including cumulative effects. The EIA Regulations do not define cumulative effects. However, a commonly accepted definition is: *"Impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions together with the project."* [2]

14.2.2 National planning policy and policies contained within the statutory Development Plan are set out in the Planning Statement (submitted as a separate standalone document) and have not been repeated here.

Assessment Methodology

14.2.3 There is no defined methodology in the UK as to how cumulative effects should be assessed. In determining the approach to this assessment, reference has been made to the following guidance:

- Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions;[2]
- Cumulative Effects Assessment Practitioners Guide;[3]
- Guidelines for Environmental Impact Assessment;[4]

[1] *http://www.legislation.gov.uk/uksi/2017/571/contents/made*
[2] *European Commission, 1999*
[3] *Canadian Environmental Assessment Agency 1999*
[4] *Institute of Environmental Management and Assessment 2006*

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- The State of Environmental Impact Assessment Practice in the UK;[5] and
- Advice note seventeen: Cumulative effects assessment relevant to nationally significant infrastructure projects.[6]

14.2.4 Paragraph 5(e) of Schedule 4 of the EIA Regulations require a: *"description of the likely significant effects of the development on the environment resulting from … the culmination of effects with other existing and/or approved projects."* In this regard the Regulations are specific about the projects that should be considered to result in cumulative effects (i.e. existing and / or approved projects). However, projects that are currently awaiting determination have also been included within the cumulative assessment as there is a possibility that these projects could be approved whilst the application for the Proposed Development is being determined. Accordingly, the assessment of cumulative impacts encompasses the effects of the Proposed Development in combination with:

- Existing development, either built or under construction;
- Approved development, awaiting implementation; and
- Schemes awaiting determination within the planning process.

14.2.5 The presence of operational schemes (and for some disciplines, schemes that are under construction, but not yet operational) is an established influence upon the environment, which has been taken into account when determining the baseline for the non-cumulative assessment in each Chapter. The non-cumulative assessment of effects has full regard to the presence of such schemes when arriving at any conclusions.

14.2.6 As such, schemes that form part of the assessment of cumulative effects are limited to major projects that have either been granted planning consent but have not yet been constructed and major projects for which a planning application is awaiting determination. Major projects are developments with a floorspace of 10,000 m^2 in size (or greater) and projects that have been subject to EIA.

[5] *Institute of Environmental Management and Assessment 2011*
[6] *The Planning Inspectorate 2015*

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The Study Area

14.2.7 Each topic has a different spatial zone where potential cumulative effects could occur. As illustrated on Figure 2.2, a preliminary search area of 3 km from the Application Site has been used to identify schemes that have the potential to result in cumulative effects. The search was undertaken via the interactive search facilities on Nottinghamshire and Leicestershire County Council websites; Rushcliffe, Broxtowe, Erewash Borough and North West Leicestershire District Council websites; and focussed on those planning applications that had been determined since January 2017. Additionally, a search was undertaken on the Planning Inspectorate website to identify any Nationally Significant Infrastructure Projects (NSIPs).

Consultation

14.2.8 The assessment methodology was set out in full within the EIA Scoping Report submitted to Nottinghamshire County Council (NCC) in February 2020 (**Appendix 2-1**). Table 4.2 of the Scoping Report identified several schemes with the potential to result in combination effects. However, following a review, the Scoping Report concluded that a single cumulative assessment scheme (relating to High Speed 2 Phase 2b (hereafter referred to as HS2b)) should be covered within the ES.

14.2.9 The EIA Scoping Opinion (**Appendix 2-2**) issued by NCC in April 2020 confirmed that: *"The aim of the assessment process to determine the significant of environmental impact, need for mitigation, any residual effect and consideration of any cumulative effects is considered appropriate."* Therefore, both the approach and consideration of HS2b was confirmed as being acceptable.

14.2.10 It should also be noted that during the preparation of the Transport Assessment (TA) NCC as Highway Authority and Highways England (HE) were consulted to identify any committed developments that should be specifically included in the TA. As such, the TA and the Chapters that rely on the assessment (i.e. air quality and noise) by their nature include cumulative effects of other projects that would be likely to give rise to significant transport effects. This process identified that NCC would wish to see an allowance made for the traffic that will be generated by the as-yet unoccupied employment units at the SEGRO East Midlands Gateway development located near

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East Midlands Airport, as well as the approved scheme (outline planning permission) referred to as the Hardstaffs development off Gotham Road.

14.2.11 The Application Site does not overlap with land currently subject to HS2 Safeguarding Directions.[7] Uniper and HS2 have had, and commit to continue, constructive dialogue with respect to the proposed EMERGE Centre and interfaces associated with the evolving design for the HS2 railway in this location ensuring the respective programmes are co-ordinated. Neither party foresees the EMERGE Centre proposal preventing HS2's requirements in this area being met, including access during construction, commissioning and operation of the HS2 railway.

Limitations

14.2.12 The HS2 network is proposed to be built in several phases. Phase 2b is proposed to be delivered in two sections: the 'eastern leg' between the West Midlands and Leeds and the 'western leg' between Crewe and Manchester. The Parliamentary website [8] lists all Bills currently before Parliament (2019–2021). At the time of preparing this Chapter, a Bill relating to this phase of the network had not been published.

14.2.13 In February 2020, the Prime Minister made a statement on HS2 [9] in the House of Commons. This confirmed that:

- *"I will create new delivery arrangements for both the grossly behind-schedule Euston terminus and phase 2b of the wider project."*
- *"Before those designs are finalised and legislation is introduced, we will also present an integrated plan for rail in the north. Informed by an assessment from the National Infrastructure Commission it will, in line with the findings of the Oakervee review, look at how we can best design and integrate rail investments throughout the north, including Northern Powerhouse Rail between Leeds and Manchester..."*

14.2.14 It is anticipated that revisions to the delivery arrangements for HS2b and the preparation of an integrated plan for rail in the north will take time to prepare. Furthermore, it has also be noted that the HS2 Limited Environmental Team's

[7] https://www.gov.uk/government/collections/safeguarding-information-and-maps-for-hs2#phase-2b-maps-(crewe-to-manchester-and-west-midlands-to-leeds)
[8] https://services.parliament.uk/Bills/2019-21.html
[9] https://hansard.parliament.uk/commons/2020-02-11/debates/9160CC0E-C4BB-4D51-8CD9-93EB9D76F644/TransportInfrastructure

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response to the formal EIA Scoping Report identified that: *"HS2 is still subject to significant design refinement in this area."* [10] At the time of preparing this Chapter it is not clear when design refinements or revisions to the delivery arrangements for HS2b would be made publicly available, noting that both are likely to be delayed as a result of the Covid-19 pandemic. As such, consenting timescales are currently unknown.

14.2.15 On the basis of the above, this Chapter is reliant on using the best / latest available information for the HS2b scheme to ensure any potential cumulative effects are identified within this ES. As set out in the baseline subsection (below), this includes the Working Draft Environmental Statement (WDES) (October 2018) which for certain topics reserves judgement on the effects of HS2b to a formal Environmental Statement which, to date, has not been published. Furthermore, the information contained in the WDES may potentially be superseded by the design refinements which HS2 are currently undertaking.

14.3 Baseline

Data Collection

14.3.1 The data collection process involved reviewing the available information on HS2b.[11] This included the 'HS2b WDES' which was published in October 2018 [12] and includes:

- A Non-Technical summary;
- Volume 1: Introduction and Methodology;
- Volume 2: Community Area Reports and Maps;
- Volume 3: Route-wide Effects; and
- Volume 4: Off-route Effects.

14.3.2 At the same time, a 'draft Code of Construction Practice for HS2b WDES' [13] was published. Public consultation on the documentation took place in late 2018 with a consultation summary document published in June 2019.

[10] *HS2 Consultation Response can be found in Appendix 2-1 of this ES.*
[11] https://www.gov.uk/transport/hs2-phase-2b
[12] https://www.gov.uk/government/collections/hs2-phase-2b-working-draft-environmental-statement
[13] https://www.gov.uk/government/publications/draft-code-of-construction-practice-for-hs2-phase-2b-working-draft-environmental-statement

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14.3.3 Due to the nature of the scheme (i.e. a linear railway), Volume 2 of the WDES includes 28 separate reports (known as Community Area Reports) which are supported by standalone Map Books. Each Community Area Report sets out the design and environmental assessment for the scheme, at a community area level. Of relevance to the Proposed Development is 'Community Area Report LA05: Ratcliffe-on-Soar to Long Eaton' (October 2018) as this is it the section of railway which passes the Power Station site.

14.3.4 Of note, within the Community Area Report LA05 is:

- Figure 4 which illustrates the location of construction compounds across the community area, of note is the Redhill main compound which is proposed to be located at the Power Station. The supporting 'map book' illustrates that the temporary compound is proposed to be located immediately to the north of the Flue Gas Desulphurisation Plant within the Power Station site;
- Figure 5 which identifies that the Redhill main compound is anticipated to function for a period of two and a half years. Access would be from the A453, there would be up 235 workers at peak times, but no worker accommodation; and
- Figure 7 which provides an indicative construction programme. This illustrates that construction works near to the Power Station (including the Redhill main compound) are scheduled to begin in Quarter 3 and 4 of 2025.

14.3.5 As the indicative construction programme illustrates that the scheme (within the vicinity of the Power Station site) begins 9 months after the EMERGE Centre is anticipated to be operational, there would be no potential for in-combination construction phase effects between the Proposed Development and HS2b. Furthermore, it should also be noted that the above timescale does not take account of any potential programme slippage which may have occurred since the WDES was prepared.

14.3.6 The Community Area Report LA05 considers the scheme in relation to the following topics:

1. Agricultural, Forestry and Soils;
2. Air Quality;
3. Community;
4. Ecology and Biodiversity;

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5. Health;
6. Historic Environment;
7. Land Quality;
8. Landscape and Visual;
9. Socio-Economics;
10. Sound, Noise and Vibration;
11. Traffic and Transportation; and
12. Water Resources and Flood Risk.

14.3.7 The summary of likely residual significant effects provided at the end of each chapter in the Community Area Report, confirms that either: *"no residual significant effects have been identified at this stage as a result of the scheme"* topics (Numbers: 1, 6, 7 and 12 above) or: *"a summary of the likely residual significant effects will be reported in the formal ES."* (Numbers: 2, 3, 5, 9, 10 and 11 above). However, in terms of:

- (4) Ecology: it anticipates a significant residual ecological effect on bats and barn owls during the operation of the scheme (due to collision with trains); and
- (8) Landscape and visual: although effects would reduce over time, it concludes that residual significant effects would remain after 15 years of operation on Landscape Character Areas and viewpoints (both residential, employment and recreational). Impacts are due to the Ratcliffe-on-Soar viaduct (height of circa 14 m above ground) which extends from next to the Power Station to Junction 24a of the M1 (Kegworth Embankment); and the Long Eaton and Toton viaduct (height of circa 20 m above ground) which extends from north of Redhill Green Tunnel into Long Eaton.

Baseline Environment

14.3.8 As identified previously, the indicative HS2 construction programme illustrates that construction works near to the Power Station (including the Redhill main compound) are scheduled to begin in Quarter 3 and 4 of 2025. On this basis (regardless of whether the programme may have slipped, for the reasons previously stated under the limitations subheading) it is considered reasonable to only assess the effects of the Proposed Development and potential cumulative effects against 'Future Baseline' scenario which for the avoidance of doubt is set out below.

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14.3.9 The future baseline scenario involves the operational Proposed Development, but assumes that the Power Station and related components have been removed. However, as shown on Figure 2.1, a range of infrastructure would remain on the Site post closure. For ease of reference this includes the Uniper Engineering Services offices; the National Grid Substations and power lines, the Gas Turbine generating facility; the railway sidings; the storage buildings and their conveyor links to the sidings; and other lesser elements of infrastructure such as internal roads linking the preceding elements.

14.4 Cumulative Effects Assessment

14.4.1 Each technical assessment Chapter considers the cumulative effects of the Proposed Development with the HS2b scheme in detail. The WDES identifies that no residual significant effects have been identified in relation to agricultural, forestry and soils, the historic environment, land quality, water resources and flood risk. This ES anticipates no significant cumulative effects in relation to ground conditions; surface waters and flood risk; socio-economics; and, archaeology and cultural heritage. As such, it is considered that the most likely potential for significant cumulative effects relate to landscape and visual effects; ecology and nature conservation; noise, air quality and human health; and. transport. The outcome of these assessments has been set out below.

Landscape and Visual

14.4.2 The removal of the Power Station structures would lead to appreciable beneficial change in landscape character and upon views, which would occur irrespective of the presence / absence of the Proposed Development. The introduction of HS2 (including construction) would occur in this context.

14.4.3 The route of HS2 would pass close to Viewpoints 2 (Footpath near Redhill Lock) and 3 (Midshires Way, Ratcliffe Lane) and would intrude upon views toward the Proposed Development from these locations, and from the surrounding rights of way network. As the new railway would pass over the Soar valley on a viaduct up to 14 m high, it is likely that the majority of views towards the Proposed Development from the area west of the river would be at least partially screened.

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14.4.4 The construction of HS2 would result in short-term change in character, and its presence once operational would change character on a permanent basis. The combined presence of the Proposed Development and HS2, together with the removal of the existing Power Station structures, would reflect a transition from older forms of infrastructure to contemporary infrastructure. Cumulatively, this would reinforce the trends in the landscape identified within the assessment of effects subsection of Chapter 5.0 of this ES.

14.4.5 It is emphasised that it is not the effects of HS2 that are being assessed, but rather the landscape and visual effects of the Proposed Development in a cumulative baseline where HS2 is also present. In such a scenario, the effects of the Proposed Development would be similar to but incrementally less than those identified in within the assessment of effects subsection of Chapter 5.0, due to the influence of HS2 upon areas west of the Site. Cumulative landscape and visual effects would not be significant.

Ecology and Nature Conservation

14.4.6 In terms of potential in-combination ecological effects with the HS2b scheme, the main potential for cumulative effects is as an additional pressure on sites which have been identified as being impacted by the proposal. From north to south, these include the Soar Meadow by Ratcliffe Lock Local Wildlife Site (LWS); the Thrumpton Park LWS (both direct effect – on HS2 route); and the Meadow Lane Carr LWS (potential effect – HS2 route in close proximity).

14.4.7 None of these sites are predicted to be subject to significant ecological effects as a consequence of the Proposed Development alone.

14.4.8 Soar Meadow by Ratcliffe Lock LWS is not predicted to experience any impacts in excess of Institute of Air Quality Management screening thresholds with respect to atmospheric pollutants, taking into account the sensitivities of the lowland meadow habitat at that site. Impacts of the Proposed Development can therefore be regarded as de minimis, and there is no mechanism whereby effects could operate in combination with HS2.

14.4.9 The western section of Thrumpton Park LWS would be affected by the construction of a tunnel by cut and cover methods. This would lead to the loss of habitat within

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this construction corridor, but with the potential for partial recovery of vegetation over the tunnel. The key area considered for proximal effects of noise of the Proposed Development is to the east of the proposed HS2 construction corridor, while air quality effects are also of higher magnitude to the north-east of the Proposed Development, and east of the HS2 route.

Noise

14.4.10 The cumulative impact of the Proposed Development and HS2b concludes that cumulative noise levels increase the range 0.0 dB to +0.2 dB during daytime and in the range of +0.1 dB to +1.4 dB during night-time across the six noise sensitive receptors. In line with the impact magnitude scale contained within Table 7.5 of Chapter 7.0, the impact is considered to be negligible. Based on an assumed high sensitivity of the receptors, these magnitudes are assessed as being neutral during the daytime and night-time periods.

14.4.11 Overall, the cumulative impact associated with the Proposed Development being operational alongside HS2b is considered to not be significant in EIA terms.

Air Quality and Human Health

14.4.12 The HS2b scheme would not release process emissions or odour at a level significant enough to require cumulative assessment. As the impacts of construction dust from the Proposed Development have been screened out from the requirement for detailed assessment, no cumulative assessment is required. Overall, the cumulative impact associated with the Proposed Development being operational alongside HS2b is considered to not be significant in EIA terms.

Transport

14.4.13 In accordance with the TA Scoping Report and pre-application scoping comments received from NCC and HE, traffic from the approved but as-yet unoccupied employment units at the SEGRO East Midlands Gateway Logistics Park; the Hardstaffs site; and, the Redhill and River Soar main construction compounds have been accounted for within the Transport Assessment.

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14.4.14 The detailed junction capacity assessments show that the impacts of the Proposed Development (plus the committed developments) for the future year of 2025 and 2030 on congestion levels is insignificant. All junctions with the agreed Study Area operate with ample spare capacity in all traffic flow scenarios. The development-related traffic impact within the wider area has been assessed on a percentage basis, and concludes that the predicted change in vehicle movements associated with the Proposed Development would be negligible. As such, no further assessment of the traffic impacts of the scheme is deemed necessary. The TA concludes that the Proposed Development (including committed development) would not result in 'severe' traffic impacts on the highway network.

Mitigation Measures

14.4.15 Given that the assessment has identified that there are no likely significant cumulative effects arising from the Proposed Development in combination with the HS2b scheme, no mitigation measures are considered necessary.

14.5 Residual Effects and Conclusion

14.5.1 A detailed review of planning applications, both determined and undetermined, within 3 km of the Site has been carried out using the online planning search function on the relevant planning authority websites. Additionally, a search was undertaken on the Planning Inspectorate website to identify and upon any Nationally Significant Infrastructure Projects (NSIPs). Through the EIA Scoping process, it was confirmed that both the approach and consideration of the HS2b scheme with the Proposed Development was deemed to be acceptable.

14.5.2 An assessment of potential cumulative effects during the operational phase of the Proposed Development has been undertaken. This is on the basis that the construction of the HS2b scheme is not anticipated to commence until Quarter 3 and 4 of 2025 (i.e. circa 9 months after the Proposed Development becomes operational).

14.5.3 The nature of likely significant environmental effects that may arise from the HS2b scheme has been considered in light of the predicted environmental effects of the Proposed Development. The assessment demonstrates that there would be no significant residual cumulative effect arising from the Proposed Development in combination with the HS2b scheme.

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14.5.4 In light of the above, it can be concluded that no unacceptable cumulative environmental effects would arise from the construction and operation of the Proposed Development.

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CHAPTER 15.0 SUMMARY OF EFFECTS

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15.0 SUMMARY OF EFFECTS

15.1 Introduction

15.1.1 This Environmental Statement (ES) has been prepared on behalf of Uniper UK Limited (hereafter referred to as 'Uniper' or the 'Applicant') in support of a detailed planning application for the East Midlands Energy Re-Generation (EMERGE) Centre on land at Ratcliffe-on-Soar Power Station (the 'Application Site' or 'Site').

15.1.2 The EMERGE Centre (also referred to as the Proposed Development) would be a conventional twin line combustion plant, based on grate technology. It is proposed to operate as a merchant facility (at the point of development) and is capable of processing circa 472,100 tonnes per annum (tpa) of non-hazardous residual waste from: municipal (including household); commercial and industrial; and the combustible fraction of construction and demolition waste. It is also intended to be capable of accepting certain waste biomass fuel sources.

15.1.3 The Proposed Development would generate electricity by way of a steam turbine which would be driven through the controlled combustion of residual waste. The gross power generating capacity of the EMERGE Centre would be 49.9 megawatt (MW). After subtracting the power used to run the facility itself, it would have the ability to export approximately 43.4 MW of electricity to the local electricity grid, a significant proportion of which would be classed as renewable. This is sufficient to meet the average annual domestic electricity needs of about 90,000 homes. Whilst the facility would have a grid connection, it could also supply power to individual customers via a private wire system. Finally, the Proposed Development would, in the event that viable opportunities for the supply of heat do not exist from the outset, also be Combine Heat and Power ready and capable of providing heat in the form of steam (or possibly hot water) for use by local heat users. The short to medium term objective is that the Proposed Development could serve a site heat network, and potentially also (via heat exchangers) a cooling network.

15.1.4 The scope of the ES was agreed through a formal Environment Impact Assessment (EIA) Scoping process with Nottinghamshire County Council (NCC) and a number of organisations that are consultees to the planning process. The likely significant environmental effects of the Proposed Development are described fully within the ES Main Report (Volume 1) which is supported by Illustrative Figures (Volume 2)

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and Technical Appendices (Volume 3); the latter provides supporting data for the assessments.

15.1.5 The likely significant effects of the Proposed Development, as assessed and reported in ES Chapters 5.0 to 14.0 of the Main Report (Volume 1), are summarised below.

15.2 Landscape and Visual Effects

15.2.1 Chapter 5.0, together with the supporting figures and appendices, sets out an assessment of the likely significant landscape and visual effects of the Proposed Development.

15.2.2 The proposed scope of the Landscape and Visual Impact Assessment (LVIA), including viewpoints and approach to the production of visualisation material, was agreed with Officers at NCC prior to the assessment being undertaken.

15.2.3 The Proposed Development would be introduced into the existing Ratcliffe-on-Soar Power Station (the Power Station), which includes a series of very large and very prominent structures, and which exerts a strong influence upon the surrounding area. The Proposed Development would be located in an area of existing hardstanding close to the north-eastern edge of the Power Station, with wooded ridges enclosing the Power Station to the north and east.

15.2.4 Construction activities would be temporary and localised and would take place in the context of existing activity at the Site. Much of the construction plant and equipment (and thus many of the construction activities) would be relatively low in height, and would be not be visually conspicuous over a wide area. An exception would be cranes, but these would be present in the context of the existing tall structures at the Power Station. Construction would be a temporary and intermittent activity, having only a limited influence upon the character of the surrounding landscape and upon views, which would not be significant.

15.2.5 Initially, the Proposed Development would have little or no appreciable influence upon its surroundings, due to the landform to the north and east and the existing structures to the south and west. These features would largely screen the Proposed

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Development from view, and would also limit any influence upon the character of the surrounding landscape to negligible levels.

15.2.6 Approximately nine months after the Proposed Development becomes operational, the existing Power Station is scheduled to close, and many of the existing structures would be subsequently removed. This closure would occur regardless of the presence of the Proposed Development and would lead to a clear change in landscape character and similar change in views from the surrounding area, with the influence of the Power Station reducing notably. The Proposed Development would be one of the largest structures remaining, and its presence would maintain the long-established influence of electricity generating infrastructure upon the surrounding area, and hence would have an adverse effect. This should, however, be considered in the context of the removal of many very prominent existing structures, the benefits of which would far outweigh any limited adverse effects resulting from the continued presence of the Proposed Development. The medium- and long-term landscape and visual effects of the Proposed Development would not be significant.

15.3 Ecology and Nature Conservation

15.3.1 Chapter 6.0, together with the supporting appendices, sets out an assessment of the likely significant effects of the Proposed Development upon ecology and nature conservation.

15.3.2 The assessment has been supported by a habitat survey and biological records data search of sufficient scope to assess all likely significant effects on habitats and species. Dispersion and deposition modelling undertaken as part of the Air Quality Assessment allowed consideration of effects on sensitive ecological receptors in a wider context, including nationally and locally designated sites.

15.3.3 The habitat survey confirmed that the Site is almost entirely unvegetated and includes hard standing. The electrified security fence forms an effective barrier to ingress of terrestrial fauna, and none of the habitats within the Site were assessed as having any potential to support protected species.

15.3.4 No effects on legally protected species are predicted as a consequence of the Proposed Development, and it would not be necessary to obtain a protected species disturbance licence in order to undertake works on the Site. Although current

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potential has been assessed as low, there is a risk that habitats within the Site could be utilised by breeding birds. A nesting bird survey is therefore recommended prior to the commencement of development, with timing of site clearance works scheduled to commence outside the bird breeding season.

15.3.5 With the implementation of the proposed soft landscaping, the residual effect of the Proposed Development would result in a biodiversity net gain, which significantly exceeds the anticipated future requirements under the Environment Bill (i.e. a 10 % net biodiversity gain).

15.3.6 Off-site effects of noise and air quality on sensitive ecological receptors have been assessed for the Proposed Development. Predicted noise levels during construction and operational phases are below thresholds likely to have any effect on birds. The Air Quality Assessment predicted a number of exceedances of screening thresholds with respect to ammonia levels, nitrogen and acid deposition. Taking into account the sensitivity of the receiving environment, and interpreting predictions, it can be safely concluded that none of the modelled impacts are significant in EIA terms. In conclusion, the Proposed Development would not result in any significant environmental effects in EIA terms.

15.4 Noise

15.4.1 Chapter 7.0, together with the supporting figure and appendices, sets out an assessment of the likely significant effects of the Proposed Development upon noise. The assessment has been undertaken in accordance with the methodology and the noise sensitive receptors were agreed through the EIA Scoping process.

15.4.2 Noise levels have been considered and assessed during the construction and operational phases of the Proposed Development. Relevant and appropriate noise guidance and standards have been used to determine the impact. The assessment has been undertaken to inform and guide the initial design of the Proposed Development, such that any likely noise impact on existing and potential noise sensitive receptors is minimised.

15.4.3 To establish a robust basis for the assessment, baseline sound levels have been monitored near the noise sensitive receptors for the Proposed Development using a combination of fixed continuous and attended measurements. The continuous

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monitoring extended over several days to allow representative background sound levels to be established.

15.4.4 In accordance with appropriate standards, best practical means would be employed to control noise generation during the construction period. Measures would include restricting hours when noisy activities can occur and suitable selection of piling rigs to minimise noise. Appropriate construction plant and techniques would be defined within the site-specific Construction Environmental Management Plan (CEMP).

15.4.5 For the operational phase, initial noise control measures for the plant and building have formed the basis of the noise predictions and subsequent assessment of impact and significance. Future detailed design of the plant would be undertaken on the basis of optimally achieving rating levels for operation of the Proposed Development which are less than or equal to current or estimated future daytime and night-time background levels.

15.4.6 The assessment shows that there would be no significant noise impacts during the construction and operation of the Proposed Development by implementing the proposed mitigation.

15.5 Air Quality and Human Health

15.5.1 Chapter 8.0, together with the supporting figures and appendices, sets out an assessment of the likely significant effects of the Proposed Development upon air quality, odour, plume visibility and human health.

15.5.2 An assessment of the potential for dust to give rise to adverse effects during the construction periods demonstrated the risk to be negligible in relation to exposure at residential and ecological locations. Industry best practice for dust control would be implemented as part of the CEMP.

15.5.3 The main air quality effect would be as a result of emissions from the stacks associated with the Proposed Development. Vehicle emissions during the construction and operational phases have also been considered. Detailed dispersion modelling of vehicle and process emissions has been undertaken using a number of conservative assumptions.

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15.5.4 In order to define the magnitude of change, details of the future baseline are also needed. Cumulative modelling of the Proposed Development, the existing Open Cycle Gas Turbines and the existing Power Station has been carried out.

15.5.5 The assessment has shown that process emissions from the Proposed Development are predicted to have a negligible effect on human health. The assessment has also concluded that the impact of the Proposed Development in combination with the Open Cycle Gas Turbines and the Power Station would not be significant.

15.5.6 The assessment has also shown that vehicle and process emissions from the Proposed Development are predicted not to be at levels that could lead to significant adverse effects on the ecological features at off-site ecological designations (i.e. Sites of Special Scientific Interest, Local Nature Reserves or Local Wildlife Sites).

15.5.7 The Proposed Development also has the potential to cause impacts associated with the release of dust and odour. A qualitative analysis has been undertaken, which takes into account the control measure in place, existing sources of odour and the distance to the nearest receptors. This has concluded that the impact of the operation of the Proposed Development would not be significant.

15.5.8 In conclusion, the Proposed Development is not predicted to have a significant environmental effect in relation to air quality, odour and human health.

15.6 Ground Conditions

15.6.1 Chapter 9.0, together with the supporting appendix, sets out an assessment of the likely significant effects of the Proposed Development that could occur upon ground conditions, incorporating aspects of geology, hydrogeology, contamination and geotechnical stability at the Site.

15.6.2 A preliminary assessment of existing ground conditions and contamination risk at the Site has been undertaken, involving desk-based research and a site walkover. No project-specific intrusive field surveys were undertaken prior to the production of this ES. However, the understanding of the Site was supported by the findings of a site investigation carried out in 2008, covering approximately the same area.

NCC received 29.06.2020

15.6.3 The main pollutant linkages are associated with low levels of heavy metal contamination and potential asbestos in the significant thickness of Made Ground present onsite, as identified during previous ground investigation. Prior to construction, the Site would be subject to intrusive investigation which would provide site-specific, contemporary, environmental information pertaining to the presence of contaminants at the Site. This would enable a detailed remediation strategy to be developed, it would also provide data for robust foundation design requirements based on ground conditions encountered and the structural loads imparted by the building.

15.6.4 The preliminary assessment has established that the Made Ground present on-site represents a potential source of hazardous ground gasses. As such, the required level of gas protection measures determined from the Site investigation data would be incorporated into the design of the building to fully mitigate the effect.

15.6.5 Appropriate measures to protect construction workers from exposure to any hazardous substances would be taken, where required. All construction related mitigation measures would be incorporated into the CEMP.

15.6.6 Once operational, the Proposed Development would operate under an Environmental Permit and Environmental Management Systems which would ensure that chemicals and fuels are stored and utilised in a manner that would not present a risk to soils or groundwater.

15.6.7 Following the implementation of the recommended mitigation measures, the residual effect of the Proposed Development is assessed to be negligible on the basis that ground contamination sources or effective pathways to receptors would have been sufficiently modified or removed entirely. As such, the Proposed Development would not result in any significant environmental effects in relation to ground conditions.

15.7 Surface Water and Flood Risk

15.7.1 Chapter 10.0, together with the supporting appendix, considers the impact of the Proposed Development in terms of flood risk, foul and surface water management and water quality during the construction and operational phases.

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15.7.2 The Site is not at risk of flooding from a major source (e.g. fluvial and / or tidal). The Site has a ‘low probability’ of fluvial / tidal flooding as it is located within Flood Zone 1 with less than a 1 in 1,000 annual probability of river or sea flooding in any year (< 0.1 %). A secondary flooding source (surface water flooding) has been identified which may pose a low risk to the Site.

15.7.3 The Application Site has never previously been ‘developed’, but has been utilised as a laydown area and car park for contractors working on the wider Power Station site. As such, it is surfaced with a mixture of tarmac and compacted stone hardstanding which benefits from drainage infrastructure that connects into the wider Power Station site drainage system. The Power Station system includes existing pipework, pollution control infrastructure and settling lagoons which ultimately discharge into the River Trent. It efficiently and effectively manages surface water run-off generated at the Site and it is understood that the existing drainage infrastructure would remain following the closure of the Power Station. As such, there is no history of flooding at the Site.

15.7.4 On the basis that standard working practices are adopted throughout the construction phase, the Proposed Development would adequately manage flood risk, water quality, foul and surface water drainage. These working practices would be detailed in the CEMP. The assessment concludes that the mitigation measures would prevent significant adverse effects from arising.

15.7.5 The Proposed Development would be operated under an Environmental Permit that would ensure adequate protection is provided to surface water resources from potentially polluting substances stored and processed at the Proposed Development.

15.7.6 A Sustainable Drainage System is proposed to be developed on the Site. The system includes underground attenuation (cellular storage and oversized pipes), rainwater harvesting, a swale (with reedbed within the proposed soft landscaping area), pollution control measures (interceptors and grit trap) and restricted outfall. The surface water run-off from the Site would be restricted for all events up to and including the 1 in 100 year (+40 % allowance for climate change) event before discharge to the wider system that supports the Power Station site. Due to limiting the rate of discharge from the Site, at times of heavy rainfall the volume of water leaving the Site would be significantly less than that currently draining from it.

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15.7.7 The proposed Sustainable Drainage System has been designed to ensure that the Proposed Development would not give rise to an increased risk of flooding or pollution either on the Site or within the wider hydrological catchment. Ultimately the proposed drainage design is proposed to be subject of a condition and may be revisited if it can be demonstrated that the attenuation storage can be met within the wider Power Station site system.

15.7.8 It is anticipated that the existing foul drainage system that supports the wider Power Station site would be destroyed following the closure of the Power Station. As such foul effluent arising from the Proposed Development would be collected in a septic tank located within the Application Site. It would then be tankered across the wider Power Station site to the sewage farm (located to the south of the existing cooling towers) where it would be treated before being pumped by existing pipework to the existing lagoons which form part of the drainage system (described previously) and ultimately the River Trent. A new water supply would be taken from the existing private water supply with supports the Power Station. As such, no additional mitigation measures are deemed necessary beyond the works described above.

15.7.9 A preliminary Water Framework Directive (WFD) assessment has been undertaken that concludes the Proposed Development would not result in the deterioration of any WFD quality element or prevention of the improvement predicted for this waterbody.

15.7.10 The assessment concludes that the Proposed Development would not result in any significant residual adverse impacts on surface water, ground water or flood risk.

15.8 Transport

15.8.1 Chapter 11.0 has been prepared to consider the highways and transport related environmental impact of the construction and operation of the Proposed Development. Further details are provided in the supporting formal Transport Assessment, which forms a standalone document in support of the planning application. The Transport Assessment sets out the detailed appraisal of highway network operational impact in terms of percentage link flow change and local network operational performance (junction capacity).

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15.8.2 Changes in traffic flows that would result from the Proposed Development during the construction and operational phases have been assessed. The scope, study area and relevant cumulative / committed developments that are likely to affect the future baseline traffic conditions was agreed through a scoping process with highways officers at Nottinghamshire County Council and Highways England.

15.8.3 Traffic impacts associated with the construction phase would be temporary in nature and would likely vary over the course of the construction period dependent upon the nature of activities taking place. Traffic related environmental effects associated with construction would be no more than negligible in nature. Nonetheless, a Construction Traffic Management Plan could also be prepared to ensure that suitable mitigation measures are adopted to manage any adverse effects of construction. This would include ensuring vehicle deliveries during the construction phase would, where at all practical, be managed to avoid impact on traditional rush hour periods. In addition, further on-site vehicle management practices would be employed to address typical construction traffic impacts such as dirt, dust and noise.

15.8.4 The assessment has found that, during the construction and operational phases (both at 2025 and 2030) of the Proposed Development, the changes in overall daily vehicle demands are well below the Institute of Environmental Management & Assessment Rule 1 30 % threshold on all links apart from Link 6, which relates to the Eastern Site Access Road, north of Barton Lane. According to the Institute of Environmental Management & Assessment guidelines, the effects on this link requires further detailed assessment.

15.8.5 The character of Link 6 has been considered in terms of driver delay and safety, i.e. those considered relevant to the proposal under the Institute of Environmental Management & Assessment guidelines. It was found that the link: does not contain sensitive receptors; it is unlikely to accommodate high levels of pedestrian movement; and, at times when junctions are experiencing the highest demands, they operate with significant spare capacity and without any excessive driver delay or highway safety issue.

15.8.6 It is concluded that the Proposed Development would not result in a significant impact on operational or environmental conditions over the local transport network and there is no requirement for off-site transport improvement / mitigation works. The impact of trips generated by the Proposed Development, during both the construction

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and operational phases, has been assessed against anticipated future road conditions and with reference to appropriate guidance. It is concluded that in all scenarios the effects are considered to be not significant in EIA terms.

15.8.7 Notwithstanding the above, the Proposed Development has been designed with features that would encourage the use of non-car modes of transport. These include the provision of secure cycle parking for bicycles; staff showers, changing and locker facilities; and staff food preparation areas to encourage staff to remain on-site during working hours. Sustainable transport could be further encouraged through the implementation of a Travel Plan, which can be secured though a suitably worded planning condition.

15.9 Socio-Economics

15.9.1 Chapter 12.0, together with the supporting figures, provides an assessment of the likely significant socio-economic effects of the Proposed Development.

15.9.2 The assessment identifies the socio-economic impacts associated with direct, indirect and induced effects, that would arise from the construction and operation of the Proposed Development.

15.9.3 The Proposed Development would have a moderate beneficial effect on construction employment within the Study Area. This would benefit contractor companies and other businesses in the supply chain. These benefits are likely to be significant effects for certain businesses, and for individuals employed in construction. Construction effects are inherently temporary, so the Proposed Development provides additional continued opportunity for employees in this sector, enabling the retention and possible upgrading of skilled workers, within construction sector businesses.

15.9.4 Once operational, the Proposed Development would directly create approximately 45 jobs at the Site. Through indirect or induced expenditure (e.g. services bought-in to the Site, or spending outside the Site by employees) a further 101–102 jobs are likely to be created or supported. This would add an estimated £3.7 million to the economy of the Study Area each year. The effects of the Proposed Development would clearly be beneficial in generating employment within the area, as well as providing a range of jobs with different skill sets. This would result in a major beneficial effect to the economy of the Study Area, which would be significant.

15.9.5 Finally, the East Midlands Development Corporation recognises that the wider Power Station site is pivotal in delivering its aspirations and it offers the prime opportunity to develop a new regional economy based around an integrated energy solution spanning power, heat and transport. The high-level Masterplan for the Power Station site is underpinned by the EMERGE 'Energy Hub', the first and most important component of which is the EMERGE Centre. Whilst the Proposed Development would clearly underpin the overall redevelopment of the wider Power Station site, on the basis that the future modern industrial and manufacturing uses are at this point in time unknown, this assessment is focused upon the Proposed Development only, which in its own right would result in a beneficial effect.

15.10 Archaeology and Cultural Heritage

15.10.1 Chapter 13.0, together with the supporting figures and appendices, sets out an assessment of the likely significant effects of the Proposed Development in relation to potential effects upon archaeological and cultural heritage assets at the Site and within the surrounding study area.

15.10.2 The assessment has identified a low potential for previously unrecorded finds and deposits of all periods to exist within the Site. Landscaping works in the north and central parts of the Site have likely removed or heavily truncated any archaeological remains or deposits in these areas and thus potential is limited to the south of the Site, where pockets of less disturbed material may survive buried beneath later levelling deposits. Chapter 9.0 of this ES advises that further geotechnical works be undertaken as a condition of planning consent to provide more information about ground conditions underlying the Site. It is advised that any intrusive geotechnical investigations in the south of the Site are subject to archaeological monitoring and that results are reviewed by a geoarchaeologist to allow for the deposit model for the Site to be updated accordingly. If the results of geotechnical works confirm that modern Made Ground deposits extend across the Site, then no further archaeological works would be advised. If geotechnical works indicate potential for undisturbed deposits, it is advised that an archaeological evaluation is undertaken across a representative proportion of the southern half of the Site to establish the extent of any surviving archaeological remains that might be damaged during

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construction of the Proposed Development. It is recommended that this is secured as a condition of planning. This would enable identification and preservation by record of any unrecorded archaeological remains. The presence of ash within one of the previous borehole logs indicates the potential for ground contamination within the south of the Site and therefore any such work should be undertaken in accordance with prevailing legislative requirements and guidance.

15.10.3 This assessment has identified negligible through to minor–moderate effects on the settings of designated and non-designated heritage assets within the study area, resulting either from the Proposed Development on its own or from cumulative effects. These effects would relate to the visual impact of the Proposed Development. The assessment has taken into account the sensitivity of these assets to changes in their setting and the magnitude of any effects which would be experienced. The assessment has concluded that there would be no significant effects on the heritage significance any of these assets.

15.11 Cumulative Effects

15.11.1 Chapter 14.0 provides an assessment of the potential cumulative effects during the construction and operation of the Proposed Development. The methodology, scope and approach to the cumulative assessment was agreed through the formal scoping process with Nottinghamshire County Council. This confirmed that the only project that had the potential to result in a significant environmental effect in combination with the Proposed Development was High Speed 2 Phase 2b (hereafter referred to as HS2b), on the basis the route travels past the wider Power Station site.

15.11.2 An assessment of potential cumulative effects during the operational phase of the Proposed Development has been undertaken. This is on the basis that the construction of the HS2b scheme is not anticipated to commence until Quarter 3 and 4 of 2025 (i.e. circa 9 months after the Proposed Development becomes operational).

15.11.3 The nature of likely significant environmental effects that may arise from the HS2b scheme has been considered in light of the predicted environmental effects of the Proposed Development. The assessment demonstrates that there would be no significant residual cumulative effect arising from the Proposed Development in combination with the HS2b scheme.

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15.11.4 In light of the above, it can be concluded that no unacceptable cumulative environmental effects would arise from the construction and operation of the Proposed Development.

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uniper

computer generated image for illustrative purposes

East Midlands Energy Re-Generation (EMERGE) Centre

Environmental Statement Volume 2 Figures

June 2020

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PROPOSED DEVELOPMENT OF THE EAST MIDLANDS ENERGY RE-GENERATION (EMERGE) CENTRE ON LAND AT THE RATCLIFFE-ON-SOAR POWER STATION, NOTTINGHAMSHIRE

ENVIRONMENTAL STATEMENT
VOLUME 2: ILLUSTRATIVE FIGURES

This Document has been prepared in support of the application of full planning permission in accordance with the provisions of the Town and Country Planning Act 1990 for the development of the proposed East Midlands Energy Re-Generation (EMERGE) Centre on land at the Ratcliffe-on-Soar Power Station, Nottinghamshire. The application and associated documentation have been produced and co-ordinated by AXIS with technical inputs from:

- AXIS – Traffic and Transportation and Landscape and Visual;
- Uniper Technologies – Noise, Air Quality and Human Health, Ground Conditions and Socio-Economics;
- Argus Ecology – Ecology and Nature Conservation;
- AOC Archaeology – Archaeology and Cultural Heritage; and
- KRS Environmental – Surface Waters and Flood Risk Assessment.

JUNE 2020

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FOREWORD

This Environmental Statement is submitted in support of a planning application made by Uniper UK Limited for the construction and operation of the proposed East Midlands Energy Re-Generation (EMERGE) Centre on land at the Ratcliffe-on-Soar Power Station, Nottinghamshire.

The ES has been prepared in accordance with the Town and County Planning (Environmental Impact Assessment) Regulations 2017 and comprises the following documents:

- The Environmental Statement (ES) Main Report (Volume 1), which contains the detailed project description; an evaluation of the current environment in the area of the EMERGE Centre; the likely significant environmental impacts of the scheme; and details of the proposed mitigation measures which would alleviate, compensate for, or remove adverse impacts identified in the study. Volume 1 also includes a summary of the overall likely significant environmental impacts of the EMERGE Centre;

- Illustrative Figures (Volume 2) which contains all relevant schematics, diagrams and illustrative figures;

- Technical Appendices (Volume 3), which includes details of the methodology and information used in the assessment, detailed technical schedules and, where appropriate, raw data; and

- A Non-Technical Summary (Volume 4), containing a brief description of the EMERGE Centre and a summary of the ES, expressed in non-technical language.

Hard copies of the ES, as a four Volume set, are available at a cost of £300 by writing to AXIS, Camellia House, Water Lane, Wilmslow, Cheshire, SK9 5BB. Alternatively, the Non-Technical Summary can be purchased on its own from the same point of contact for £15, with the entire ES available for purchase on a CD for £15. Finally, all of the planning application documentation, including the ES, can be downloaded free of charge from the planning portal on Nottinghamshire County Council’s website.

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FIGURES

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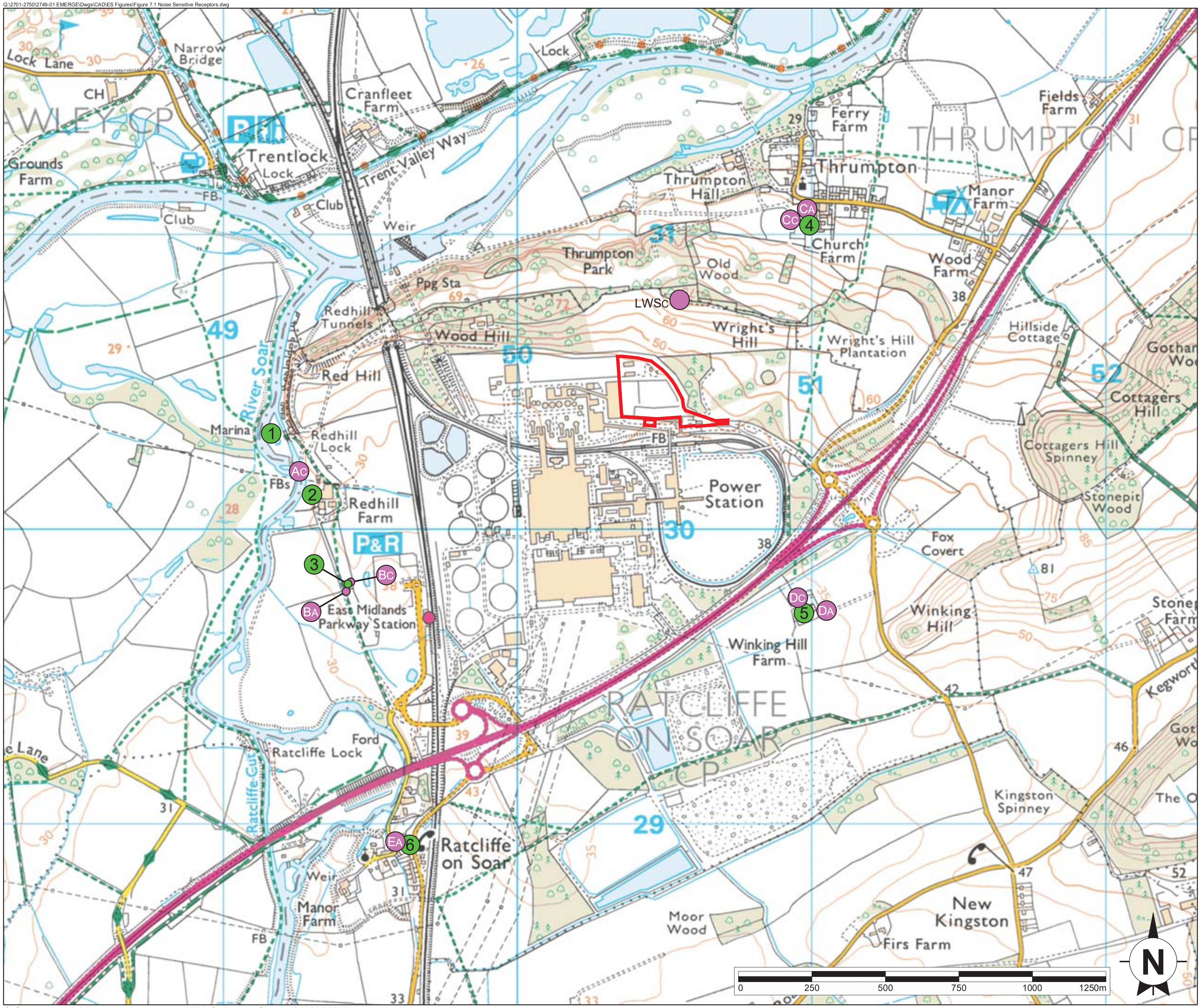
Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 7.1 Noise Sensitive Receptors.dwg



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Site Boundary

Noise Sensitive Receptors

1 Red Hill Marina
2 Red Hill Farm
3 Middle Gate Farm
4 Thrumpton
5 Winking Hill Farm
6 Ratcliffe On Soar Village

Noise Monitoring Positions

AC	Red Hill Marina/Farm [A] Continuous
BA	Middle Gate Farm [B] Attended
BC	Middle Gate Farm [B] Continuous
CA	Thrumpton [C] Attended
CC	Thrumpton [C] Continuous
DA	Winking Hill Farm [D] Attended
DC	Winking Hill Farm [D] Continuous
EA	Ratcliffe On Soar Village [E] Attended
LWSC	Thrumpton LWS Continuous

EMERGE Centre

Figure 7.1

Noise Sensitive Receptors

Scale	Date
1:12,500@A3	May 2020

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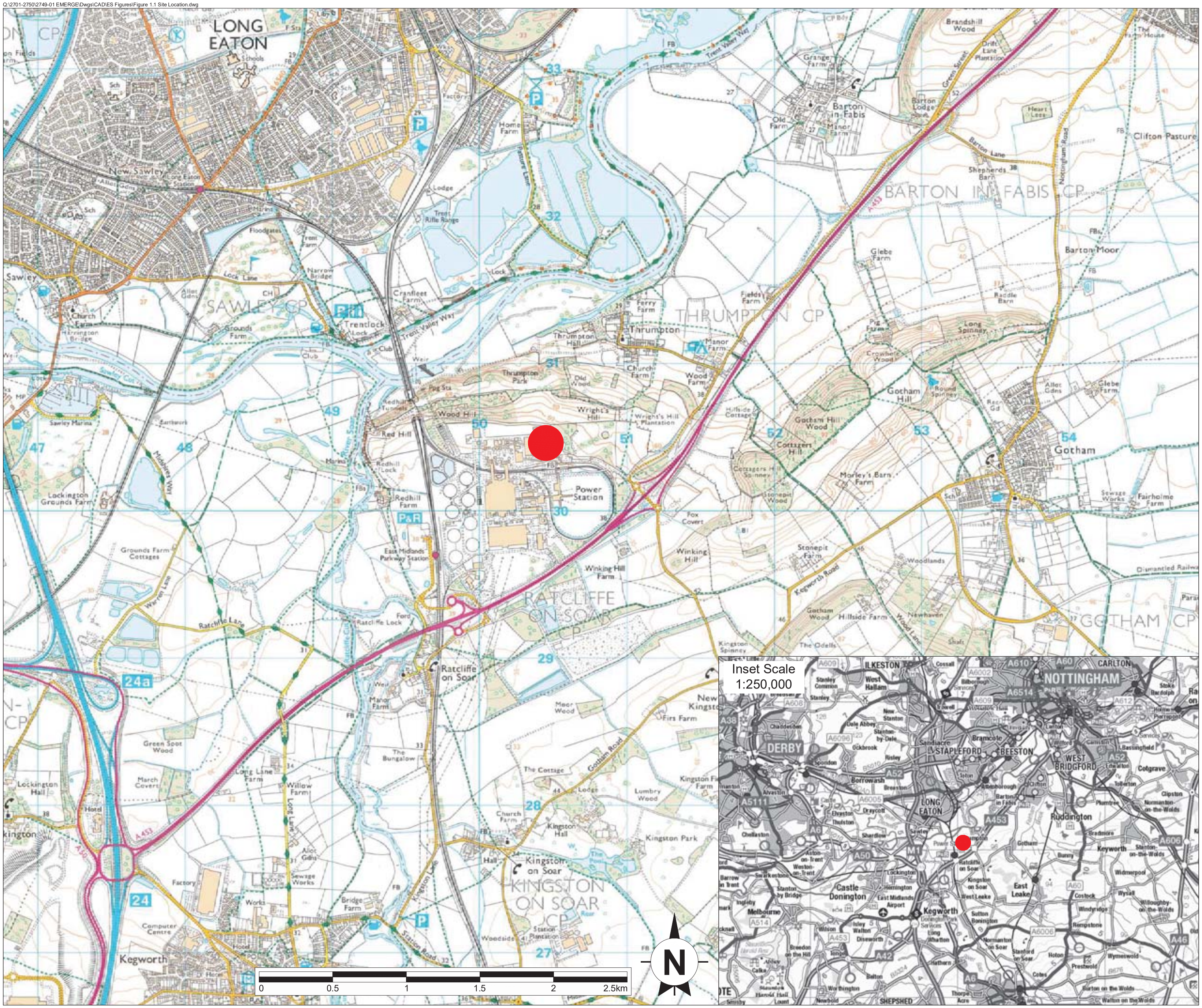
Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 1.1 Site Location.dwg



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Site Location

EMERGE Centre

Environmental Statement

Figure 1.1
Site Location Plan

Scale	Date
1:25,000@A3	May 2020

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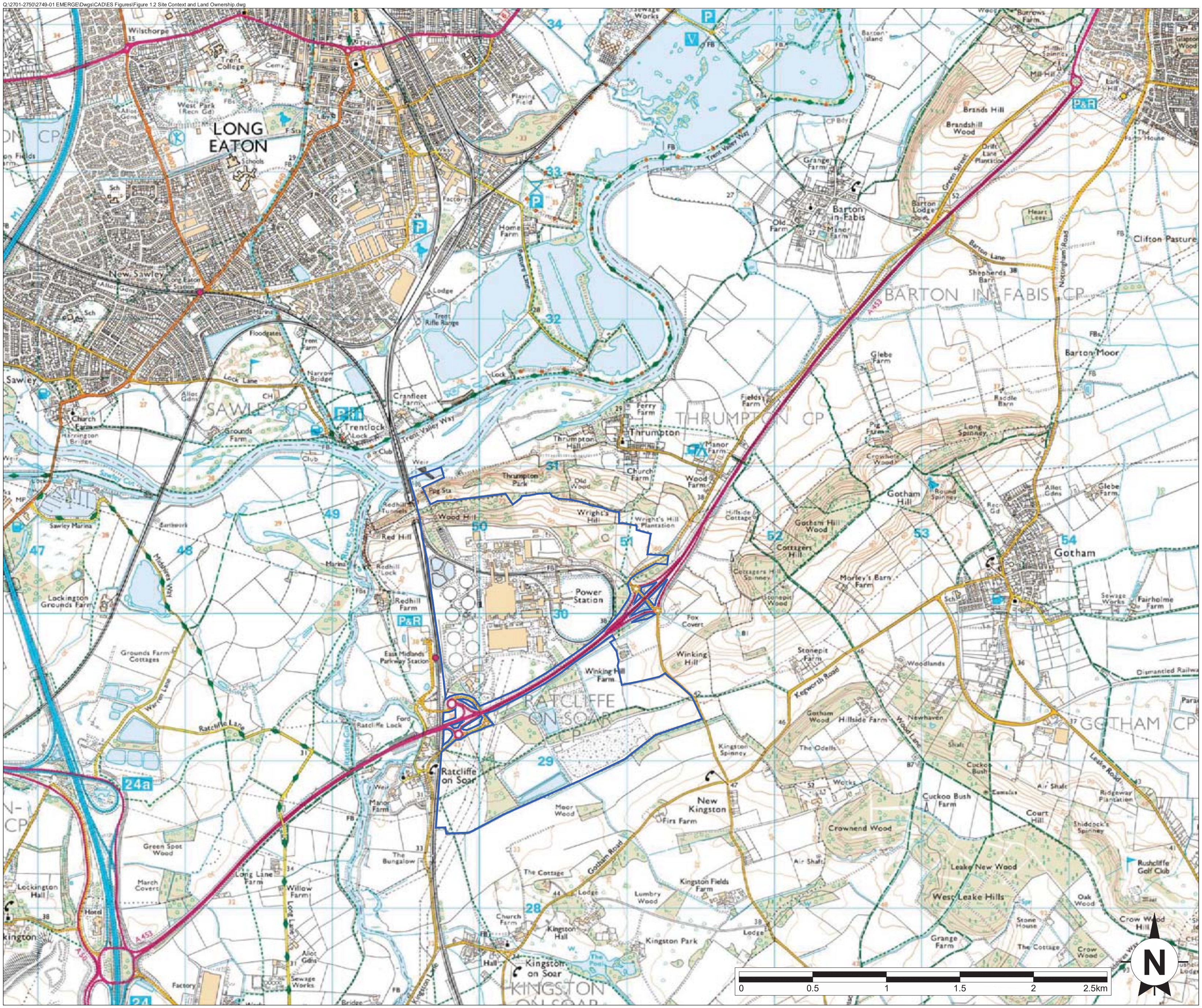
Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 1.2 Site Context and Land Ownership.dwg



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Power Station Site

EMERGE Centre	
Environmental Statement	
Figure 1.2 Power Station Site Context and Land Ownership	
Scale 1:25,000@A3	Date May 2020

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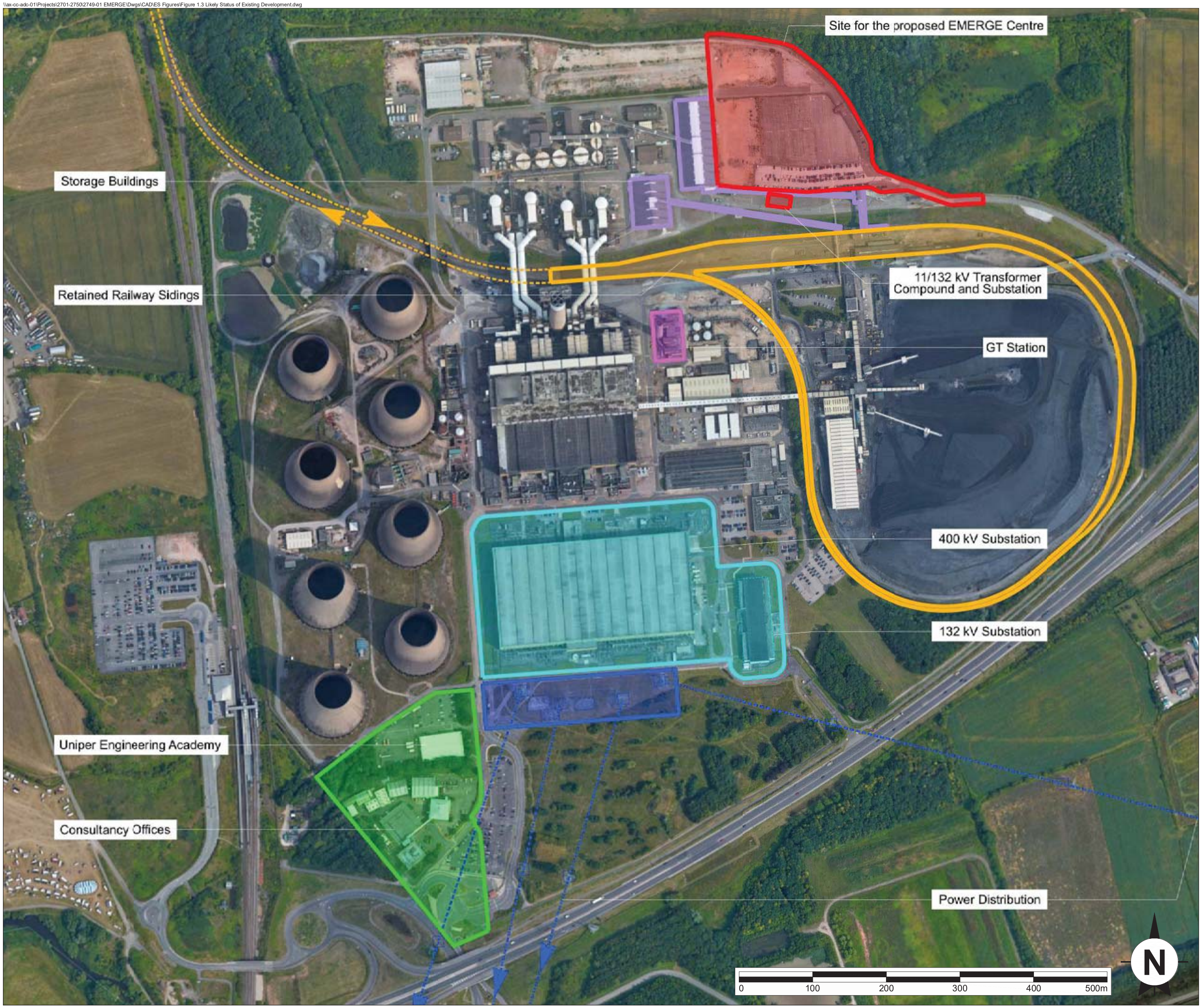
\\ax-cc-adc-01\Projects\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 1.3 Likely Status of Existing Development.dwg



axis

Site for the proposed EMERGE Centre

Buildings / Structures likely to be retained

Retained Railway Sidings

Gas Turbine Station

Substations

Consultancy offices & Uniper Engineering Academy

Power Distribution Network

Storage Buildings linked to the Rail Siding

EMERGE Centre

Figure 1.3

Likely Status of Existing Development

Scale	Date
1:5000@A3	May 2020

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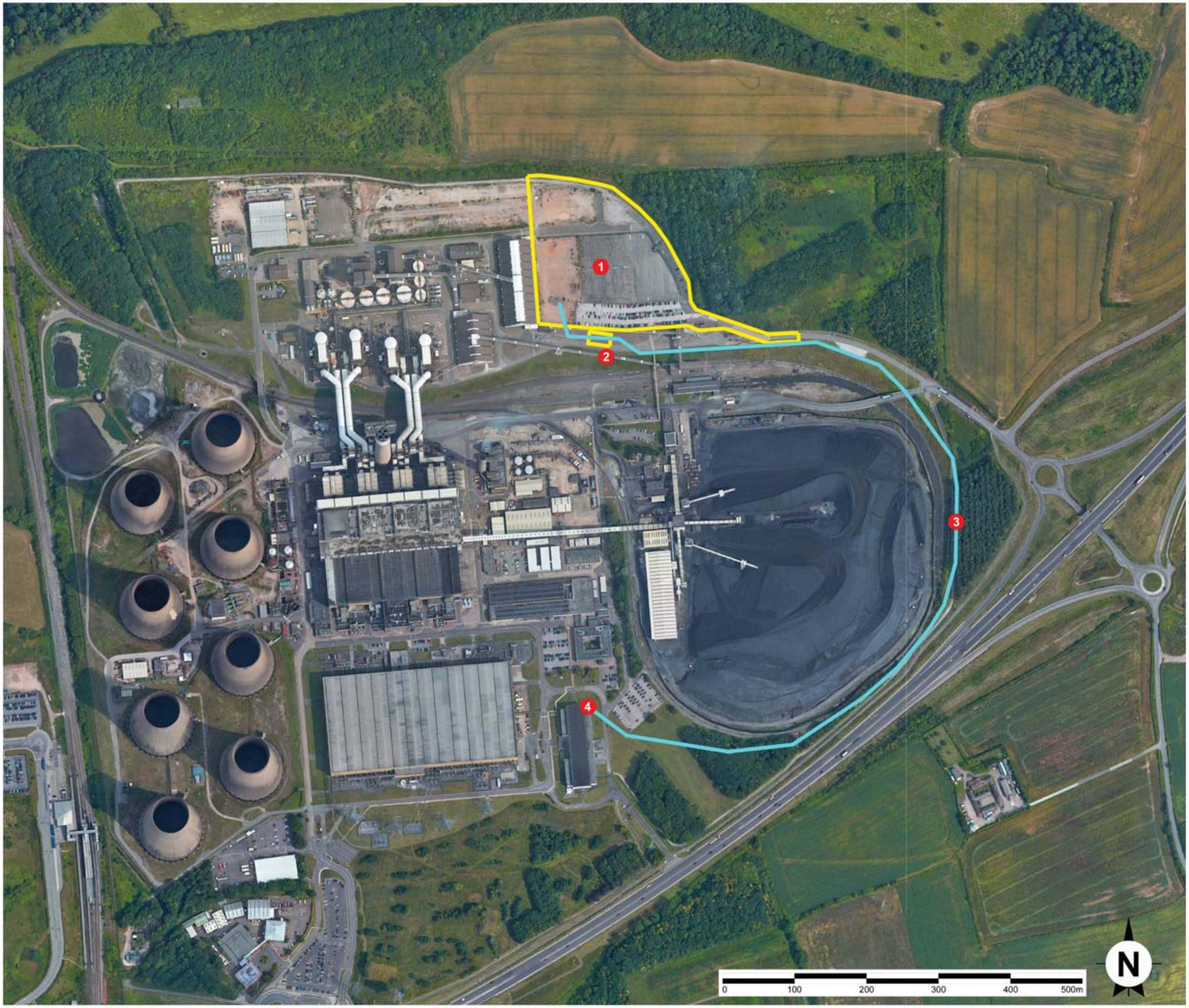

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axis

1: EMERGE Centre

2: 11/132 kV Transformer Compound and Substation

3: Indicative 132 kV Cable Route

4: Connection to Existing 132 kV Substation

EMERGE Centre	
Figure 1.4	
EMERGE Centre Site Location Plan	
Scale 1:2,500@A1	Date June 2020

NCC received 16.07.2020

\\ax-cc-adc-01\Projects\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 1.5 Site Aerial Photo.dwg

axis

1. Cooling Towers (114 m high)
2. Power Distribution Network
3. 400 kV Substation
4. 132 kV Substation
5. Coal Storage Area
6. Turbine Hall
7. Power Station Stack (199 m high)
8. Flue Gas Treatment Infrastructure
9. Gas Turbine Station
10. Gas Turbine Station Stack (95 m high)
11. Rail Siding
12. Storage Buildings Linked to Rail Siding
13. Site of the proposed EMERGE Centre
14. Consultancy Offices and Uniper Engineering Academy

EMERGE Centre

Figure 1.5

Site Aerial Photo

Scale Not to Scale	Date May 2020

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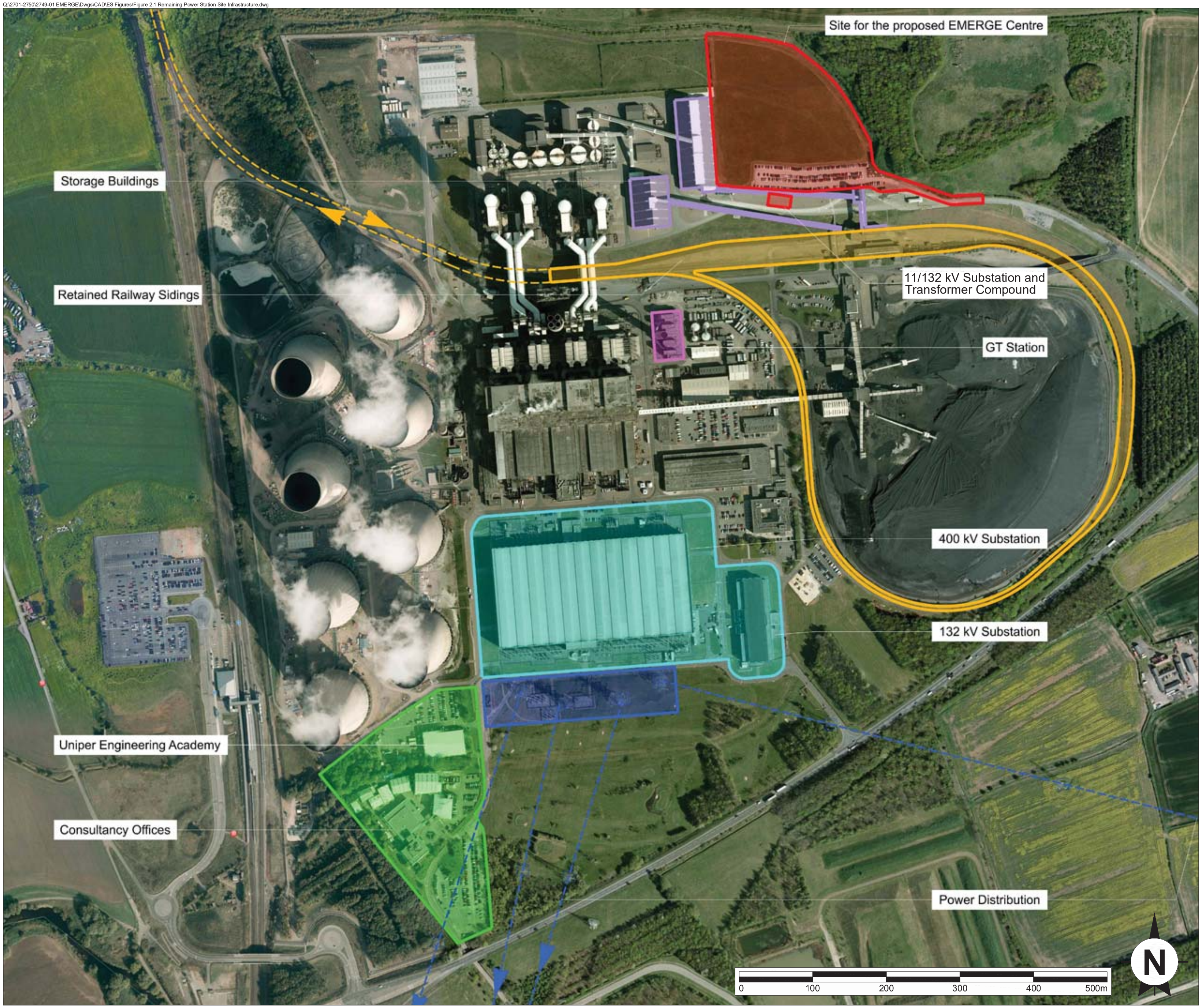
Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 2.1 Remaining Power Station Site Infrastructure.dwg



axis

Site for the proposed EMERGE Centre

Buildings / Structures likely to be retained

Retained Railway Sidings

Gas Turbine Station

Substations

Consultancy offices & Uniper Engineering Academy

Power Distribution Network

Storage Buildings linked to the Rail Siding

EMERGE Centre

Figure 2.1

Remaining Power Station Site Infrastructure

Scale	Date
1:5000@A3	May 2020

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Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 2.2 Cumulative Effects Area of Search.dwg

axis

EMERGE Centre	
Figure 2.2	
Cumulative Effects Area of Search	
Scale Not to Scale	Date May 2020

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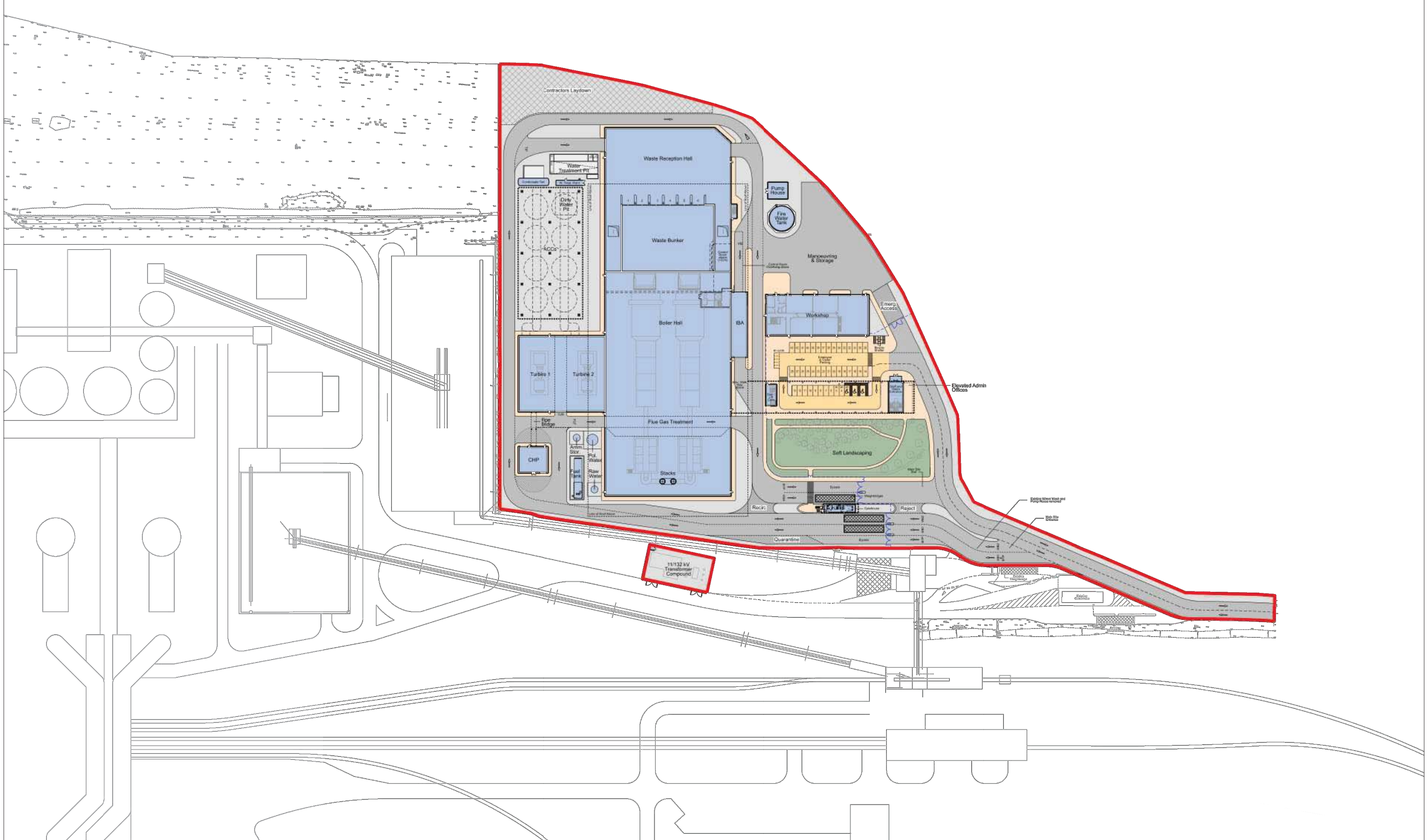
Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 4.1 Proposed Site Layout.dwg



Red Line Boundary

Security Fencing

Soft landscaping

Buildings / Structures

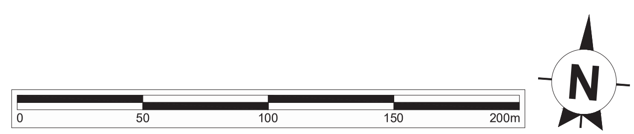
Concrete / Tarmac Circulation

Hardstanding

Footpaths

Parking

ec Electric Vehicle Charging Point



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EMERGE Centre

Figure 4.1

Proposed Site Layout

Scale	Date
1:2000@A3	May 2020

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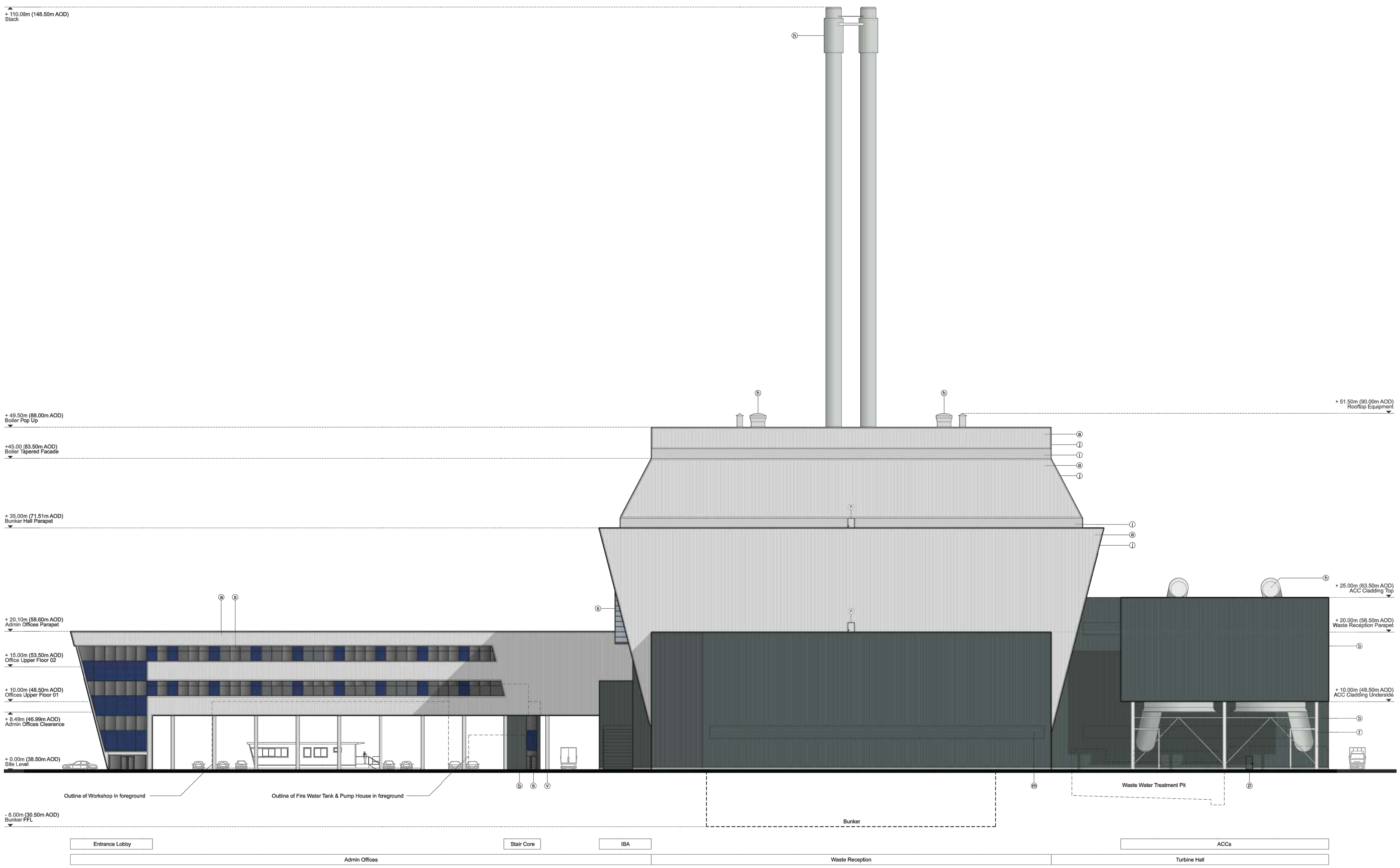
Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 4.2 Proposed North Elevation.dwg



LEGEND Note: All materials, finishes and colours will be as stated or similar approved.

- (a) Kalzip AluPlusZinc standing seam aluminium cladding Finish: Matt Zinc Patinated
- (b) Metal trapezoidal profile wall cladding. Colour: Merlin Grey (RAL 180 40 05)
- (c) Kalzip AluPlusPatina standing seam aluminium roof cladding. Colour: Alaska Grey (RAL 7000)
- (d) Kalzip AluPlusPatina standing seam aluminium roof cladding. Colour: Merlin Grey (RAL 180 40 05)
- (e) PPC metal columns Colour: Merlin Grey (RAL 180 40 05)
- (f) PPC metal gantries, stairs and structure to ACCs Colour: Merlin Grey (RAL 180 40 05)
- (g) PPC metal casing of low level silos and Water Tank Colour: Merlin Grey (RAL 180 40 05)
- (h) PPC metal stack casing and metal ducting to ACCs Colour: Oyster (RAL 7035)
- (j) Aluminium flashing and capping. Finish: Matt Zinc Patinated
- (k) PPC metal flashing and capping. Colour: Merlin Grey (RAL 180 40 05)
- (l) PPC aluminium louvres / brise soleil Finish: Matt Zinc Patinated
- (m) PPC aluminium louvres. Colour: Merlin Grey (RAL 180 40 05)
- (n) PPC metal personnel doors Finish: Matt Zinc Patinated
- (p) PPC metal personnel doors Colour: Merlin Grey (RAL 180 40 05)
- (q) Metal roller shutter doors Colour: Merlin Grey (RAL 180 40 05)
- (r) Schueco AWS Aluminium Window System (or equal approved) Finish: Polyester powder coated. Colour: Merlin Grey RAL 180 40 05 Glazing to be a mixture of clear and ceramic back painted glass units Grey RAL 7016; Shiava Blue RAL 290 20 35
- (s) Schueco Curtain Walling System (or equal approved) Finish: Polyester powder coated. Colour: Merlin Grey RAL 180 40 05 Glazing to be a mixture of clear and ceramic back painted glass units Grey RAL 7016; Shiava Blue RAL 290 20 35
- (t) Low level plinth Colour: Fairfaced concrete
- (u) In situ cast concrete bund and process building plinth
- (v) PPC Casing to metal columns Colour: Matt Zinc Patinated
- (w) Polycarbonate wall and roof panels Colour: Clear
- (x) Sheffield type bicycle rack Colour: Merlin Grey 180 40 05
- (y) Flat roofing - single ply membrance system Colour: Merlin Grey RAL 180 40 05
- (z) Glasfabrik Lambert 'Linit' P26/60/7, type 504 1.7W 8 wires (or equal approved) Low E coating 'U' channel Glass Panel System Frame Colour: RAL 160 70 20
- (z1) Paint finish to tanks & Silos etv Colour: Merlin Grey RAL 180 40 05

axis

EMERGE Centre

Figure 4.2

Proposed North Elevation

Scale	Date
Not to Scale	May 2020

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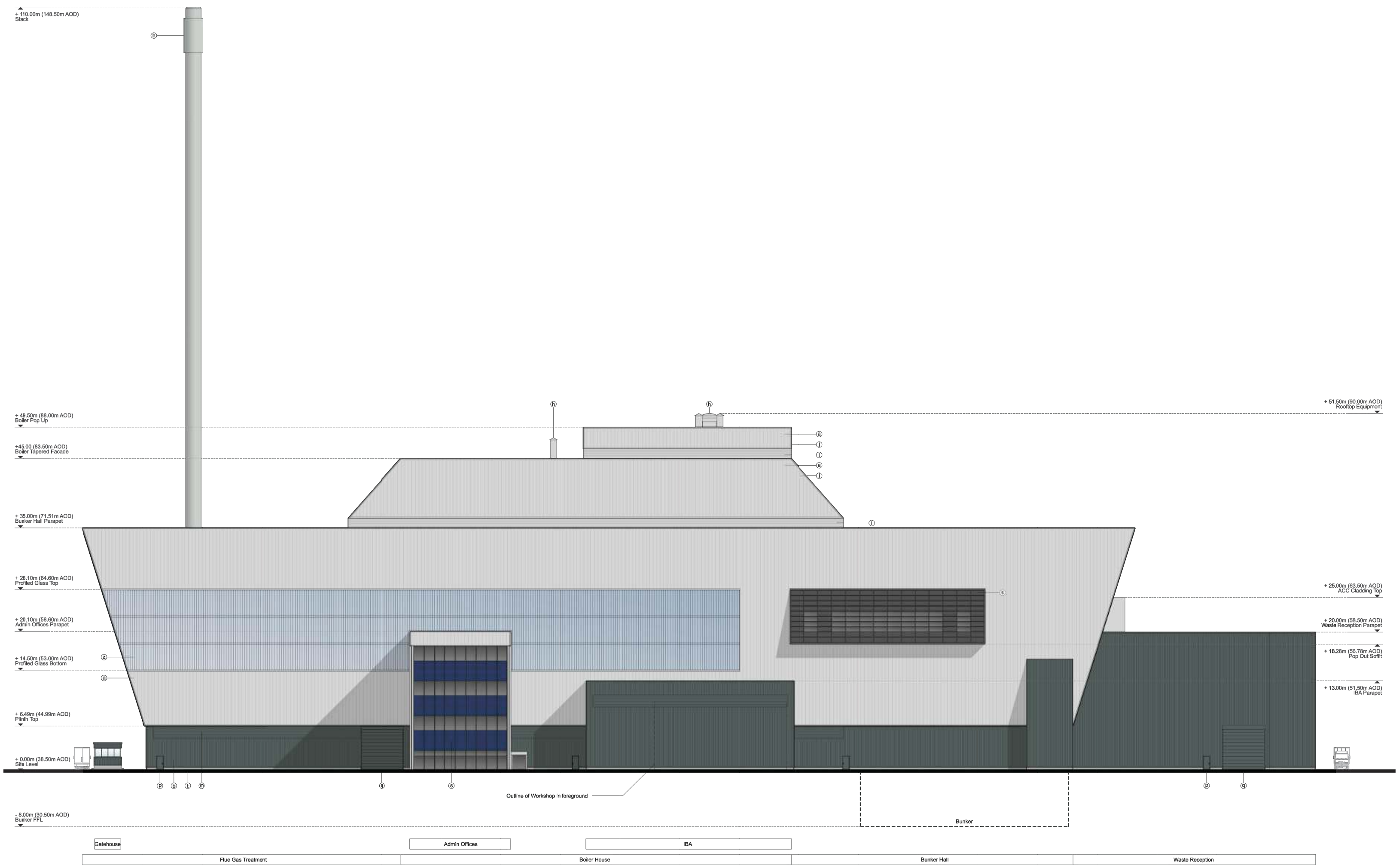


LEGEND Note: All materials, finishes and colours will be as stated or similar approved.

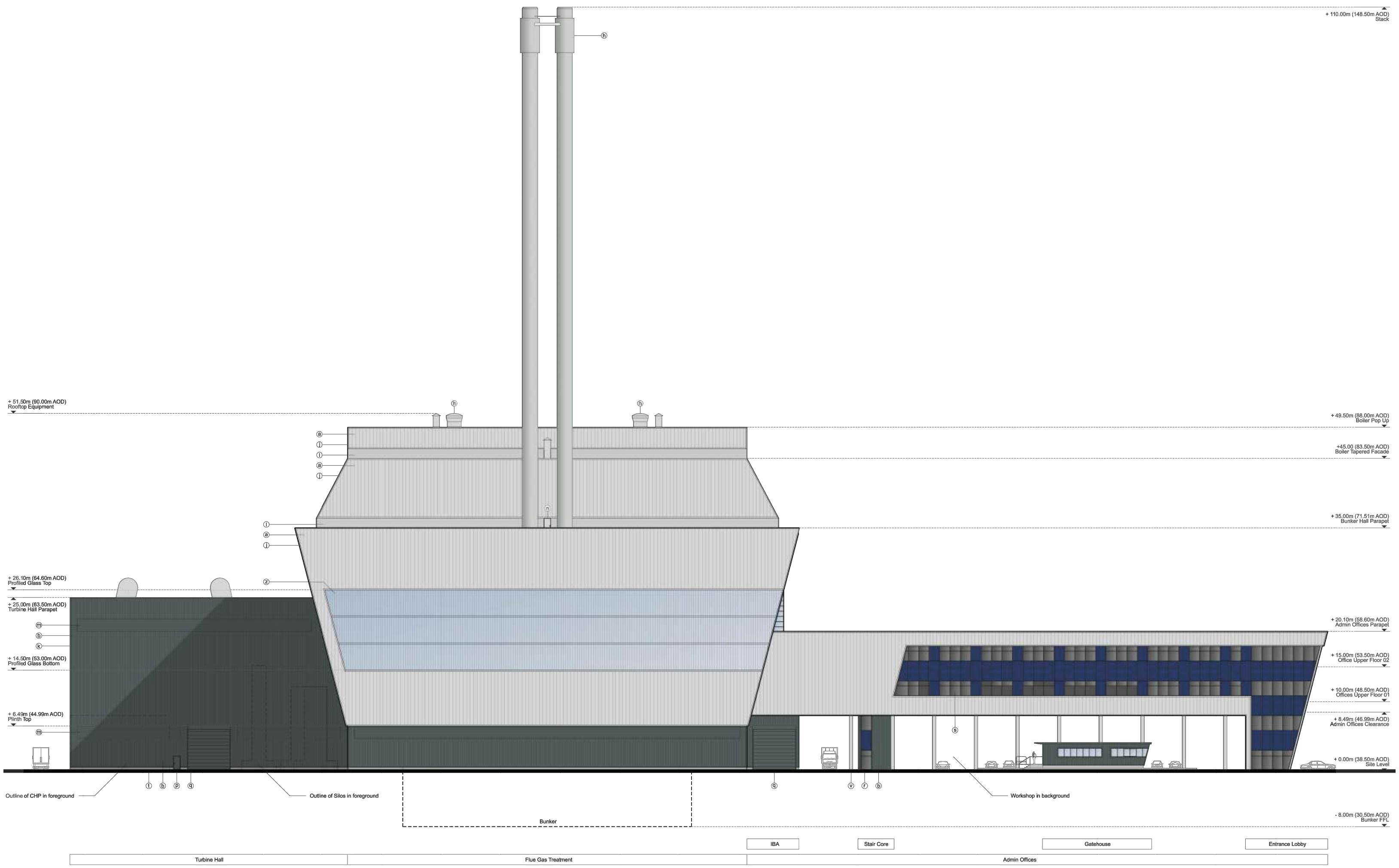
- (a) Kalzip AluPlusZinc standing seam aluminium cladding
  Finish: Matt Zinc Patinated
- (b) Metal trapezoidal profile wall cladding.
  Colour: Merlin Grey (RAL 180 40 05)
- (c) Kalzip AluPlusPatina standing seam aluminium roof cladding.
  Colour: Alaska Grey (RAL 7000)
- (d) Kalzip AluPlusPatina standing seam aluminium roof cladding.
  Colour: Merlin Grey (RAL 180 40 05)
- (e) PPC metal columns
  Colour: Merlin Grey (RAL 180 40 05)
- (f) PPC metal gantries, stairs and structure to ACCs
  Colour: Merlin Grey (RAL 180 40 05)
- (g) PPC metal casing of low level silos and Water Tank
  Colour: Merlin Grey (RAL 180 40 05)
- (h) PPC metal stack casing and metal ducting to ACCs
  Colour: Oyster (RAL 7035)
- (j) Aluminium flashing and capping.
  Finish: Matt Zinc Patinated
- (k) PPC metal flashing and capping.
  Colour: Merlin Grey (RAL 180 40 05)
- (l) PPC aluminium louvres / brise soleil
  Finish: Matt Zinc Patinated
- (m) PPC aluminium louvres,
  Colour: Merlin Grey (RAL 180 40 05)
- (n) PPC metal personnel doors
  Finish: Matt Zinc Patinated
- (p) PPC metal personnel doors
  Colour: Merlin Grey (RAL 180 40 05)
- (q) Metal roller shutter doors
  Colour: Merlin Grey (RAL 180 40 05)
- (r) Schueco AWS Aluminium Window System (or equal approved)
  Finish: Polyester powder coated,
  Colour: Merlin Grey RAL 180 40 05
  Glazing to be a mixture of clear and ceramic back painted glass units Grey RAL 7016; Shiava Blue RAL 290 20 35
- (s) Schueco Curtain Walling System (or equal approved)
  Finish: Polyester powder coated,
  Colour: Merlin Grey RAL 180 40 05
  Glazing to be a mixture of clear and ceramic back painted glass units Grey RAL 7016; Shiava Blue RAL 290 20 35
- (t) Low level plinth
  Colour: Fairfaced concrete
- (u) In situ cast concrete bund and process building plinth
- (v) PPC Casing to metal columns
  Colour: Matt Zinc Patinated
- (w) Polycarbonate wall and roof panels
  Colour: Clear
- (x) Sheffield type bicycle rack
  Colour: Merlin Grey 180 40 05
- (y) Flat roofing - single ply membrance system
  Colour: Merlin Grey RAL 180 40 05
- (z) Glasfabrik Lambert 'Linit' P26/60/7, type 504 1.7W 8 wires (or equal approved) Low E coating 'U' channel Glass Panel System
  Frame Colour: RAL 160 70 20
- (z1) Paint finish to tanks & Silos etv
  Colour: Merlin Grey RAL 180 40 05

axis

EMERGE Centre	
Figure 4.3	
Proposed East Elevation	
Scale Not to Scale	Date May 2020

NCC received 16.07.2020

Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 4.4 Proposed South Elevation.dwg



LEGEND Note: All materials, finishes and colours will be as stated or similar approved.

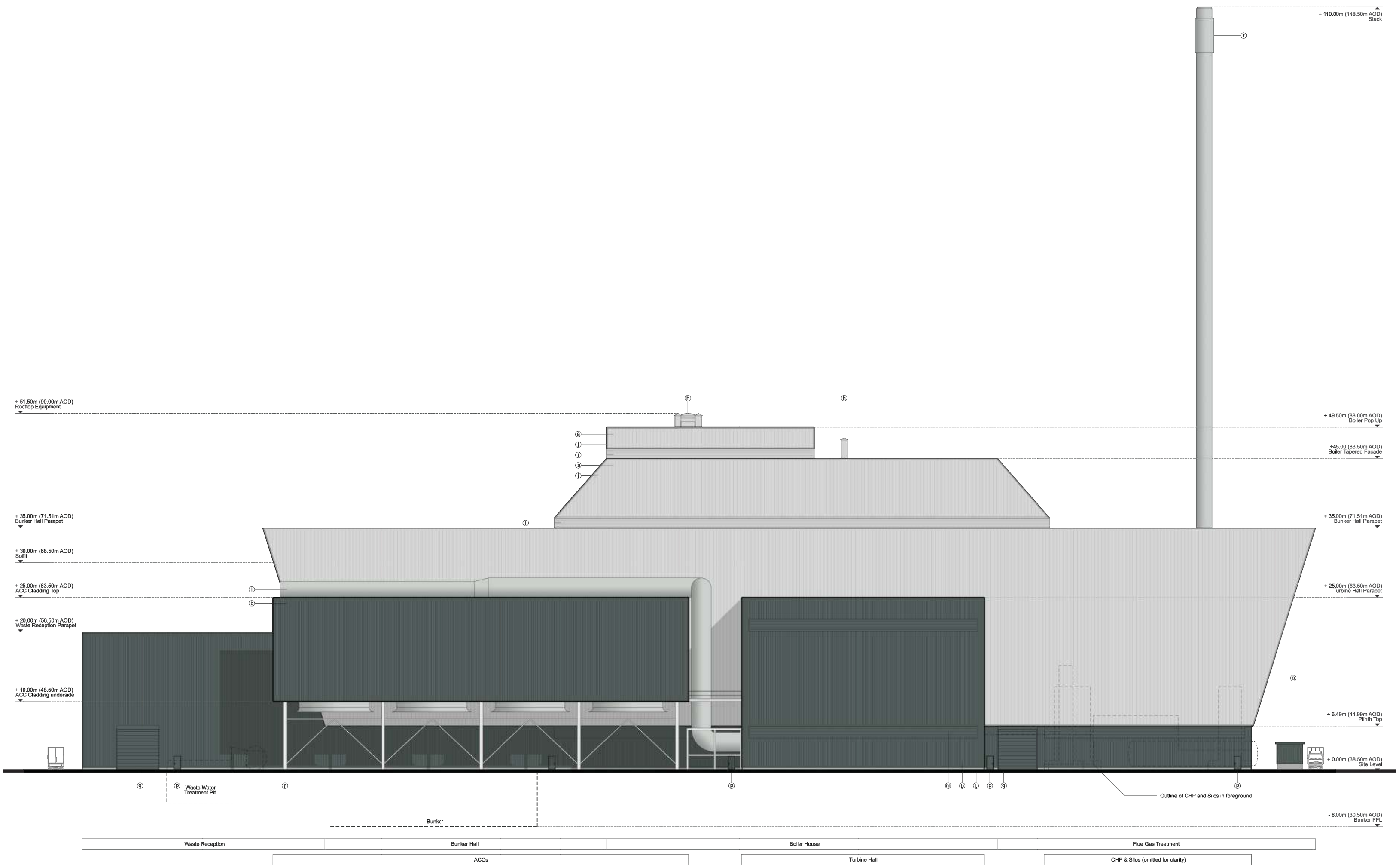
- (a) Kalzip AluPlusZinc standing seam aluminium cladding
  Finish: Matt Zinc Patinated
- (b) Metal trapezoidal profile wall cladding.
  Colour: Merlin Grey (RAL 180 40 05)
- (c) Kalzip AluPlusPatina standing seam aluminium roof cladding.
  Colour: Alaska Grey (RAL 7000)
- (d) Kalzip AluPlusPatina standing seam aluminium roof cladding.
  Colour: Merlin Grey (RAL 180 40 05)
- (e) PPC metal columns
  Colour: Merlin Grey (RAL 180 40 05)
- (f) PPC metal gantries, stairs and structure to ACCs
  Colour: Merlin Grey (RAL 180 40 05)
- (g) PPC metal casing of low level silos and Water Tank
  Colour: Merlin Grey (RAL 180 40 05)
- (h) PPC metal stack casing and metal ducting to ACCs
  Colour: Oyster (RAL 7035)
- (j) Aluminium flashing and capping.
  Finish: Matt Zinc Patinated
- (k) PPC metal flashing and capping.
  Colour: Merlin Grey (RAL 180 40 05)
- (l) PPC aluminium louvres / brise soleil
  Finish: Matt Zinc Patinated
- (m) PPC aluminium louvres.
  Colour: Merlin Grey (RAL 180 40 05)
- (n) PPC metal personnel doors
  Finish: Matt Zinc Patinated
- (p) PPC metal personnel doors
  Colour: Merlin Grey (RAL 180 40 05)
- (q) Metal roller shutter doors
  Colour: Merlin Grey (RAL 180 40 05)
- (r) Schueco AWS Aluminium Window System (or equal approved)
  Finish: Polyester powder coated.
  Colour: Merlin Grey RAL 180 40 05
  Glazing to be a mixture of clear and ceramic back painted glass units Grey RAL 7016; Shiava Blue RAL 290 20 35
- (s) Schueco Curtain Walling System (or equal approved)
  Finish: Polyester powder coated.
  Colour: Merlin Grey RAL 180 40 05
  Glazing to be a mixture of clear and ceramic back painted glass units Grey RAL 7016; Shiava Blue RAL 290 20 35
- (t) Low level plinth
  Colour: Fairfaced concrete
- (u) In situ cast concrete bund and process building plinth
- (v) PPC Casing to metal columns
  Colour: Matt Zinc Patinated
- (w) Polycarbonate wall and roof panels
  Colour: Clear
- (x) Sheffield type bicycle rack
  Colour: Merlin Grey 180 40 05
- (y) Flat roofing - single ply membrance system
  Colour: Merlin Grey RAL 180 40 05
- (z) Glasfabrik Lambert 'Linit' P26/60/7, type 504 1.7W 8 wires (or equal approved)
  Low E coating 'U' channel Glass Panel System
  Frame Colour: RAL 160 70 20
- (z1) Paint finish to tanks & Silos etv
  Colour: Merlin Grey RAL 180 40 05

axis

EMERGE Centre	
Figure 4.4	
Proposed South Elevation	
Scale Not to Scale	Date May 2020

NCC received 16.07.2020

Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 4.5 Proposed West Elevation.dwg



LEGEND Note: All materials, finishes and colours will be as stated or similar approved.

- (a) Kalzip AluPlusZinc standing seam aluminium cladding Finish: Matt Zinc Patinated
- (b) Metal trapezoidal profile wall cladding. Colour: Merlin Grey (RAL 180 40 05)
- (c) Kalzip AluPlusPatina standing seam aluminium roof cladding. Colour: Alaska Grey (RAL 7000)
- (d) Kalzip AluPlusPatina standing seam aluminium roof cladding. Colour: Merlin Grey (RAL 180 40 05)
- (e) PPC metal columns Colour: Merlin Grey (RAL 180 40 05)
- (f) PPC metal gantries, stairs and structure to ACCs Colour: Merlin Grey (RAL 180 40 05)
- (g) PPC metal casing of low level silos and Water Tank Colour: Merlin Grey (RAL 180 40 05)
- (h) PPC metal stack casing and metal ducting to ACCs Colour: Oyster (RAL 7035)
- (j) Aluminium flashing and capping. Finish: Matt Zinc Patinated
- (k) PPC metal flashing and capping. Colour: Merlin Grey (RAL 180 40 05)
- (l) PPC aluminium louvres / brise soleil Finish: Matt Zinc Patinated
- (m) PPC aluminium louvres, Colour: Merlin Grey (RAL 180 40 05)
- (n) PPC metal personnel doors Finish: Matt Zinc Patinated
- (p) PPC metal personnel doors Colour: Merlin Grey (RAL 180 40 05)
- (q) Metal roller shutter doors Colour: Merlin Grey (RAL 180 40 05)
- (r) Schueco AWS Aluminium Window System (or equal approved) Finish: Polyester powder coated, Colour: Merlin Grey RAL 180 40 05 Glazing to be a mixture of clear and ceramic back painted glass units Grey RAL 7016; Shiava Blue RAL 290 20 35
- (s) Schueco Curtain Walling System (or equal approved) Finish: Polyester powder coated, Colour: Merlin Grey RAL 180 40 05 Glazing to be a mixture of clear and ceramic back painted glass units Grey RAL 7016; Shiava Blue RAL 290 20 35
- (t) Low level plinth Colour: Fairfaced concrete
- (u) In situ cast concrete bund and process building plinth
- (v) PPC Casing to metal columns Colour: Matt Zinc Patinated
- (w) Polycarbonate wall and roof panels Colour: Clear
- (x) Sheffield type bicycle rack Colour: Merlin Grey 180 40 05
- (y) Flat roofing - single ply membrance system Colour: Merlin Grey RAL 180 40 05
- (z) Glasfabrik Lambert 'Linit' P26/60/7, type 504 1.7W 8 wires (or equal approved) Low E coating 'U' channel Glass Panel System Frame Colour: RAL 160 70 20
- (z1) Paint finish to tanks & Silos etv Colour: Merlin Grey RAL 180 40 05

axis

EMERGE Centre

Figure 4.5

Proposed West Elevation

Scale	Date
Not to Scale	May 2020

NCC received 16.07.2020

Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 4.6 Illustrative 3D Views.dwg

axis

EMERGE Centre

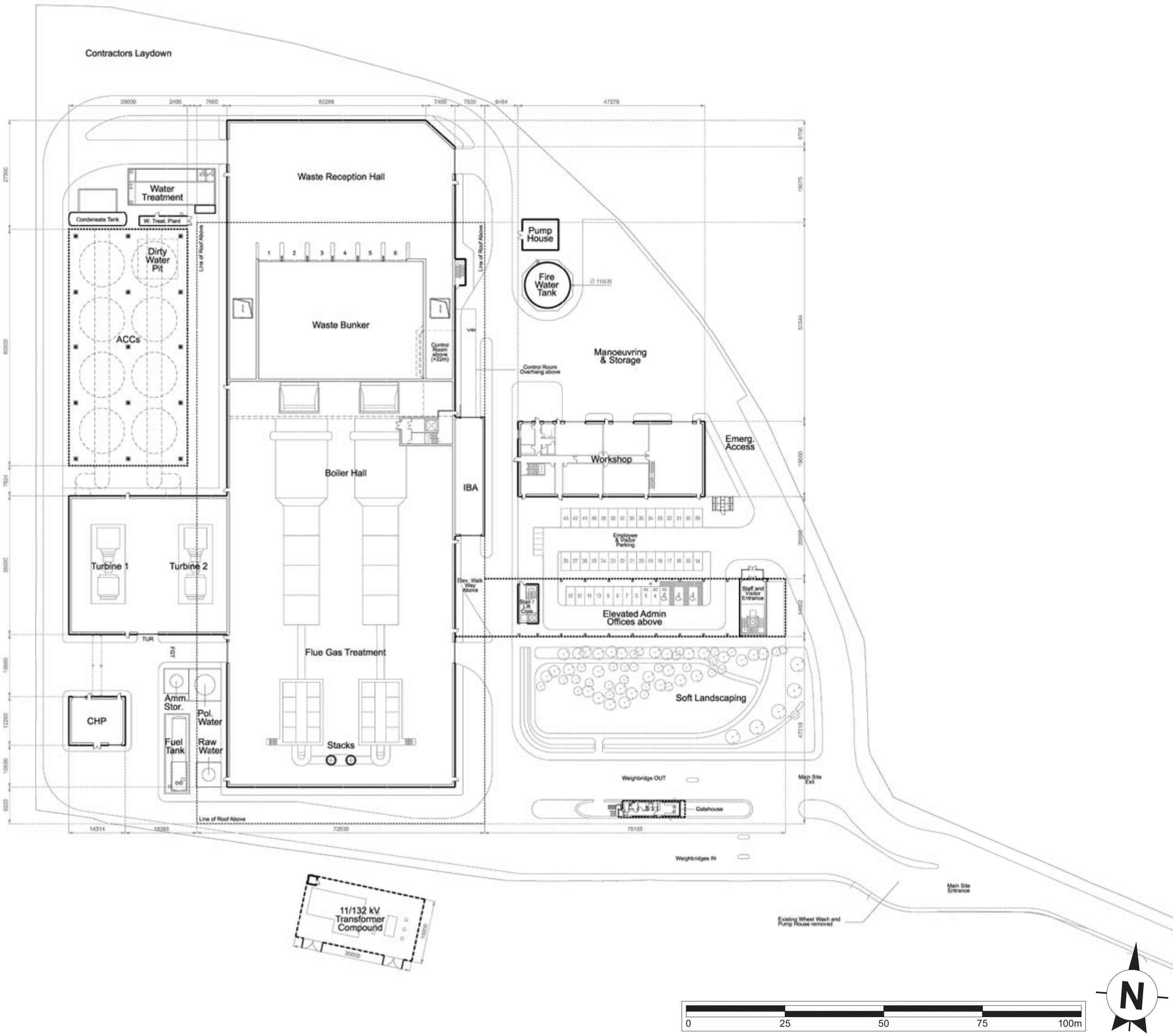
Figure 4.6

Illustrative 3D View

Scale	Date
Not to Scale	May 2020

NCC received 16.07.2020

Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 4.7 Ground Floor Plan.dwg



Red Line Boundary

EMERGE Centre

Figure 4.7

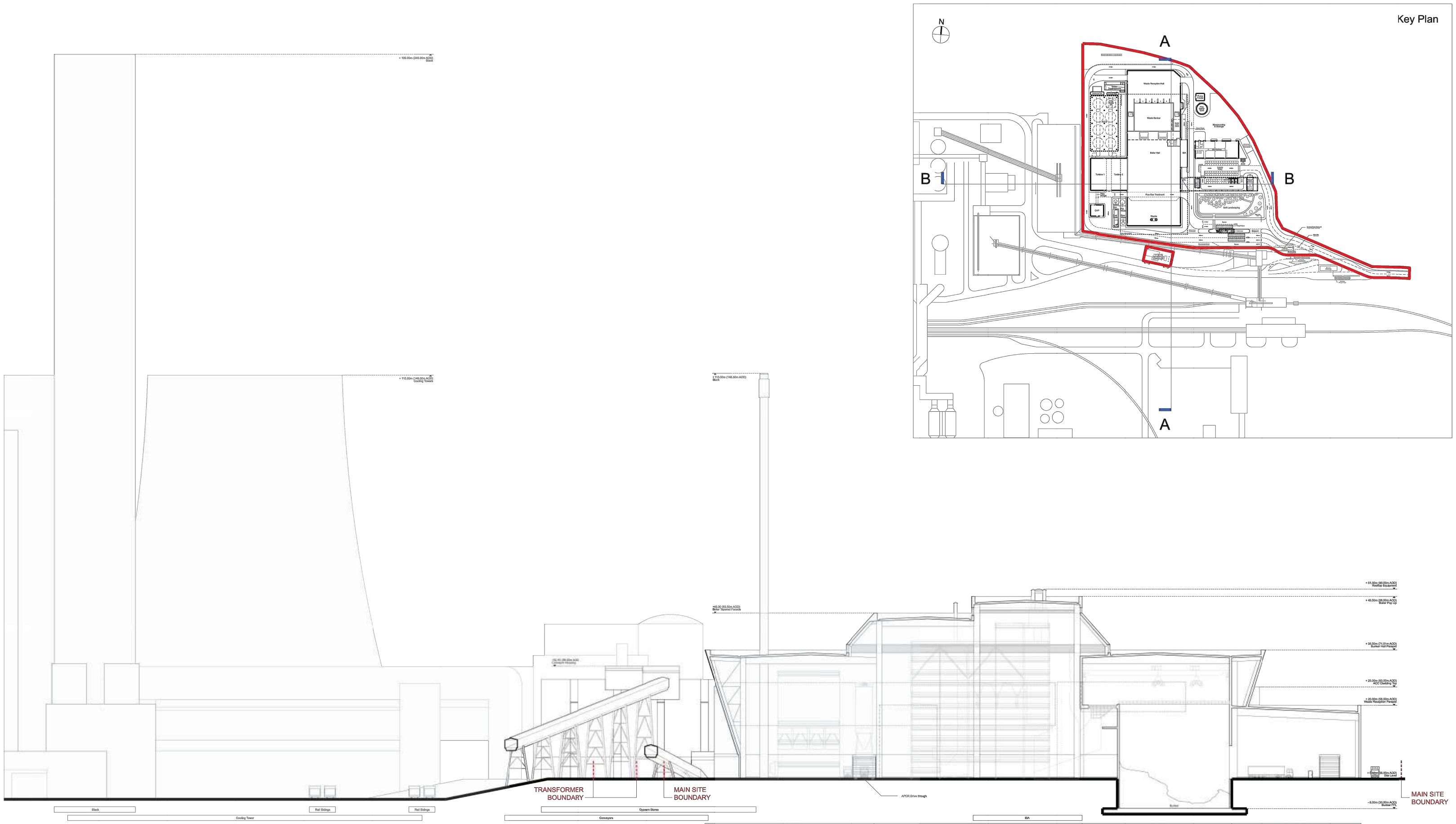
Ground Floor Plan

Scale
1:1000@A3

Date
May 2020

NCC received 16.07.2020

Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 4.8 Site Sections.dwg



axis

EMERGE Centre

Figure 4.8a

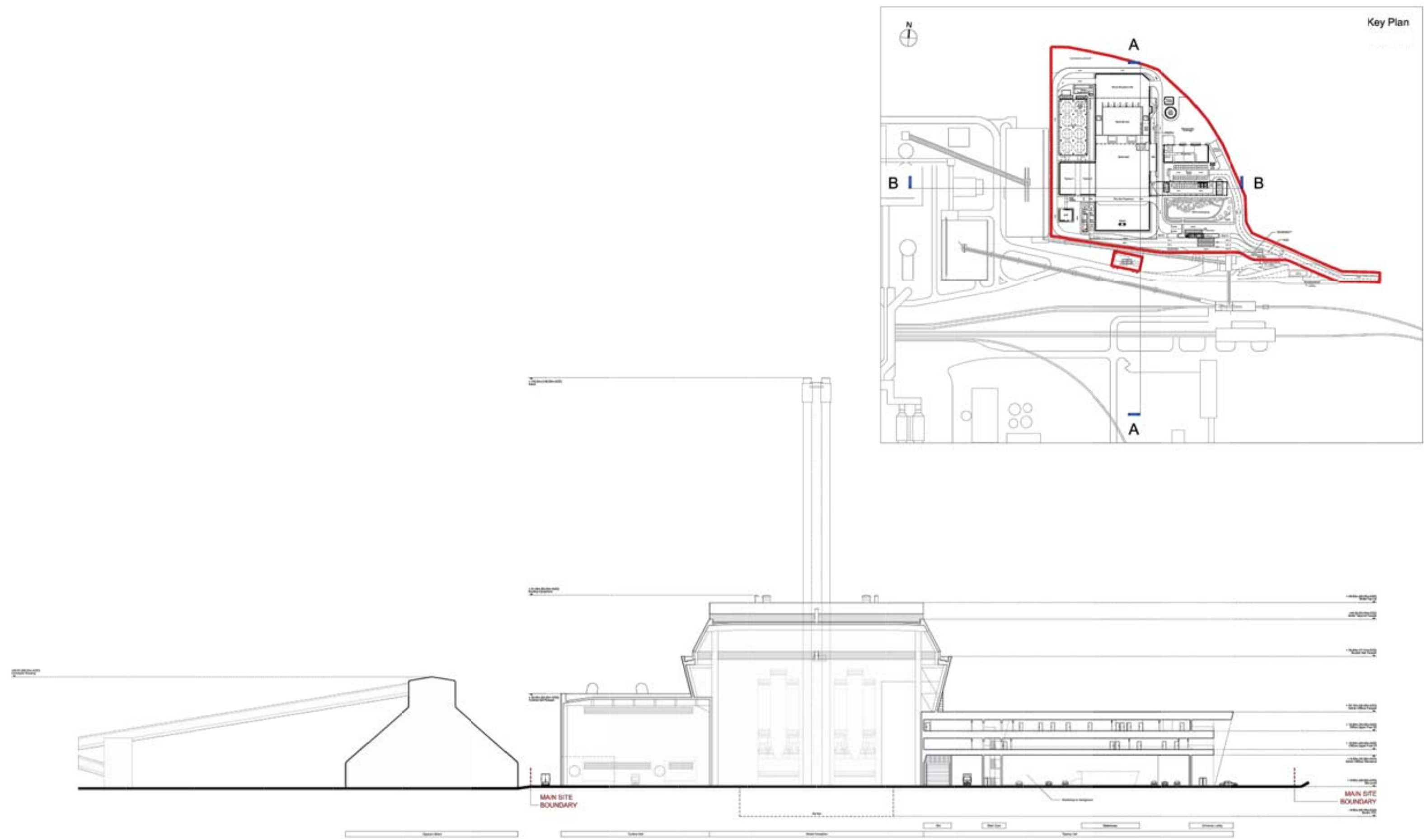
Site Section A-A

Scale
Not to Scale

Date
May 2020

NCC received 16.07.2020

Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 4.8 Site Sections.dwg



axis

EMERGE Centre

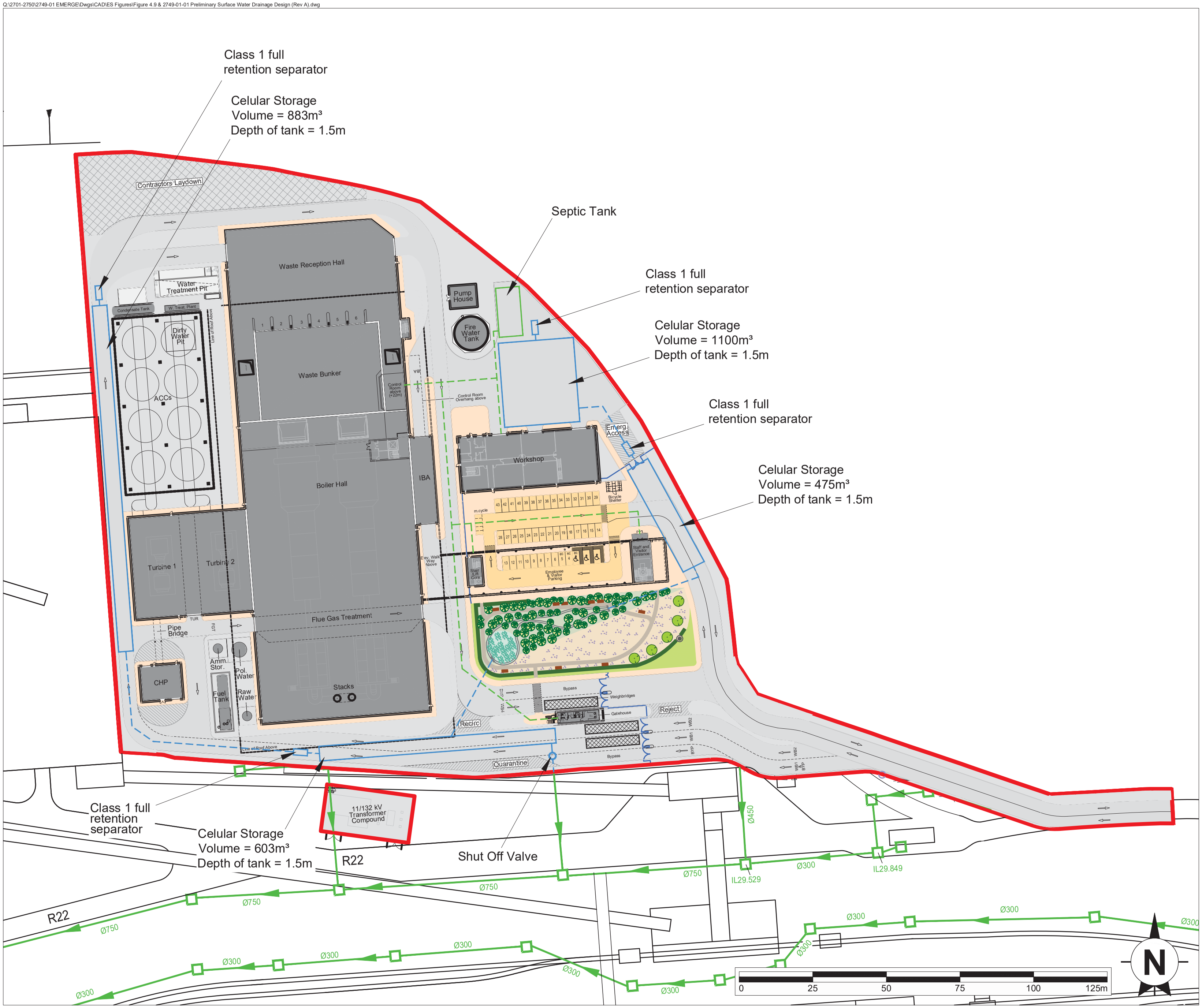
Figure 4.8b

Site Section B-B

Scale	Date
Not to Scale	May 2020

NCC received 16.07.2020

Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 4.9 & 2749-01-01 Preliminary Surface Water Drainage Design (Rev A).dwg



axis

EMERGE Centre Boundary

Surface Water

Foul Water

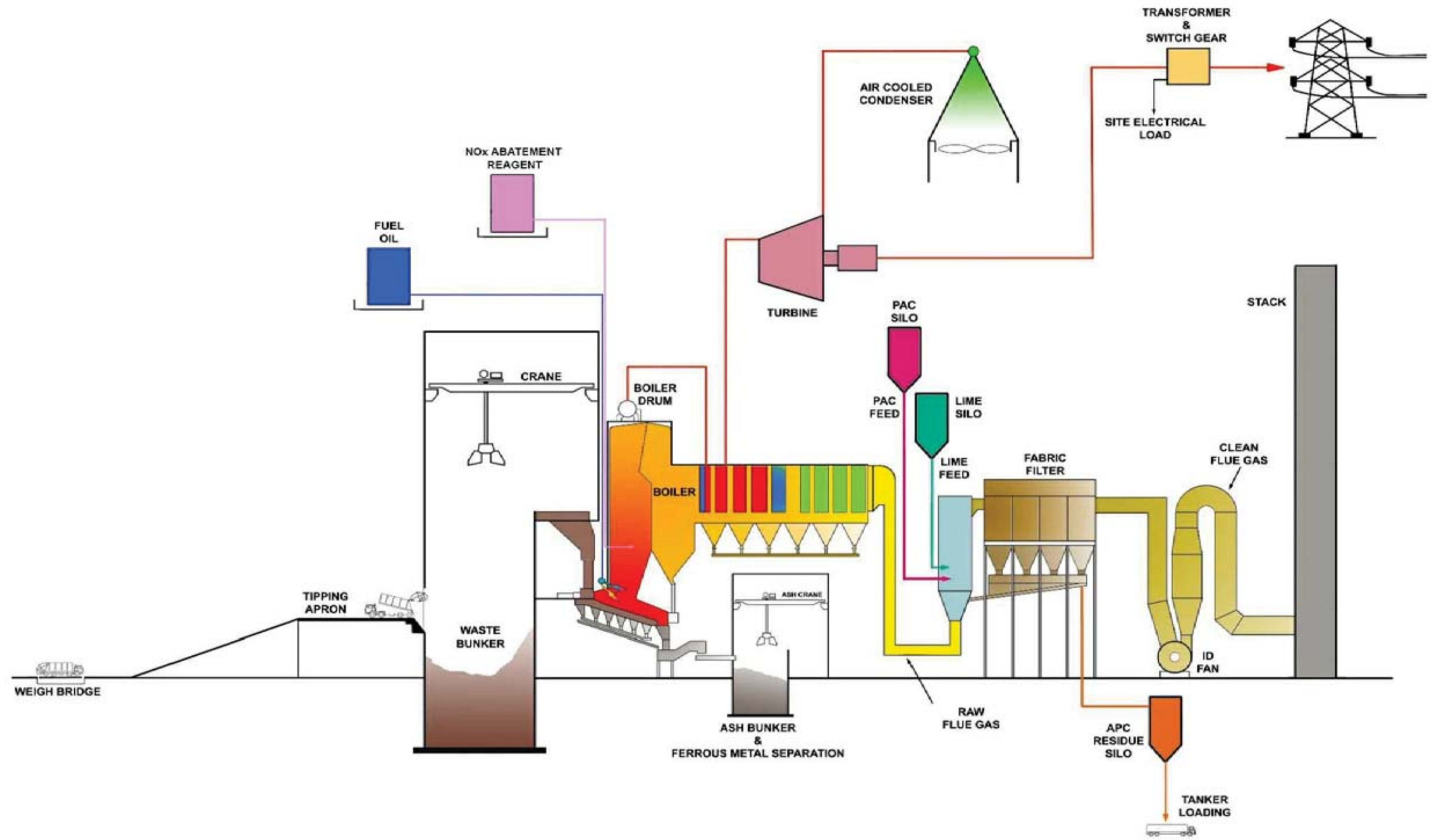
Existing Power Station Surface Water Drainage System

Note: Class 1 full retention separator has audible and visual alarms

EMERGE Centre	
Figure 4.9	
Preliminary Surface Water Drainage Design	
Scale 1:1250@A3	Date May 2020

NCC received 16.07.2020

Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 4.10 EfW Indicative Process Diagram.dwg



axis

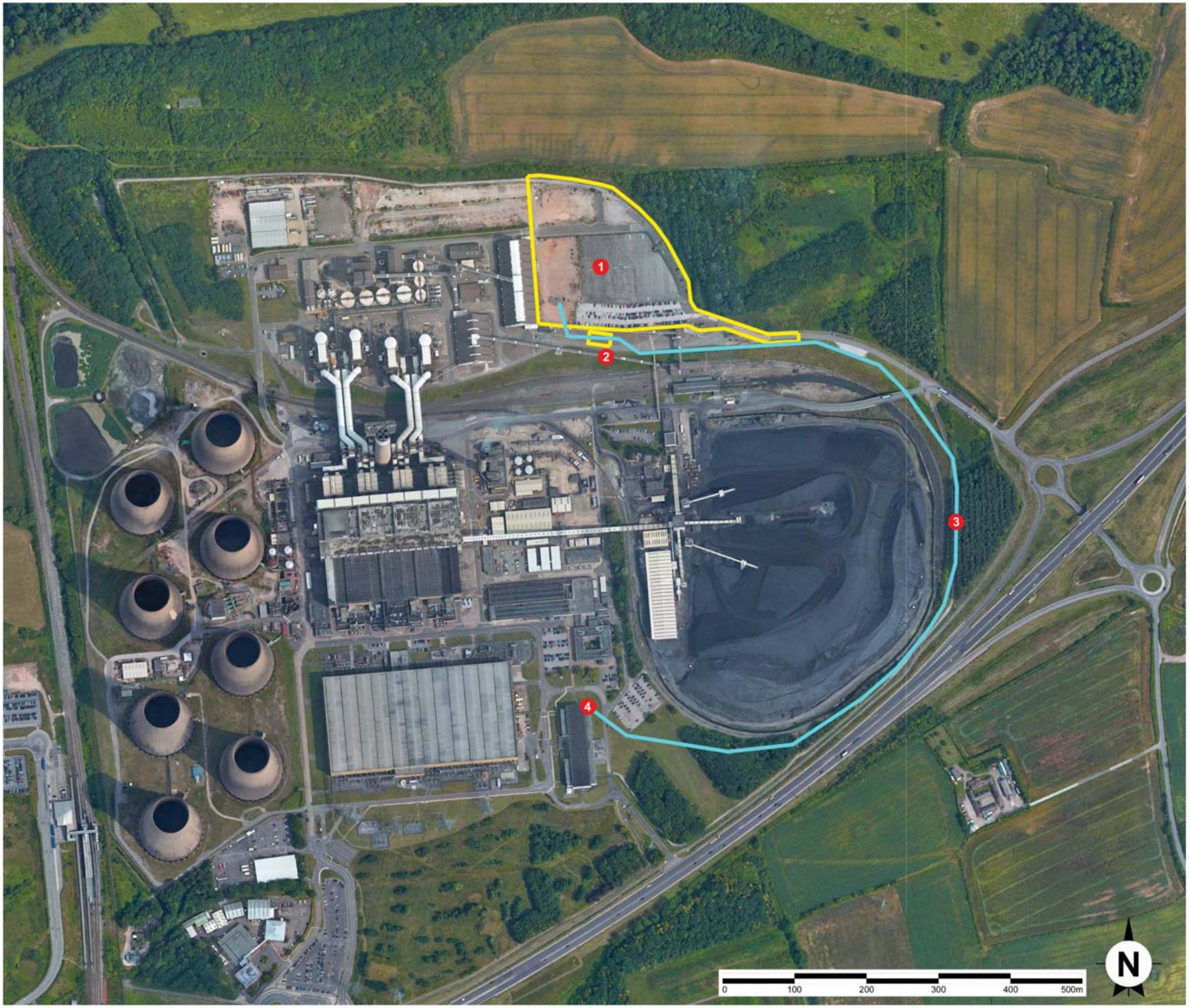
EMERGE Centre

Figure 4.10

EfW Indicative Process Diagram

Scale	Date
NA	May 2020

NCC received 16.07.2020



© Google

axis

1: EMERGE Centre

2: 11/132 kV Transformer Compound and Substation

3: Indicative 132 kV Cable Route

4: Connection to Existing 132 kV Substation

EMERGE Centre

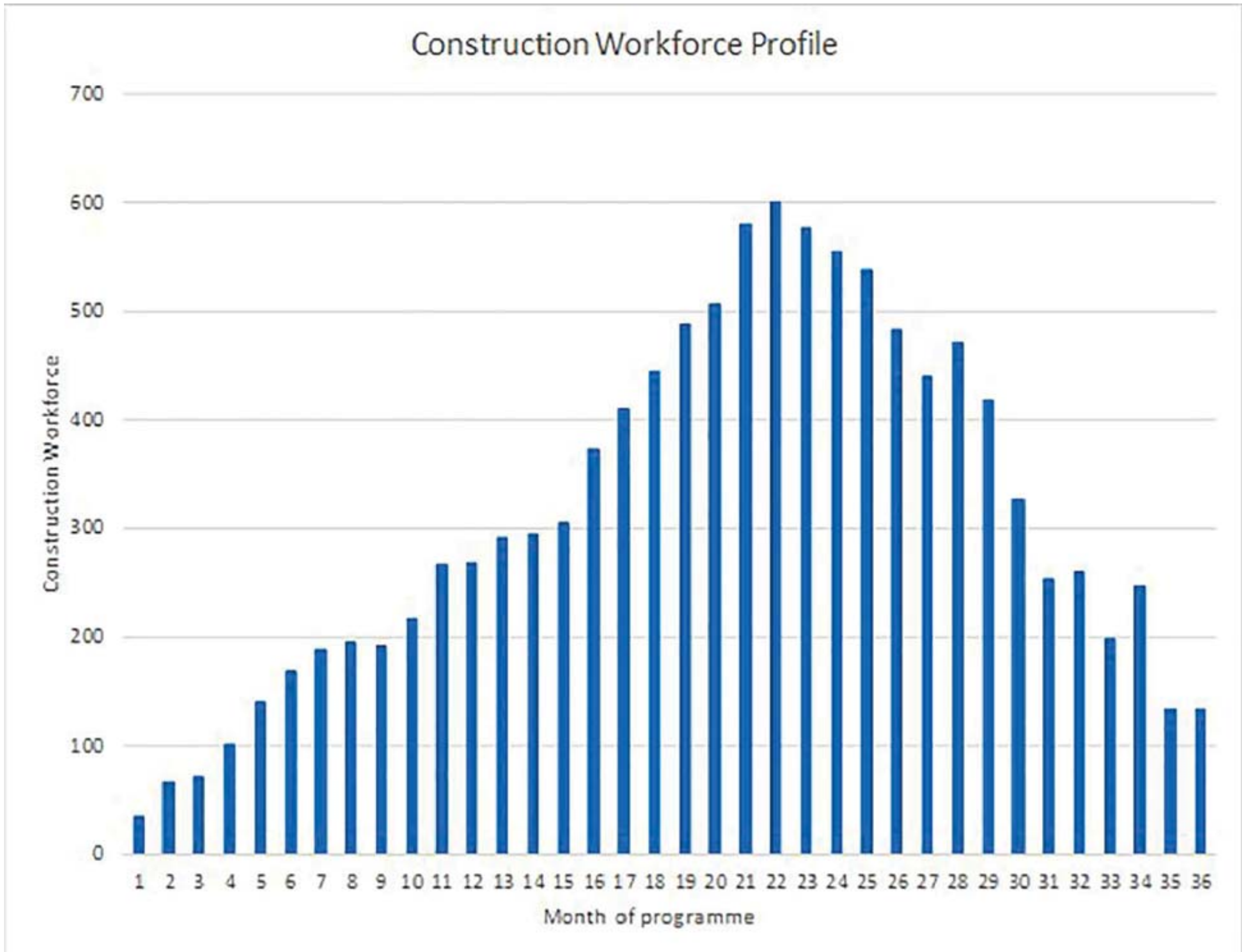
Figure 4.11

Indicative Grid Connection Route

Scale	Date
1:2,500@A1	June 2020

NCC received 16.07.2020

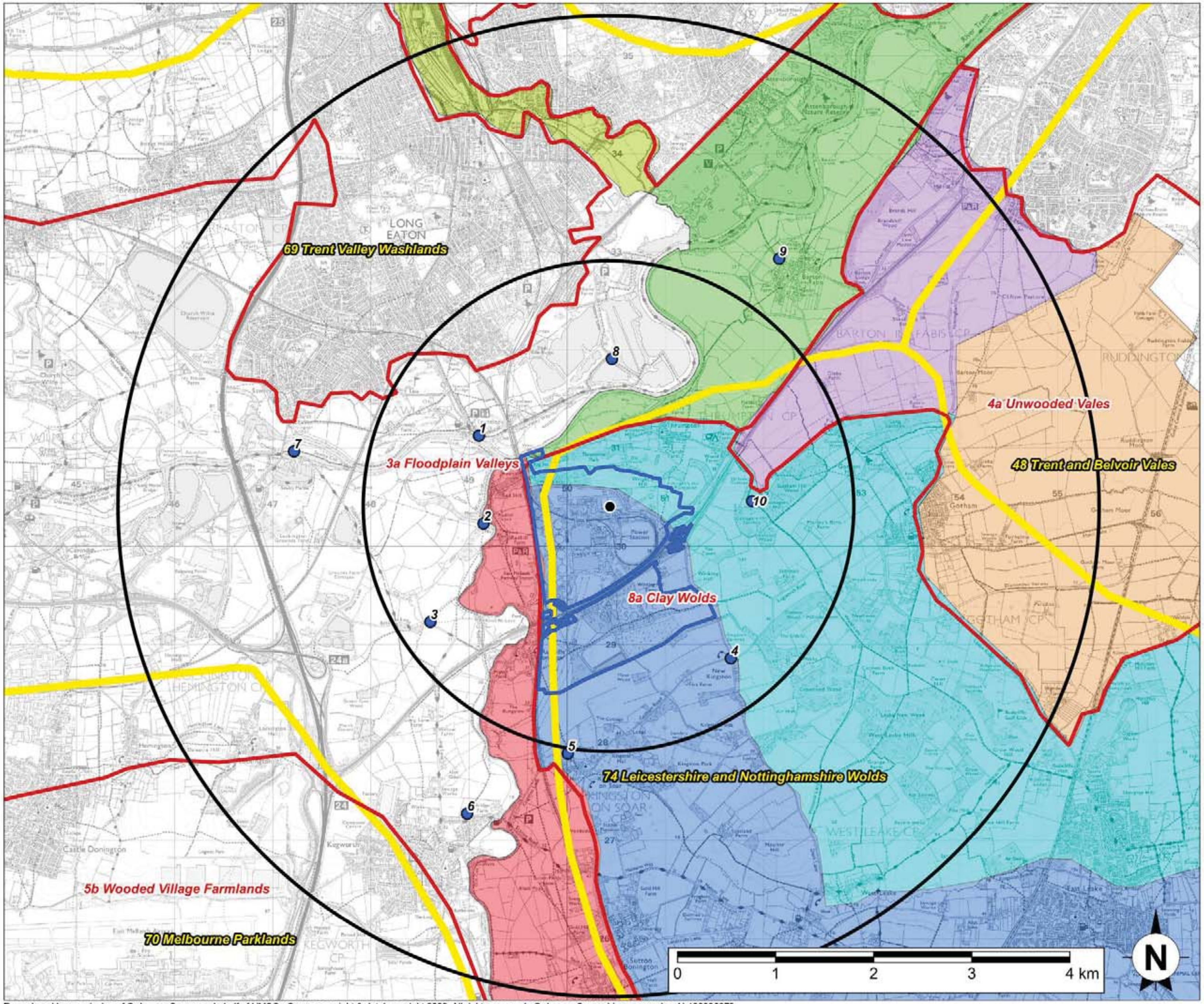
Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 4.12 Construction Workforce Profile.dwg



axis

EMERGE Centre	
Figure 4.12	
Construction Workforce Profile	
Scale NA	Date May 2020

NCC received 16.07.2020



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axis

Key

- Location of Proposed Development
- 2.5km and 5km radius from Proposed Development
- Power Station Boundary
- National Character Area
- Regional Landscape Character Type

Greater Nottingham Landscape Policy Zone

- NC01 River Meadowlands
- NW01 Gotham and West Leake Hills and Scarps
- NW02 East Leake Rolling Farmland
- SN01 Clifton Slopes
- SN02 Ruddington Alluvial Farmland
- TSV01 Attenborough Wetlands
- TSV02 Soar Valley Farmlands

NOTES:
1. The boundaries of Regional Landscape Character Types and the Greater Nottingham Landscape Policy Zone have been digitised from the respective pdf documents available online. There may as a consequence be a limited degree of inaccuracy in the boundaries shown

VIEWPOINTS:
1. Trent Lock
2. Footpath near Redhill Lock
3. Midshires Way, Ratcliffe Lane
4. New Kingston
5. Kingston on Soar
6. Kegworth
7. River Trent, Sawley Cut
8. Pasture Lane
9. Footpath, Barton in Fabis
10. Bridleway, Cottagers Hil

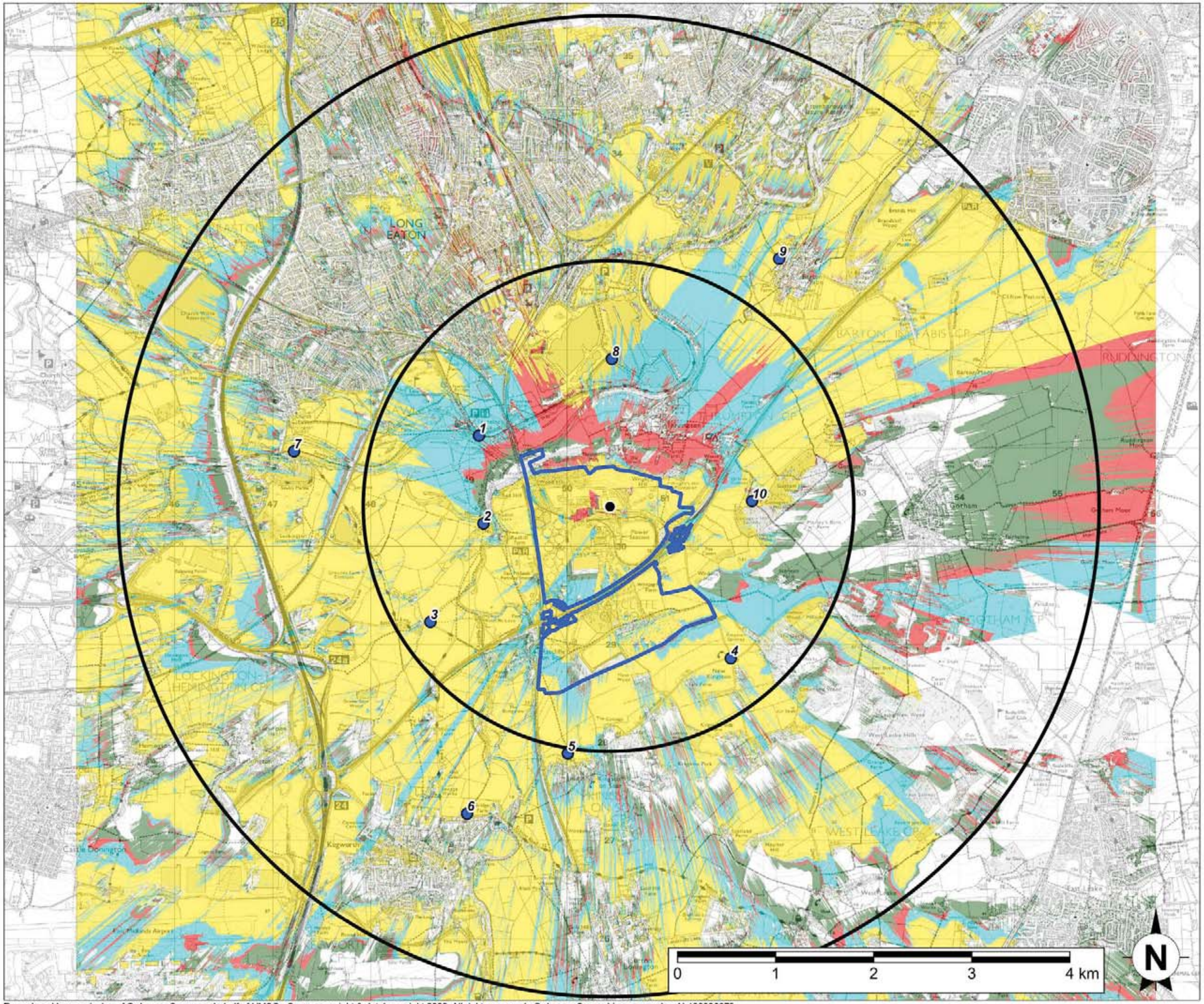
EMERGE Centre

Figure 5.1

Landscape Character

Scale	Date
1:37,500@A3	May 2020

NCC received 16.07.2020



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axis

Key

- Location of Proposed Development
- 2.5km and 5km radius from Proposed Development
- Power Station Boundary
- ZTV of Proposed Boiler House (49.5m)
- ZTV of Existing Gas Turbines Stack (95m)
- ZTV of Proposed Stack (110m)
- ZTV of Existing 199m high stack (to be removed post-2025)
- Viewpoints

VIEWPOINTS:
1. Trent Lock
2. Footpath near Redhill Lock
3. Midshires Way, Ratcliffe Lane
4. New Kingston
5. Kingston on Soar
6. Kegworth
7. River Trent, Sawley Cut
8. Pasture Lane
9. Footpath, Barton in Fabis
10. Bridleway, Cottagers Hil

NOTES:
1. Zone of Theoretical Visibility has been generated using Environment Agency 2m LIDAR digital surface model (DSM) data, which takes account of the screening effects of vegetation, buildings or other structures.

2. Structures not present on site post 2025, have been removed from the DSM.

3. ZTV generation has allowed for the curvature of the earth and light refraction.

4. ZTV has been generated based upon an observer eye height of 1.7m above ground level

EMERGE Centre

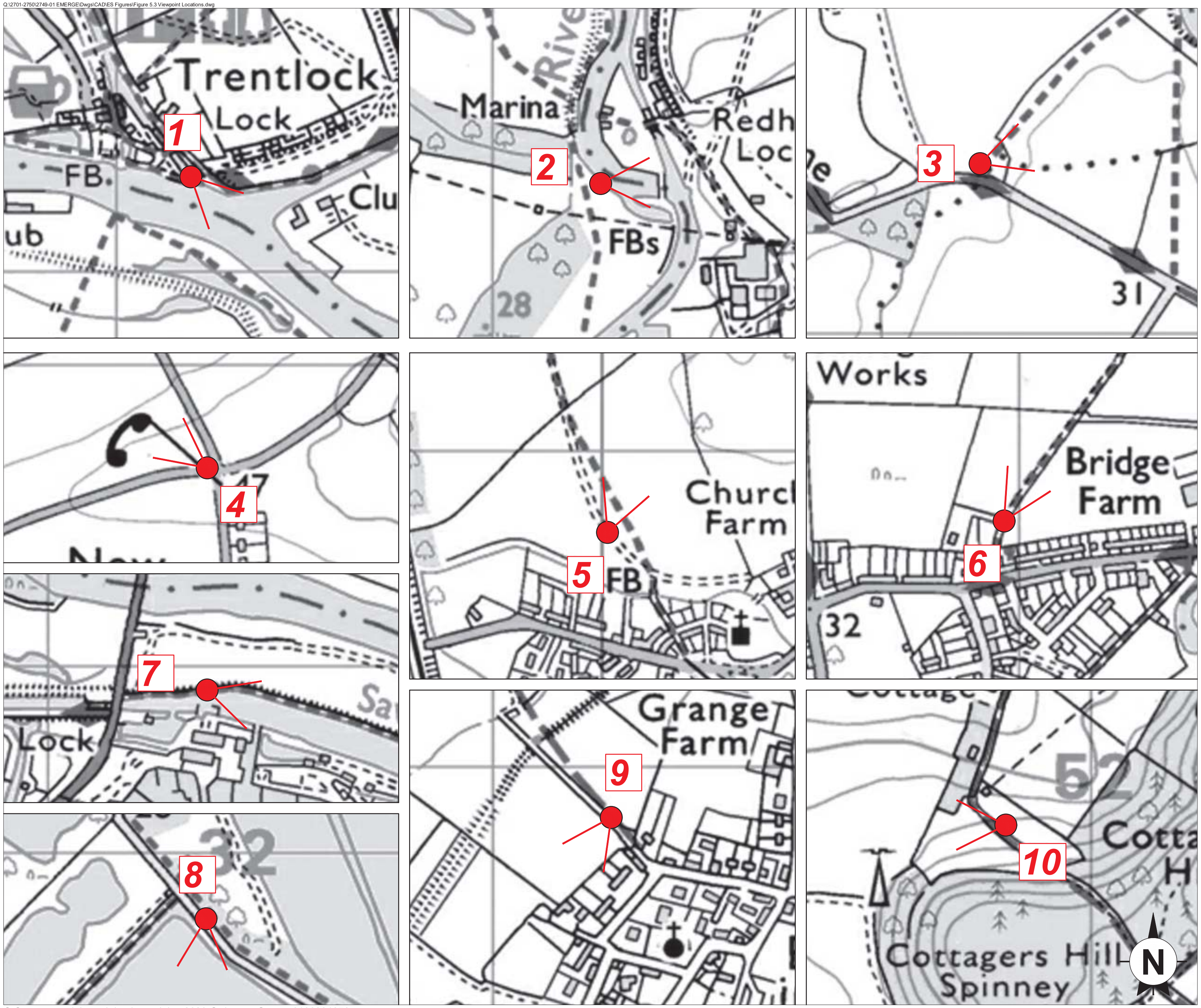
Figure 5.2

ZTV and Viewpoint Locations

Scale	Date
1:37,500@A3	May 2020

NCC received 16.07.2020

Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 5.3 Viewpoint Locations.dwg



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axis

Key:

Viewpoint Location

VIEWPOINTS
1. Trent Lock
2. Footpath near Redhill Lock
3. Midshire Way, Ratcliffe Lane
4. New Kingston
5. Kingston on Soar
6. Kegworth
7. River Trent, Sawley Cut
8. Pasture Lane
9. Footpath, Barton in Fabis
10. Bridleway, Cottagers Hill

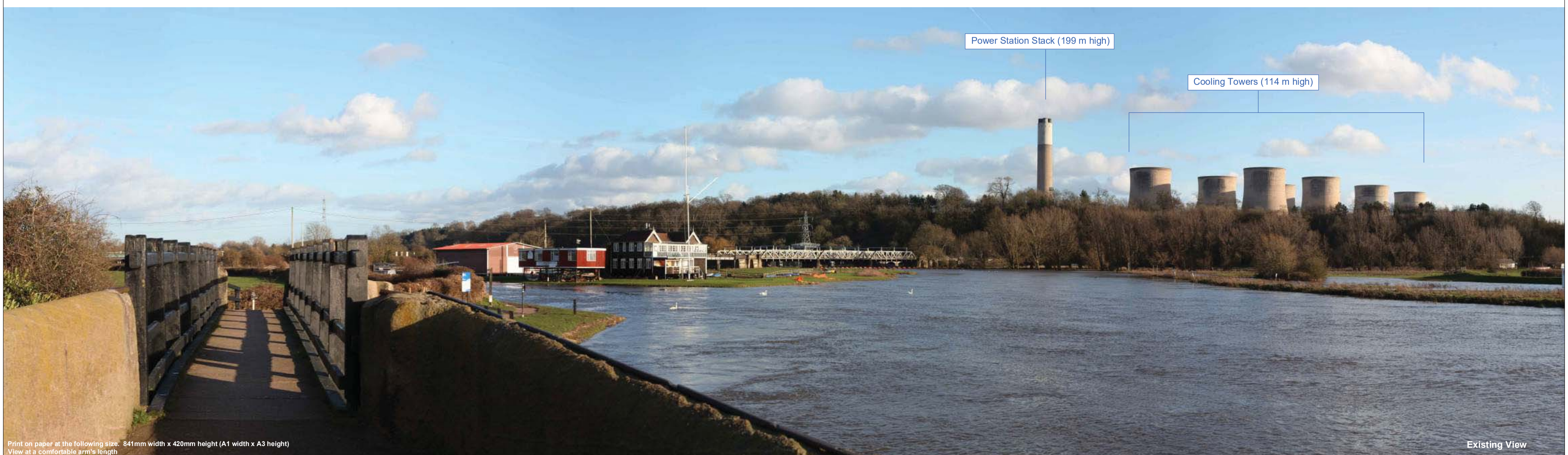
EMERGE Centre

Figure 5.3

Viewpoint Locations

Scale	Date
1:5,000@A3	May 2020

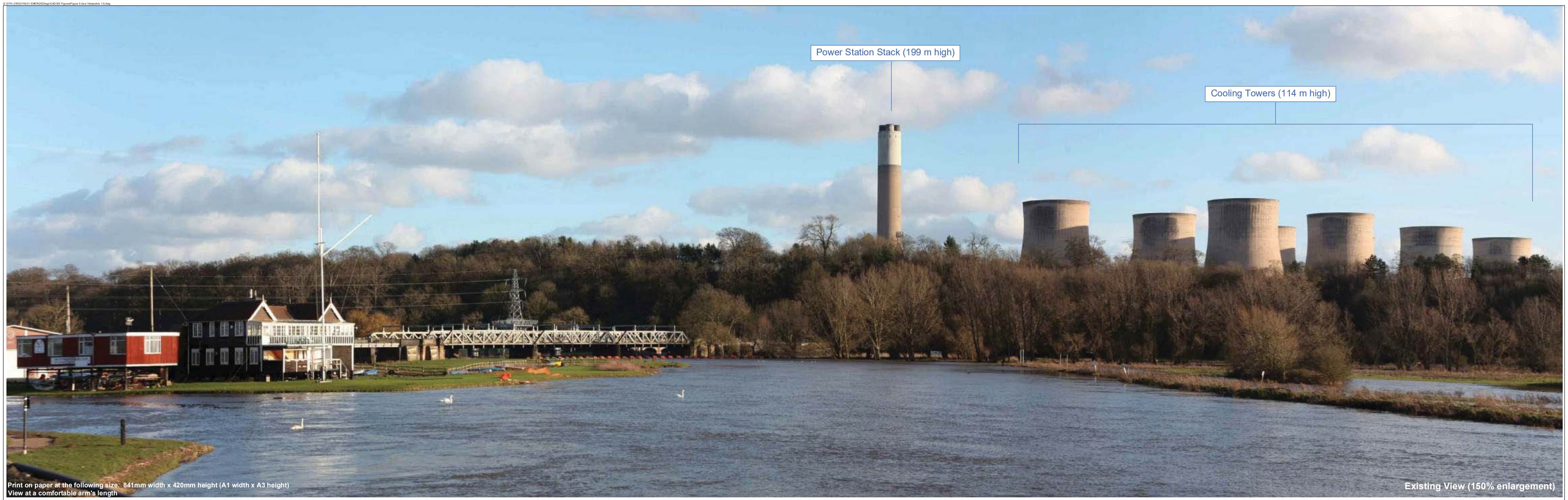
NCC received 16.07.2020



Visualisation Type:	Type 1	**Enlargement Factor:**	96%	**Camera:**	Canon EOS 5D FFS	**HFoV:**	90°
Projection:	Cylindrical	**Date and Time of Photograph:**	12/02/20 15:32	**Lens:**	Canon EF 50mm 1:1.8 II	**Direction of View:**	South-east

EMERGE CENTRE
Figure 5.4a (i) Viewpoint 1: Trent Lock

NCC received 16.07.2020

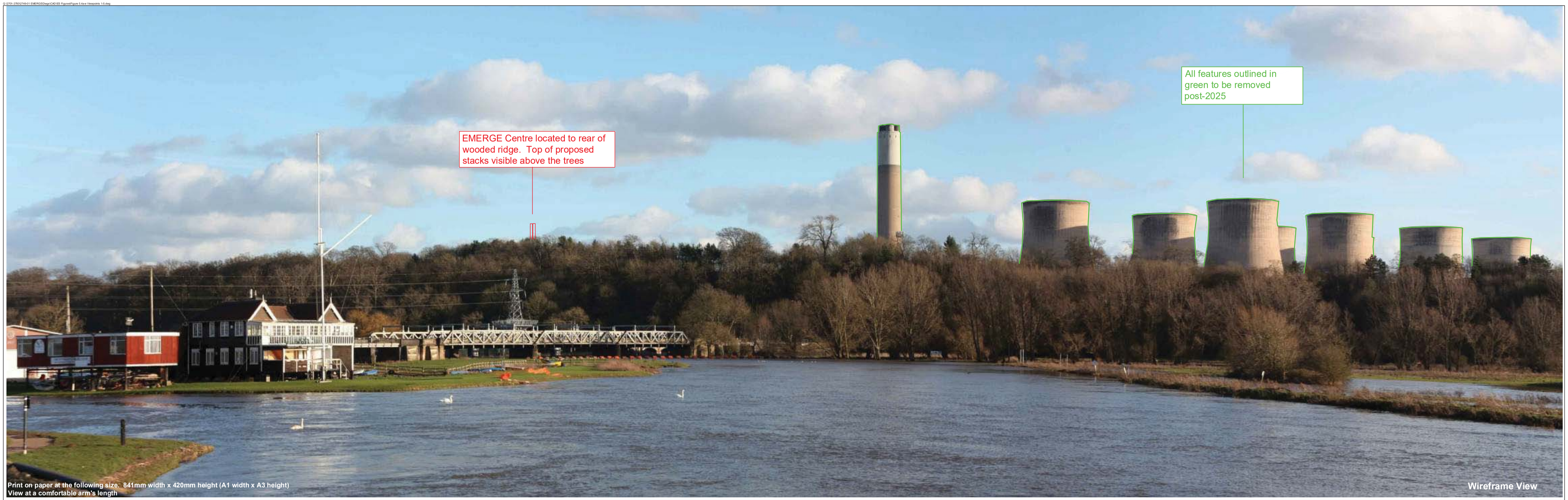


Visualisation Type:	Type 1	**Enlargement Factor:**	150%	**Camera:**	Canon EOS 5D FFS	**HFoV:**	53.5°
Projection:	Planar	**Date and Time of Photograph:**	12/02/20 15:32	**Lens:**	Canon EF 50mm 1:1.8 II	**Direction of View:**	South-east

EMERGE CENTRE
Figure 5.4a (ii) Viewpoint 1: Trent Lock

axis

NCC received 16.07.2020



Visualisation Type:	Type 4	**Enlargement Factor:**	150%	**Camera:**	Canon EOS 5D FFS	**HFoV:**	53.5°
Projection:	Planar	**Date and Time of Photograph:**	12/02/20 15:32	**Lens:**	Canon EF 50mm 1:1.8 II	**Direction of View:**	South-east

EMERGE CENTRE
Figure 5.4a (iii) Viewpoint 1: Trent Lock

axis

NCC received 16.07.2020

Visualisation Type: Type 1	**Enlargement Factor:**	96%	**Camera:**	Canon EOS 5D FFS	**HFoV:**	90°	
Projection: Cylindrical	**Date and Time of Photograph:**	12/02/20 14:24	**Lens:**	Canon EF 50mm 1:1.8 II	**Direction of View:**	East	

EMERGE CENTRE
Figure 5.4b (i) Viewpoint 2: Footpath near Redhill Lock

NCC received 16.07.2020

Visualisation Type:	Type 1	**Enlargement Factor:**	150%	**Camera:**	Canon EOS 5D FFS	**HFoV:**	53.5°
Projection:	Planar	**Date and Time of Photograph:**	12/02/20 14:24	**Lens:**	Canon EF 50mm 1:1.8 II	**Direction of View:**	East

EMERGE CENTRE

Figure 5.4b (ii) Viewpoint 2: Footpath near Redhill Lock

axis

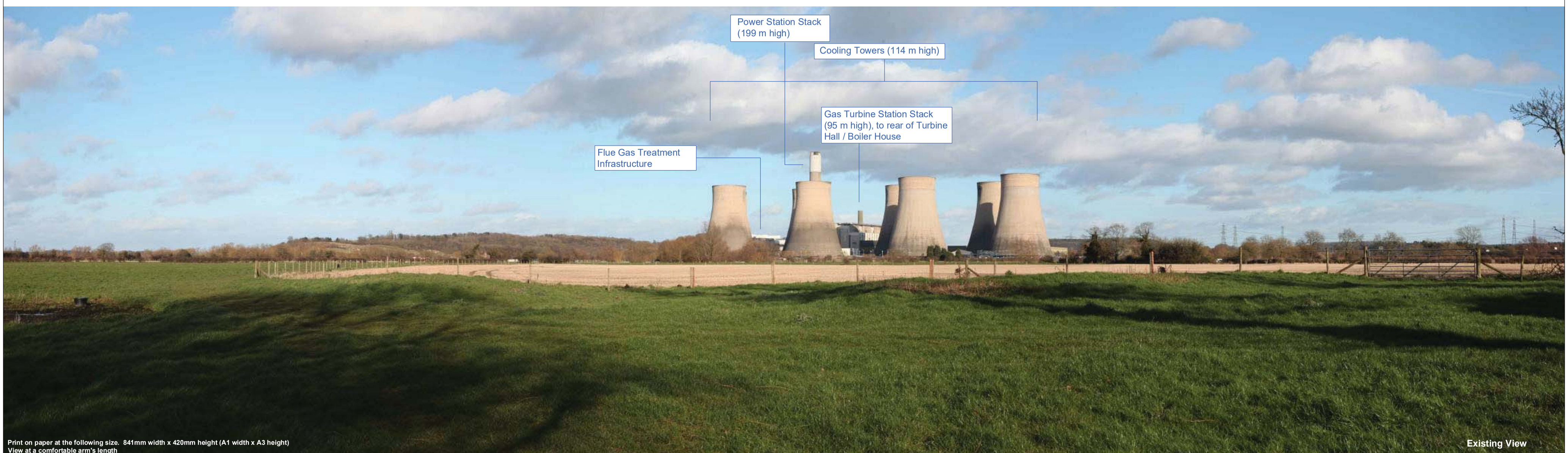
NCC received 16.07.2020

Visualisation Type:	Type 4	**Enlargement Factor:**	150%	**Camera:**	Canon EOS 5D FFS	**HFoV:**	53.5°
Projection:	Planar	**Date and Time of Photograph:**	12/02/20 14:24	**Lens:**	Canon EF 50mm 1:1.8 II	**Direction of View:**	East

EMERGE CENTRE
Figure 5.4b (iii) Viewpoint 2: Footpath near Redhill Lock

axis

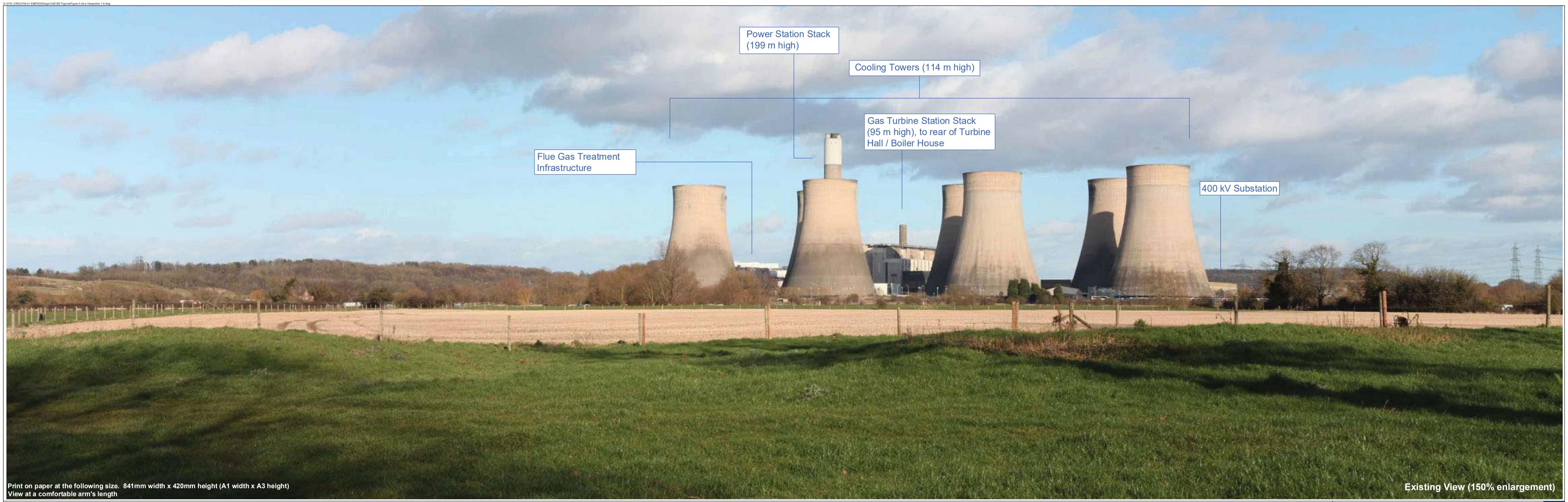
NCC received 16.07.2020



Visualisation Type:	Type 1	**Enlargement Factor:**	96%	**Camera:**	Canon EOS 5D FFS	**HFoV:**	90°
Projection:	Cylindrical	**Date and Time of Photograph:**	12/02/20 14:45	**Lens:**	Canon EF 50mm 1:1.8 II	**Direction of View:**	North-east

EMERGE CENTRE
Figure 5.4c (i) Viewpoint 3: Midshires Way, Ratcliffe Lane

NCC received 16.07.2020



Visualisation Type:	Type 1	**Enlargement Factor:**	150%	**Camera:**	Canon EOS 5D FFS	**HFoV:**	53.5°
Projection:	Planar	**Date and Time of Photograph:**	12/02/20 14:45	**Lens:**	Canon EF 50mm 1:1.8 II	**Direction of View:**	North-east

EMERGE CENTRE
Figure 5.4c (ii) Viewpoint 3: Midshires Way, Ratcliffe Lane

axis

NCC received 16.07.2020

Visualisation Type:	Type 4	**Enlargement Factor:**	150%	**Camera:**	Canon EOS 5D FFS	**HFoV:**	53.5°
Projection:	Planar	**Date and Time of Photograph:**	12/02/20 14:45	**Lens:**	Canon EF 50mm 1:1.8 II	**Direction of View:**	North-east

EMERGE CENTRE
Figure 5.4c (iii) Viewpoint 3: Midshires Way, Ratcliffe Lane

axis

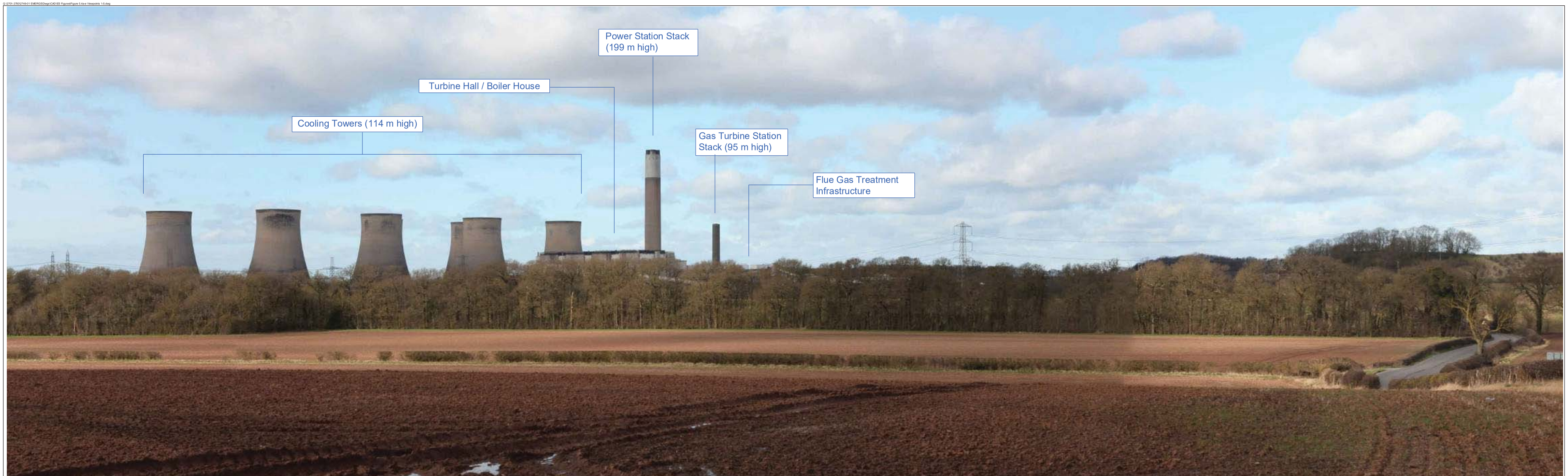
NCC received 16.07.2020

Visualisation Type:	Type 1	**Enlargement Factor:**	96%	**Camera:**	Canon EOS 5D FFS	**HFoV:**	90°
Projection:	Cylindrical	**Date and Time of Photograph:**	12/02/20 12:35	**Lens:**	Canon EF 50mm 1:1.8 II	**Direction of View:**	North-west

EMERGE CENTRE
Figure 5.4d (i) Viewpoint 4: New Kingston

axis

NCC received 16.07.2020



Print on paper at the following size: 841mm width x 420mm height (A1 width x A3 height)
View at a comfortable arm's length

Existing View (150% enlargement)

Visualisation Type:	Type 1	**Enlargement Factor:**	150%	**Camera:**	Canon EOS 5D FFS	**HFoV:**	53.5°
Projection:	Planar	**Date and Time of Photograph:**	12/02/20 12:35	**Lens:**	Canon EF 50mm 1:1.8 II	**Direction of View:**	North-west

EMERGE CENTRE
Figure 5.4d (ii) Viewpoint 4: New Kingston

axis

NCC received 16.07.2020

Visualisation Type:	Type 4	**Enlargement Factor:**	150%	**Camera:**	Canon EOS 5D FFS	**HFoV:**	53.5°
Projection:	Planar	**Date and Time of Photograph:**	12/02/20 12:35	**Lens:**	Canon EF 50mm 1:1.8 II	**Direction of View:**	North-west

EMERGE CENTRE
Figure 5.4d (iii) Viewpoint 4: New Kingston

axis

NCC received 16.07.2020

Visualisation Type:	Type 1	**Enlargement Factor:**	96%	**Camera:**	Canon EOS 5D FFS	**HFoV:**	90°	EMERGE CENTRE
Projection:	Cylindrical	**Date and Time of Photograph:**	12/02/20 12:51	**Lens:**	Canon EF 50mm 1:1.8 II	**Direction of View:**	North	**Figure 5.4e (i) Viewpoint 5:** Kingston on Soar

NCC received 16.07.2020

Visualisation Type:	Type 1	**Enlargement Factor:**	150%	**Camera:**	Canon EOS 5D FFS	**HFoV:**	53.5°
Projection:	Planar	**Date and Time of Photograph:**	12/02/20 12:51	**Lens:**	Canon EF 50mm 1:1.8 II	**Direction of View:**	North

EMERGE CENTRE
Figure 5.4e (ii) Viewpoint 5: Kingston on Soar

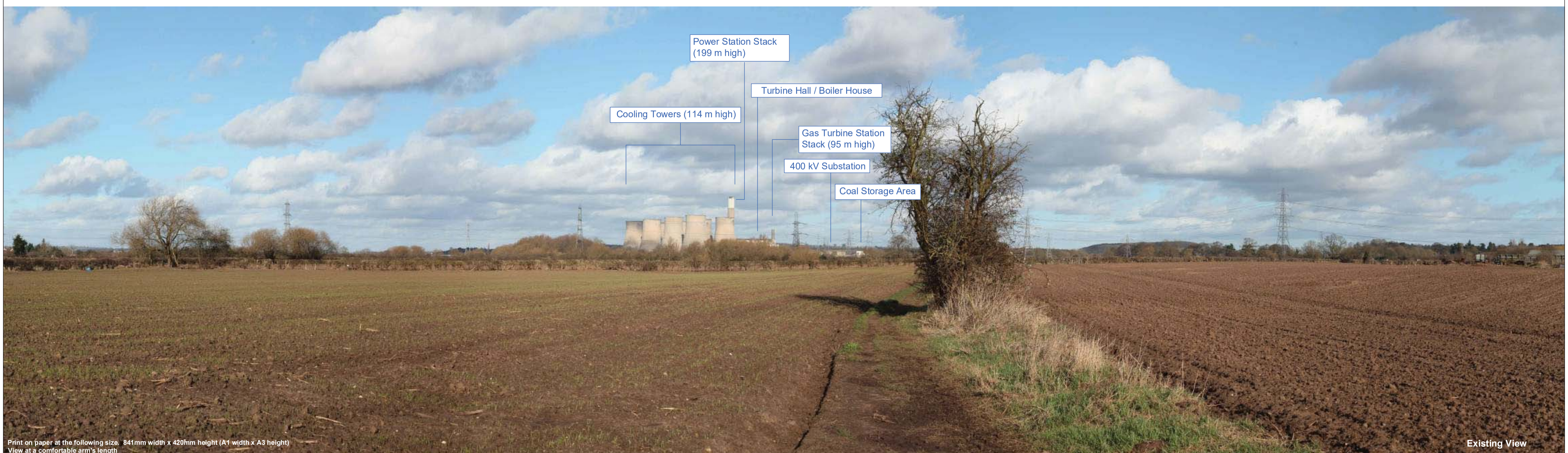
axis

NCC received 16.07.2020

Visualisation Type:	Type 4	**Enlargement Factor:**	150%	**Camera:**	Canon EOS 5D FFS	**HFoV:**	53.5°		EMERGE CENTRE
Projection:	Planar	**Date and Time of Photograph:**	12/02/20 12:51	**Lens:**	Canon EF 50mm 1:1.8 II	**Direction of View:**	North		**Figure 5.4e (iii) Viewpoint 5:** Kingston on Soar

axis

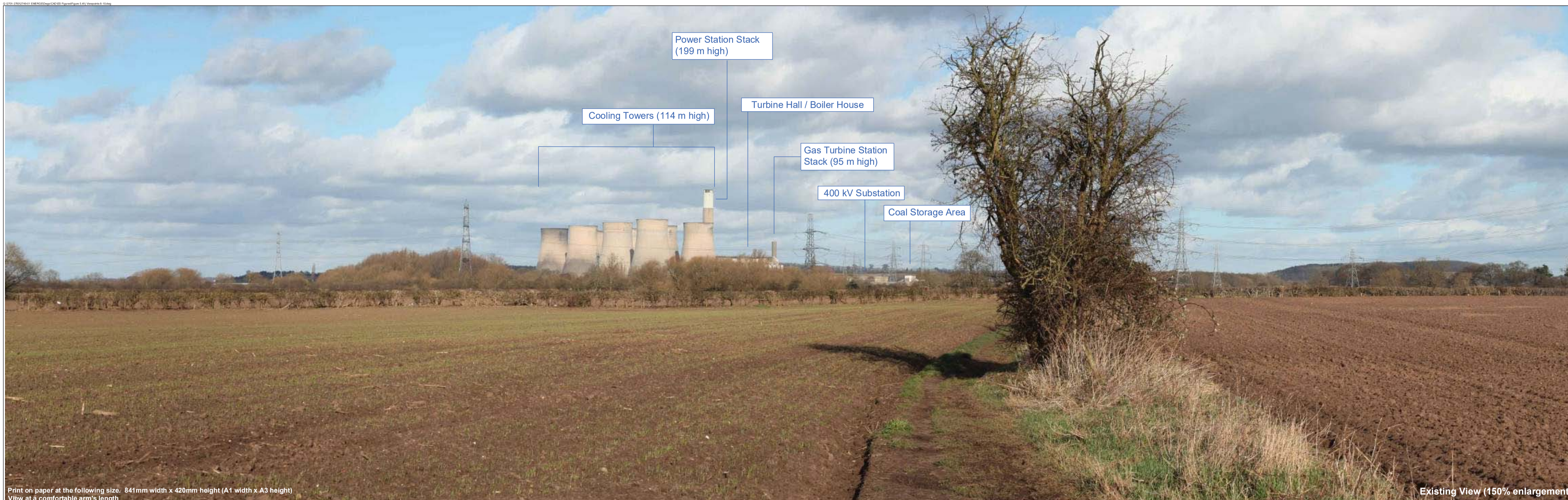
NCC received 16.07.2020



Visualisation Type:	Type 1	**Enlargement Factor:**	96%	**Camera:**	Canon EOS 5D FFS	**HFoV:**	90°
Projection:	Cylindrical	**Date and Time of Photograph:**	12/02/20 13:12	**Lens:**	Canon EF 50mm 1:1.8 II	**Direction of View:**	North-north-east

EMERGE CENTRE
Figure 5.4f (i) Viewpoint 6: Kegworth

NCC received 16.07.2020

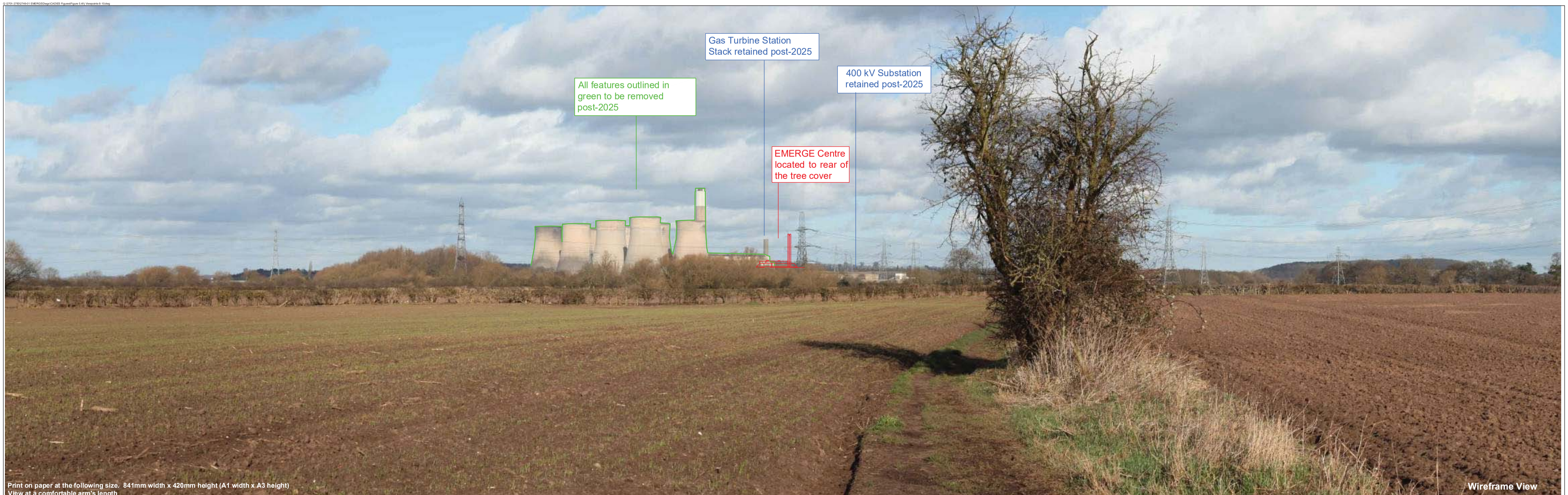


Visualisation Type:	Type 1	**Enlargement Factor:**	150%	**Camera:**	Canon EOS 5D FFS	**HFoV:**	53.5°
Projection:	Planar	**Date and Time of Photograph:**	12/02/20 13:12	**Lens:**	Canon EF 50mm 1:1.8 II	**Direction of View:**	North-north-east

EMERGE CENTRE
Figure 5.4f (ii) Viewpoint 6: Kegworth

axis

NCC received 16.07.2020



Visualisation Type:	Type 4	**Enlargement Factor:**	150%	**Camera:**	Canon EOS 5D FFS	**HFoV:**	53.5°
Projection:	Planar	**Date and Time of Photograph:**	12/02/20 13:12	**Lens:**	Canon EF 50mm 1:1.8 II	**Direction of View:**	North-north-east

EMERGE CENTRE
Figure 5.4f (iii) Viewpoint 6: Kegworth

axis

NCC received 16.07.2020

Visualisation Type:	Type 1	**Enlargement Factor:**	96%	**Camera:**	Canon EOS 5D FFS	**HFoV:**	90°
Projection:	Cylindrical	**Date and Time of Photograph:**	12/02/20 15:09	**Lens:**	Canon EF 50mm 1:1.8 II	**Direction of View:**	East

EMERGE CENTRE
Figure 5.4g (i) Viewpoint 7: River Trent, Sawley Cut

axis

NCC received 16.07.2020

Visualisation Type:	Type 1	**Enlargement Factor:**	150%	**Camera:**	Canon EOS 5D FFS	**HFoV:**	53.5°
Projection:	Planar	**Date and Time of Photograph:**	12/02/20 15:09	**Lens:**	Canon EF 50mm 1:1.8 II	**Direction of View:**	East

EMERGE CENTRE
Figure 5.4g (ii) Viewpoint 7: River Trent, Sawley Cut

NCC received 16.07.2020

Visualisation Type:	Type 4	**Enlargement Factor:**	150%	**Camera:**	Canon EOS 5D FFS	**HFoV:**	53.5°
Projection:	Planar	**Date and Time of Photograph:**	12/02/20 15:09	**Lens:**	Canon EF 50mm 1:1.8 II	**Direction of View:**	East

EMERGE CENTRE
Figure 5.4g (iii) Viewpoint 7: River Trent, Sawley Cut

axis

NCC received 16.07.2020

Visualisation Type:	Type 1	**Enlargement Factor:**	96%	**Camera:**	Canon EOS 5D FFS	**HFoV:**	90°	EMERGE CENTRE
Projection:	Cylindrical	**Date and Time of Photograph:**	12/02/20 10:49	**Lens:**	Canon EF 50mm 1:1.8 II	**Direction of View:**	South	**Figure 5.4h (i) Viewpoint 8:** Pasture Lane

axis

NCC received 16.07.2020

Visualisation Type:	Type 1	**Enlargement Factor:**	150%	**Camera:**	Canon EOS 5D FFS	**HFoV:**	53.5°
Projection:	Planar	**Date and Time of Photograph:**	12/02/20 10:49	**Lens:**	Canon EF 50mm 1:1.8 II	**Direction of View:**	South

EMERGE CENTRE
Figure 5.4h (ii) Viewpoint 8: Pasture Lane

axis

NCC received 16.07.2020

Visualisation Type:	Type 4	**Enlargement Factor:**	150%	**Camera:**	Canon EOS 5D FFS	**HFoV:**	53.5°
Projection:	Planar	**Date and Time of Photograph:**	12/02/20 10:49	**Lens:**	Canon EF 50mm 1:1.8 II	**Direction of View:**	South

EMERGE CENTRE
Figure 5.4h (iii) Viewpoint 8: Pasture Lane

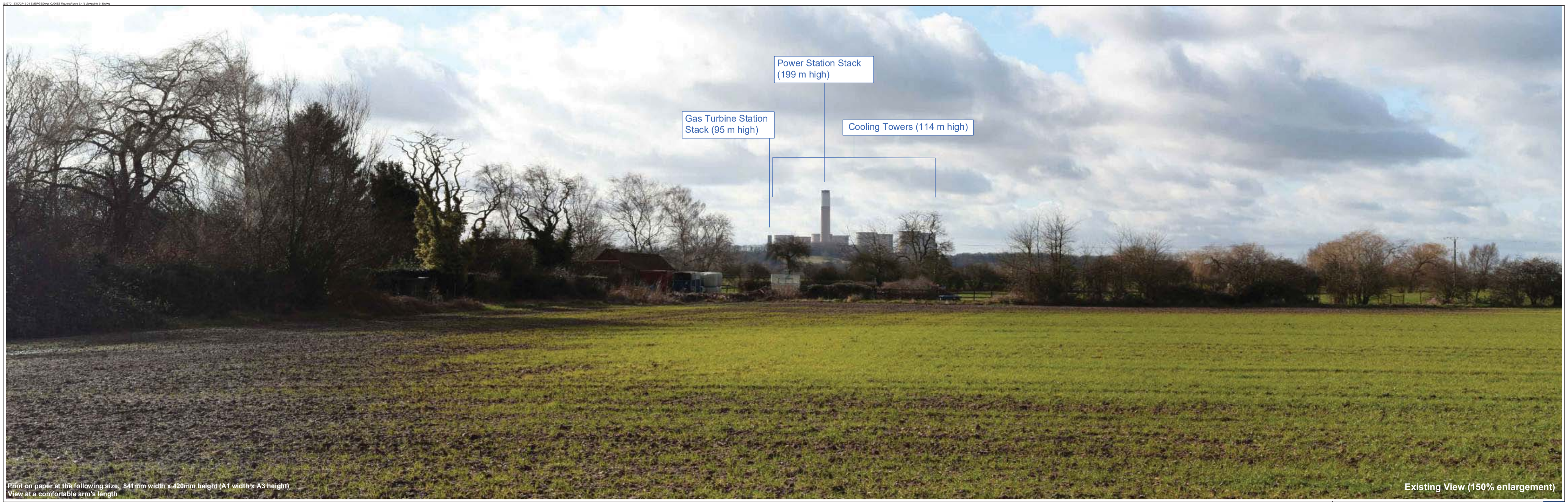
axis

NCC received 16.07.2020

Visualisation Type: Type 1	**Enlargement Factor:**	96%	**Camera:**	Canon EOS 5D FFS	**HFoV:**	90°	
Projection: Cylindrical	**Date and Time of Photograph:**	12/02/20 11:36	**Lens:**	Canon EF 50mm 1:1.8 II	**Direction of View:**	South-west	

EMERGE CENTRE
Figure 5.4i (i) Viewpoint 9: Footpath, Barton in Fabis

NCC received 16.07.2020

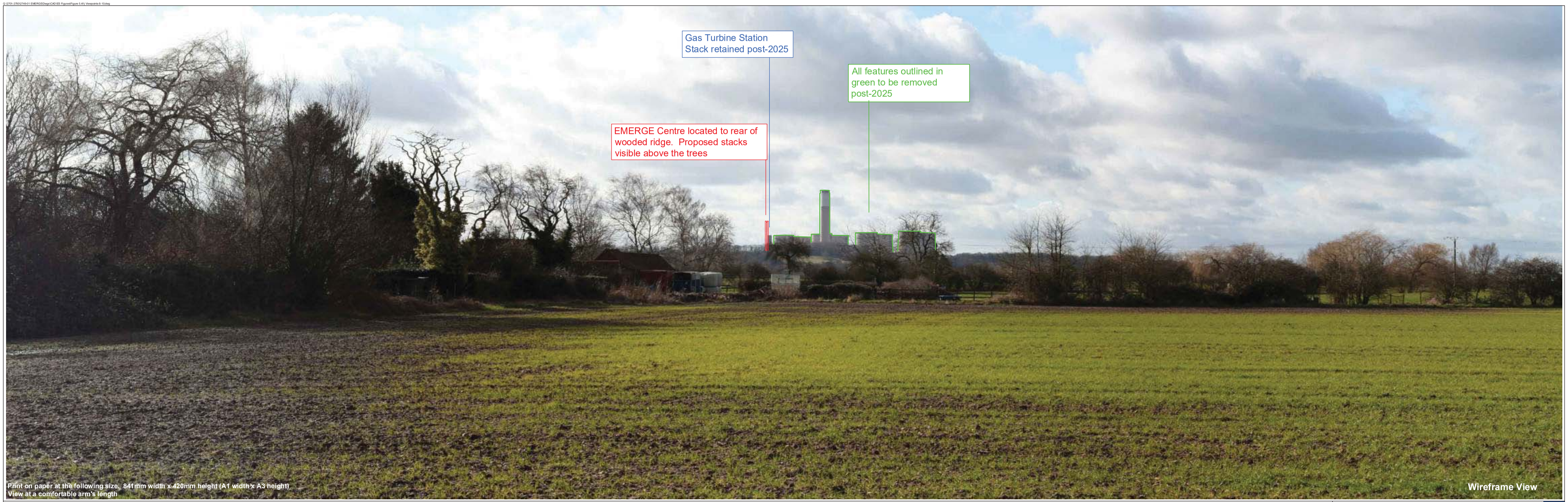


Visualisation Type:	Type 1	**Enlargement Factor:**	150%	**Camera:**	Canon EOS 5D FFS	**HFoV:**	53.5°
Projection:	Planar	**Date and Time of Photograph:**	12/02/20 11:36	**Lens:**	Canon EF 50mm 1:1.8 II	**Direction of View:**	South-west

EMERGE CENTRE
Figure 5.4i (ii) Viewpoint 9: Footpath, Barton in Fabis

axis

NCC received 16.07.2020



Visualisation Type:	Type 4	**Enlargement Factor:**	150%	**Camera:**	Canon EOS 5D FFS	**HFoV:**	53.5°
Projection:	Planar	**Date and Time of Photograph:**	12/02/20 11:36	**Lens:**	Canon EF 50mm 1:1.8 II	**Direction of View:**	South-west

EMERGE CENTRE
Figure 5.4i (iii) Viewpoint 9: Footpath, Barton in Fabis

axis

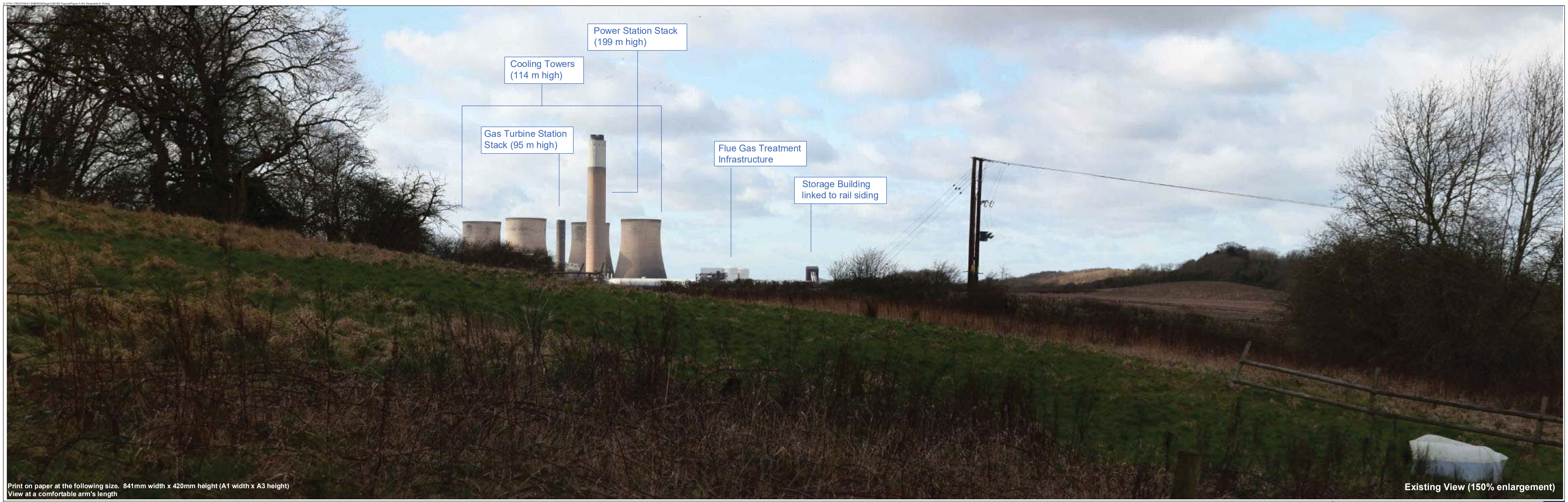
NCC received 16.07.2020

Visualisation Type:	Type 1	**Enlargement Factor:**	96%	**Camera:**	Canon EOS 5D FFS	**HFoV:**	90°
Projection:	Cylindrical	**Date and Time of Photograph:**	12/02/20 12:09	**Lens:**	Canon EF 50mm 1:1.8 II	**Direction of View:**	West

EMERGE CENTRE
Figure 5.4j (i) Viewpoint 10: Bridleway, Cottagers Hill

axis

NCC received 16.07.2020



Visualisation Type:	Type 1	**Enlargement Factor:**	150%	**Camera:**	Canon EOS 5D FFS	**HFoV:**	53.5°
Projection:	Planar	**Date and Time of Photograph:**	12/02/20 12:09	**Lens:**	Canon EF 50mm 1:1.8 II	**Direction of View:**	West

EMERGE CENTRE
Figure 5.4j (ii) Viewpoint 10: Bridleway, Cottagers Hill

NCC received 16.07.2020

Print on paper at the following size. 841mm width x 420mm height (A1 width x A3 height)
View at a comfortable arm's length

Visualisation Type:	Type 4	**Enlargement Factor:**	150%	**Camera:**	Canon EOS 5D FFS	**HFoV:**	53.5°
Projection:	Planar	**Date and Time of Photograph:**	12/02/20 12:09	**Lens:**	Canon EF 50mm 1:1.8 II	**Direction of View:**	West

EMERGE CENTRE
Figure 5.4j (iii) Viewpoint 10: Bridleway, Cottagers Hill

axis

NCC received 16.07.2020

Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 5.5a-b Illustrative Landscape Design.dwg

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axis

Key:

- Native Woodland Copse
- Birch Woodland with Herbaceous Understorey
- Semi-mature Fastigiate Oak
- Native Hedgerow
- Species-rich Mown Grassland
- Herbaceous Perennial Meadow
- Swale (approx depth 600 mm)
- Reedbed
- Footpath
- Headwalls for incoming/ outgoing surface water drainage
- Inset (see Sheet 2)

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Figure 5.5a	
Illustrative Landscape Design: Sheet 1 of 2 Overview	
Scale 1:1250@A3	Date May 2020

NCC received 16.07.2020

Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 5.5a-b Illustrative Landscape Design.dwg

axis

Key:

- Birch Woodland with Herbaceous Understorey
- Semi-mature Fastigiate Oak
- Native Hedgerow
- Species-rich Mown Grassland
- Herbaceous Perennial Meadow
- Swale (approx depth 600 mm)
- Reedbed
- Footpath
- Bench
- Entrance Sign
- Headwalls for incoming/ outgoing surface water drainage

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Figure 5.5b

Illustrative Landscape Design: Sheet 2 Inset

Scale	Date
1:250@A3	May 2020

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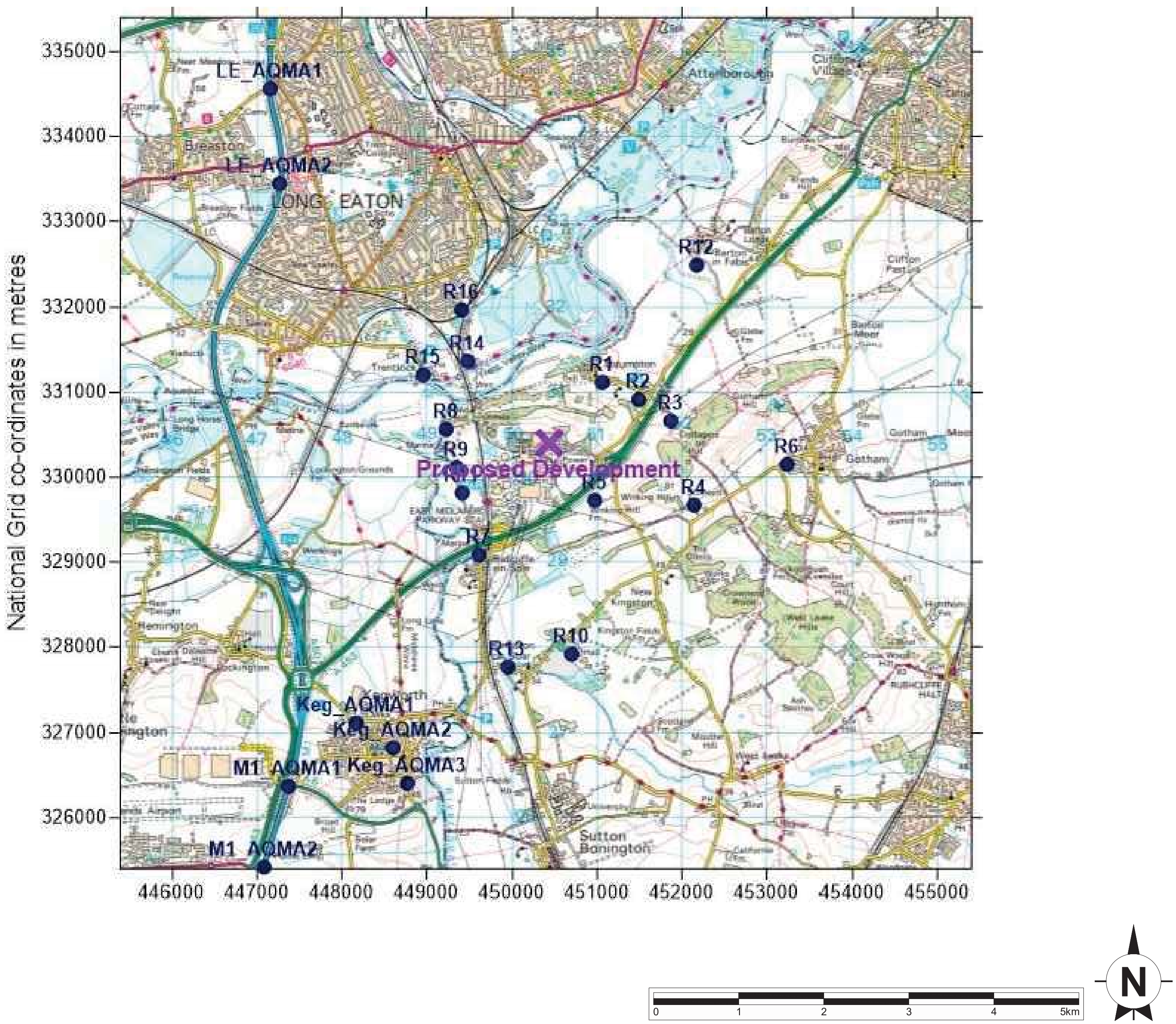
NCC received 16.07.2020

Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 8.1 Proposed Development and Human Health Receptor Locations.dwg



axis

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Figure 8.1

Proposed Development and Human Health Receptor Locations

Scale	Date
1:50,000@A3	May 2020

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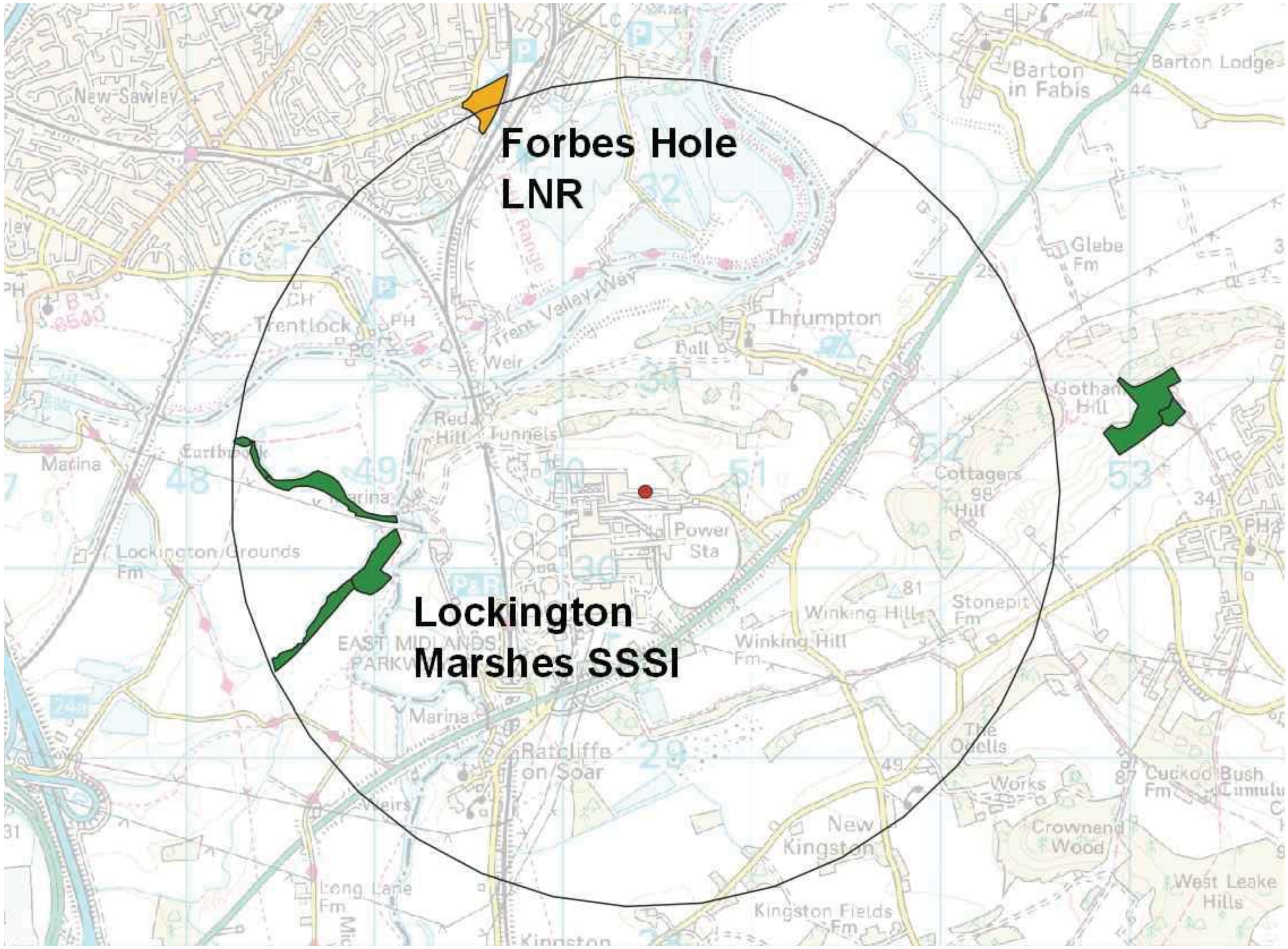
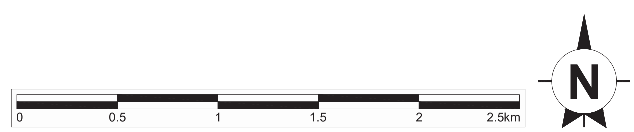
NCC received 16.07.2020

Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 8.2 Map showing SSSI and LNRs within 2 km of the Proposed Development.dwg



Note that the screened area is based on a 2.2 km radius to account for the site boundary



axis

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Figure 8.2

Sites of Special Scientific interest (SSSIs) and Local Nature Reserves (LNRs) within 2 km of the Proposed Development

Scale	Date
1:25,000@A3	May 2020

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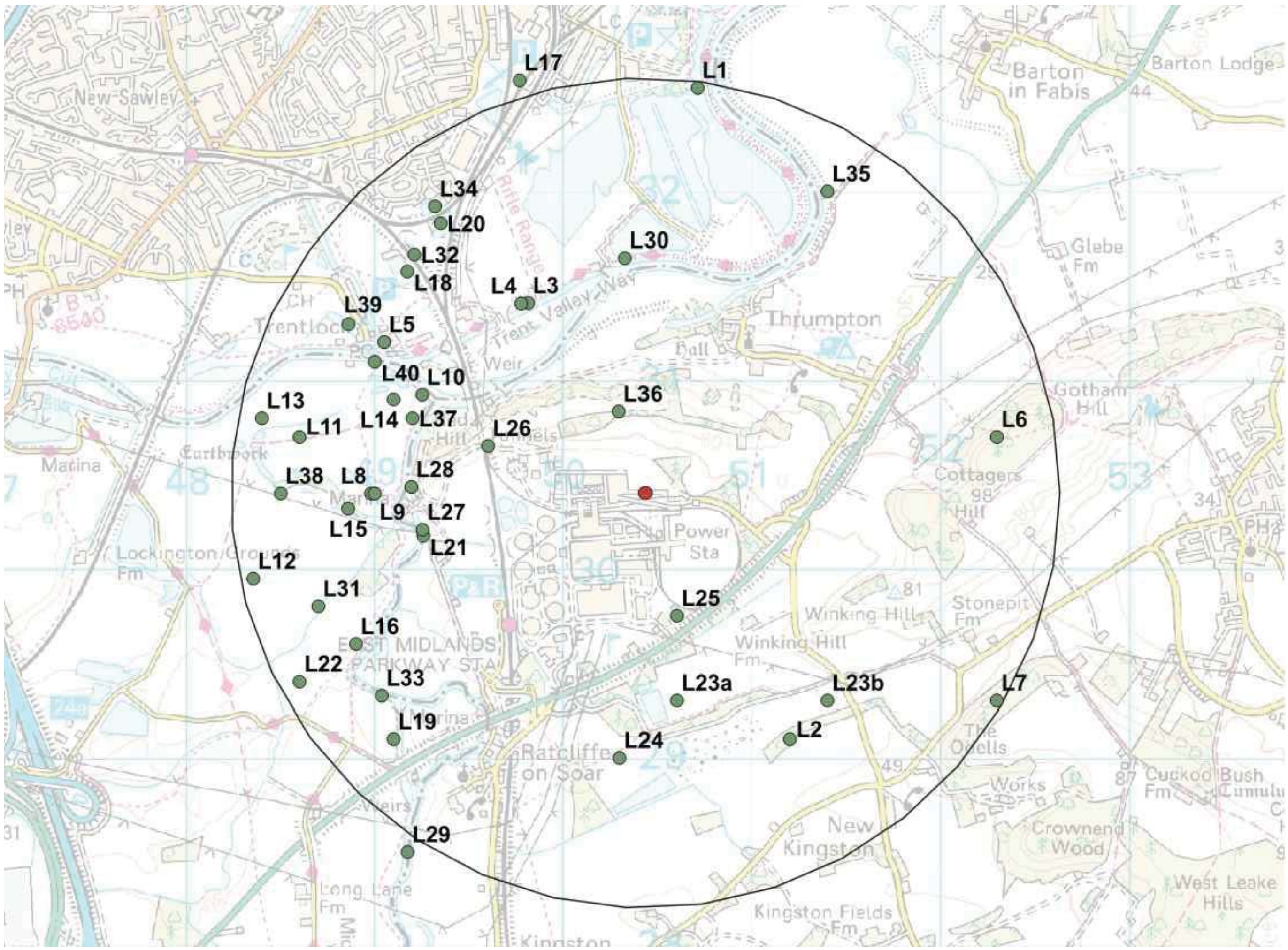
Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 8.3 Map showing Local Wildlife Sites within 2 km of the Proposed Development.dwg



Note that the screened area is based on a 2.2 km radius to account for the site boundary

L1	Attenborough West Gravel Pits
L2	Copse Kingston-on-Soar
L3	Cranfleet Farm Floodbanks
L4	Cranfleet Ponds (West Pond)
L5	Erewash Canal
L6	Gotham Hill Woods
L7	Gotham Wood
L8	Lockington Ash
L9	Lockington Ash 2
L10	Lockington Confluence Backwater
L11	Lockington Confluence Hedges
L12	Lockington Fen
L13	Lockington Grounds, pond and marsh near Trent
L14	Lockington Trentside Pools
L15	Lockington swamp by SSSI
L16	Lower Soar Floodplain Wetland
L17	Meadow Lane Carr
L18	Narrow Bridge Fish Pond
L19	Pond in hedgeline between two improved grasslands
L20	Poplars Fish Pond
L21	Rare Plant Register Mousetail Pasture
L22	Ratcliffe Lane Pasture and Stream
L23a	Ratcliffe-on-Soar Flyash Grassland1
L23b	Ratcliffe-on-Soar Flyash Grassland2
L24	Ratcliffe-on-Soar Flyash Track Grassland
L25	Ratcliffe-on-Soar Pond
L26	Red Hill Ratcliffe on Soar
L27	Redhill Marina Backwater
L28	River Soar Loughborough Meadows to Trent
L29	River Soar West Bank south of A453
L30	River Trent North Bank
L31	Shooting Ground Marsh Grassland, Lockington
L32	Sheetstores Junction Pond
L33	Soar Meadow near Ratcliffe Lock
L34	South Junction Pond
L35	Thrumpton Bank
L36	Thrumpton Park
L37	Trent Floodplain Wetland - Lock M07
L38	Trent Floodplain Wetland Lock M13
L39	Trent Lock Marsh
L40	River Trent

axis

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Figure 8.3

Local Wildlife Sites within 2 km of the Proposed Development

Scale	Date
1:25,000@A3	May 2020

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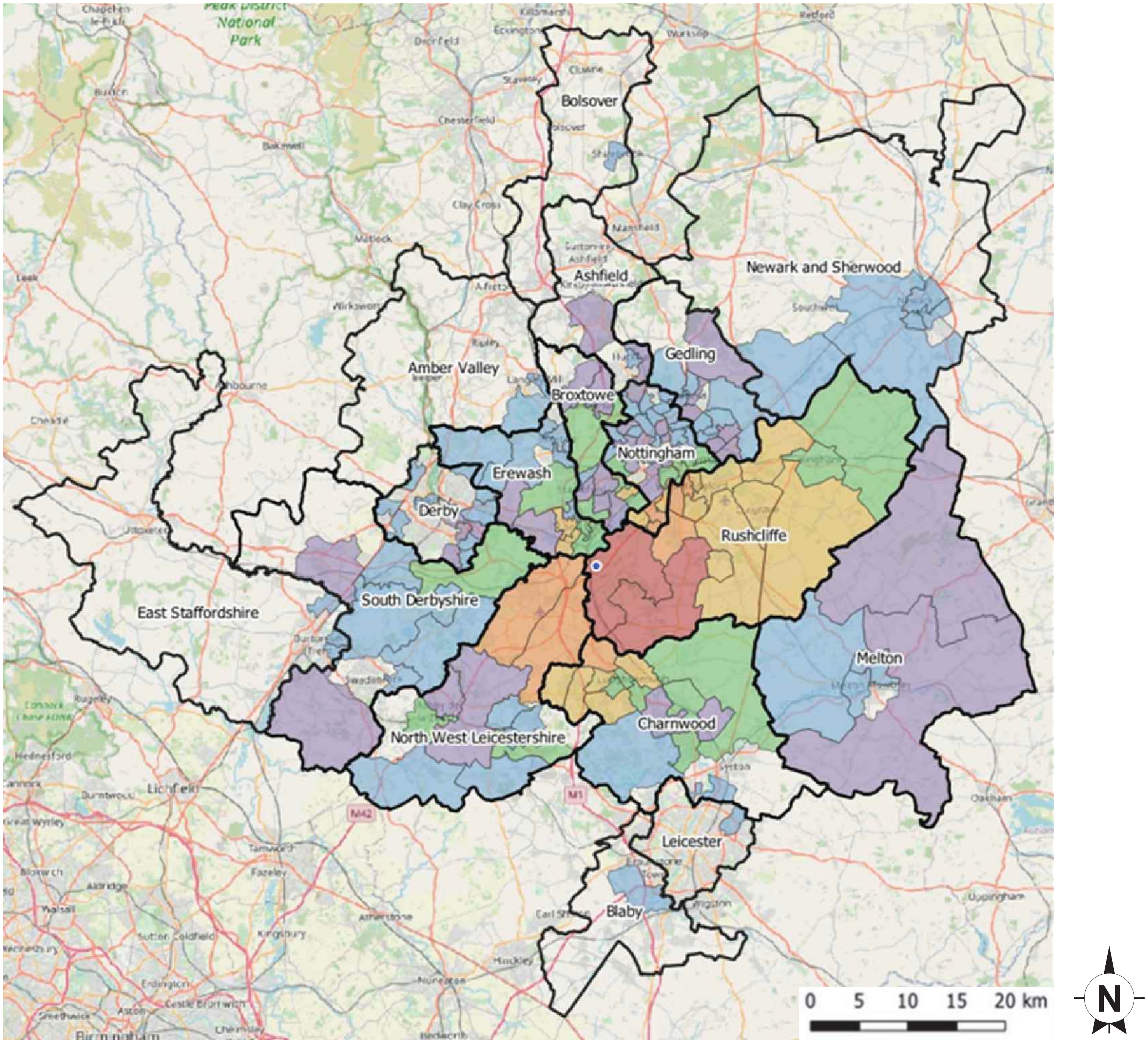
\\ax-cc-adc-01\Projects\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 12.1 Interrogation of Study Area using MSOAs and LA Boundaries.dwg



axis

Number of people travelling from each MSOA to Rushcliffe 014
- 6 - 10
- 11 - 15
- 16 - 25
- 26 - 50
- 51 - 300
- 301 +
- Ratcliffe-on-soar Power Station
- Local Authority boundaries
- MSOA boundaries

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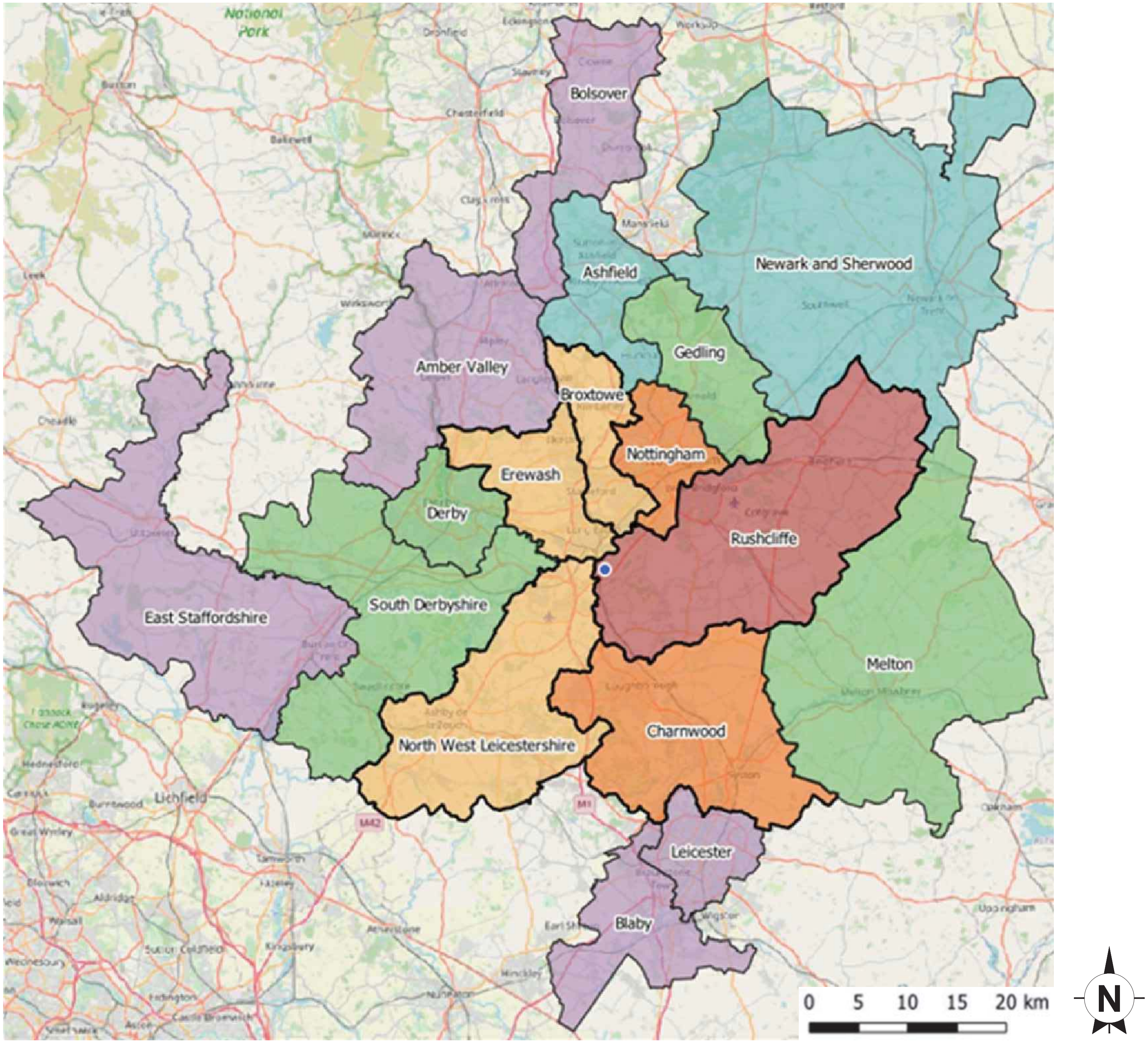
Figure 12.1

Interrogation of Study Area using MSOAs and LA Boundaries

Scale	Date
1:400,000@A3	May 2020

NCC received 16.07.2020

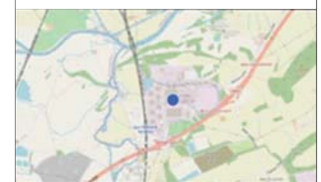
\\ax-cc-adc-01\Projects\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 12.2 Socio-Economic Study Area.dwg



axis

Number of people travelling from each Local Authority to Rushcliffe 014

- > 601
- 301 - 600
- 151 - 300
- 51 - 150
- 26 - 50
- 6 - 25
- Ratcliffe-on-soar Power Station
- Study Area
- Local Authorities outside Study Area



Ratcliffe-on-soar Power Station

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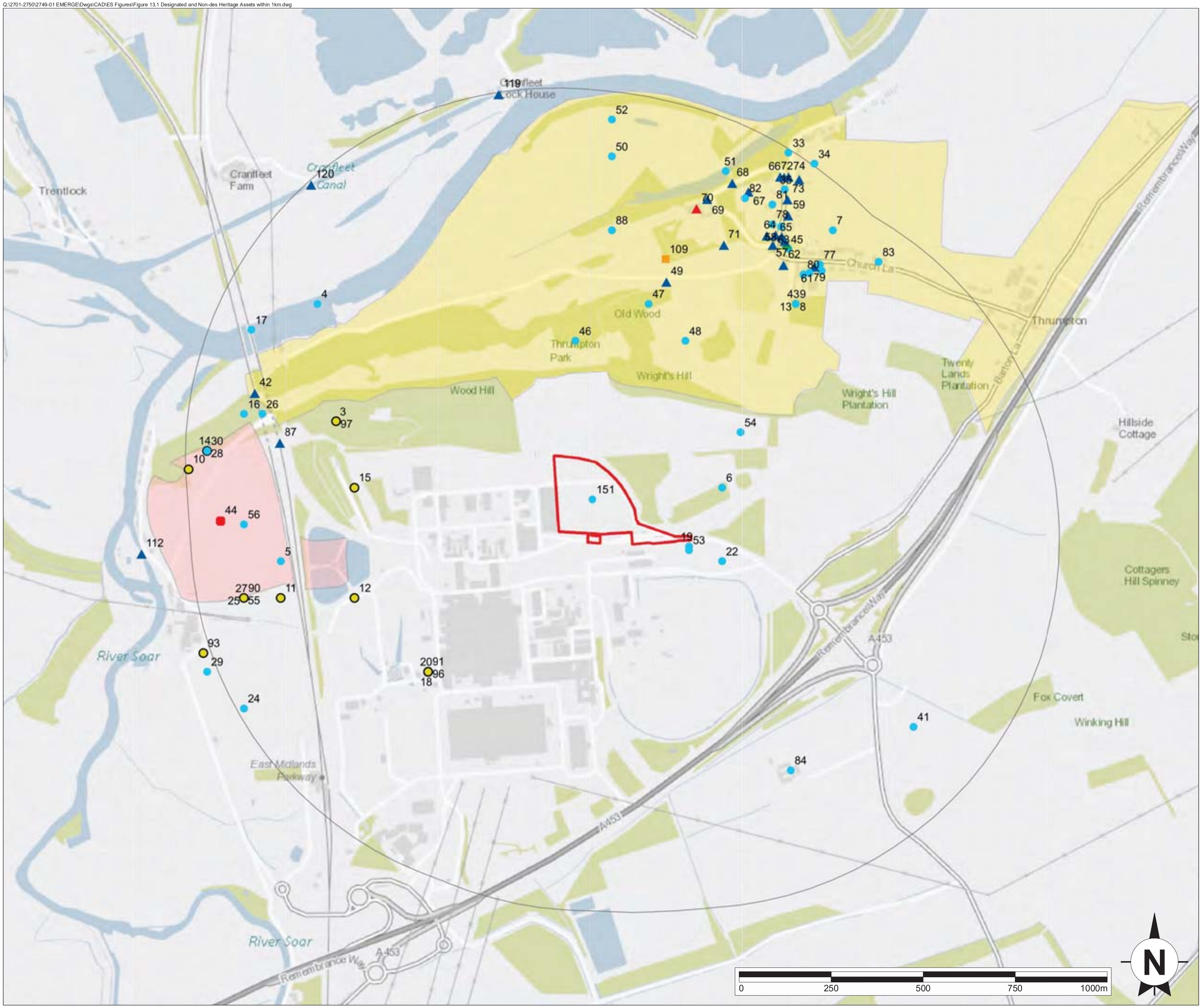
Figure 12.2

Socio-Economic Study Area

Scale	Date
1:400,000@A3	May 2020

NCC received 16.07.2020

Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 13.1 Designated and Non-des Heritage Assets within 1km.dwg



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axis

Legend
- Site Boundary
- 1 km Study Area
- Scheduled Monument
- Grade: I Listed Building
- Grade: II Listed Building
- Grade: II* Listed Building
- Conservation Area
- Non-designated asset
- Event
- Extent of Scheduled Monument
- Extent of Conservation Area

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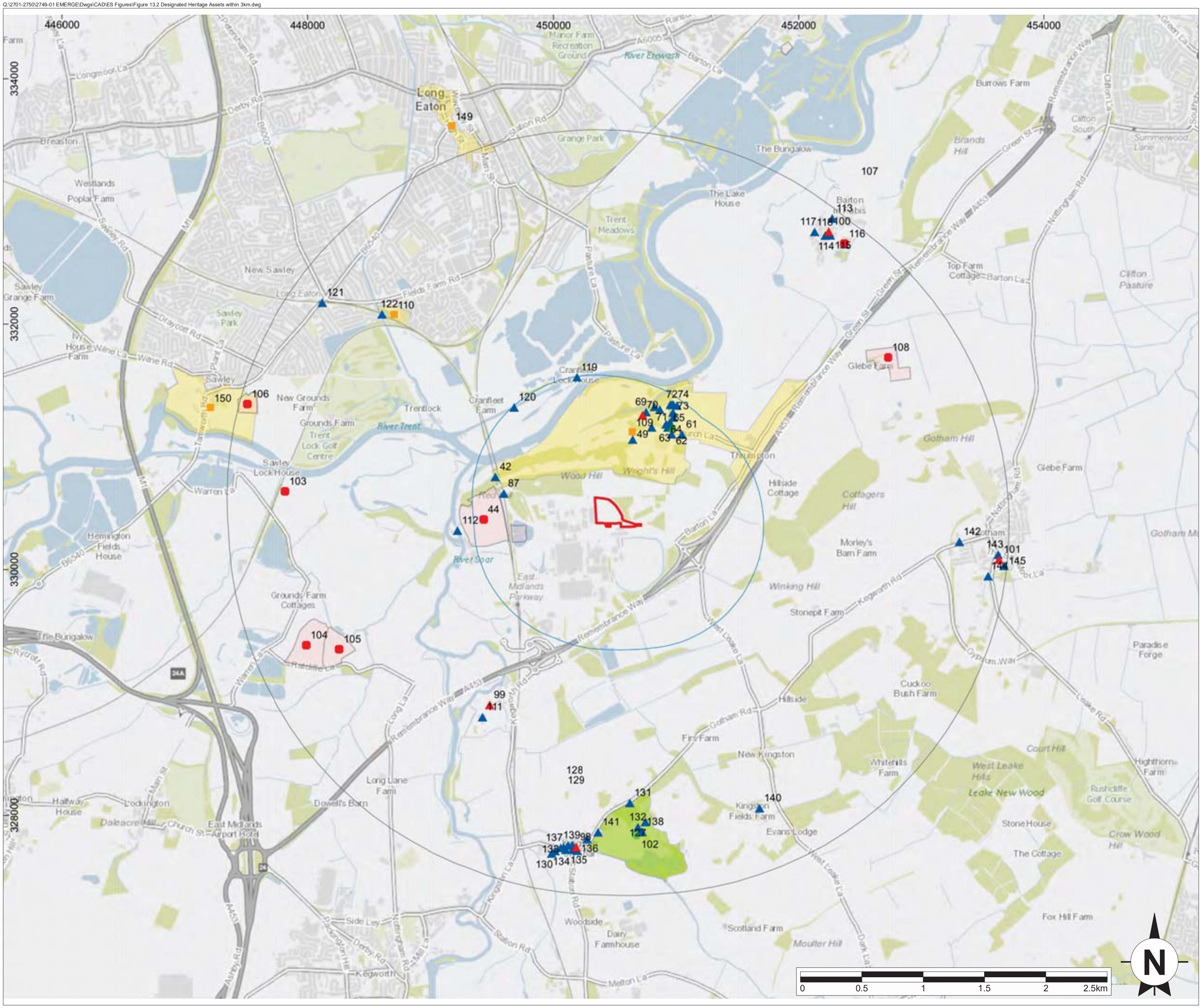
Figure 13.1

Designated and Non-Designated Heritage Assets within 1 km of the Proposed Development Site

Scale	Date
1:10,000@A3	May 2020

NCC received 16.07.2020

Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 13.2 Designated Heritage Assets within 3km.dwg



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Legend

- Site Boundary
- 1 km Study Area
- 3 km Study Area
- Scheduled Monument
- Grade: I Listed Building
- Grade: II* Listed Building
- Grade: II Listed Building
- Grade: II RPG
- Conservation Area
- Extent of RPG
- Extent of Scheduled Monument
- Extent of Conservation Area

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Figure 13.2

Designated Heritage Assets within 3 km of the Proposed Development Site

Scale	Date
1:30,000@A3	May 2020

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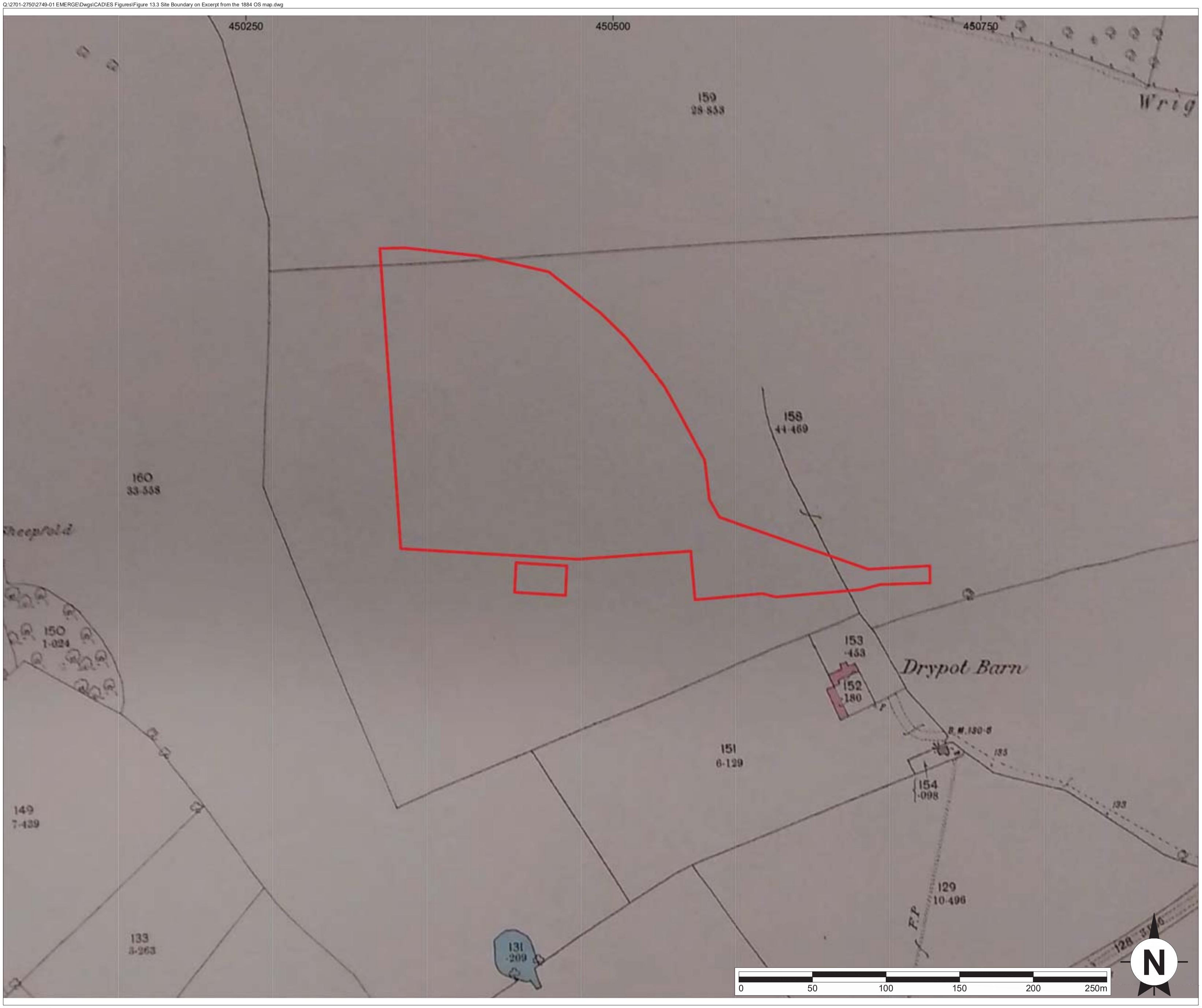
Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 13.3 Site Boundary on Excerpt from the 1884 OS map.dwg



© Crown Copyright 1884 and © Landmark 2020

axis

Legend

Site Boundary

EMERGE Centre
Figure 13.3
Site Boundary Overlain on Excerpt from the 1884 OS Map

Scale	Date
1:2500@A3	May 2020

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Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 13.4 Site Boundary on Excerpt from the 1921 OS map.dwg

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axis

Legend

Site Boundary

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Figure 13.4

Site Boundary Overlain on Excerpt from the 1921 OS Map

Scale	Date
1:2500@A3	May 2020

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Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 13.5 Site Boundary on Excerpt from the 1971-73 OS map.dwg

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axis

Legend
Site Boundary

EMERGE Centre

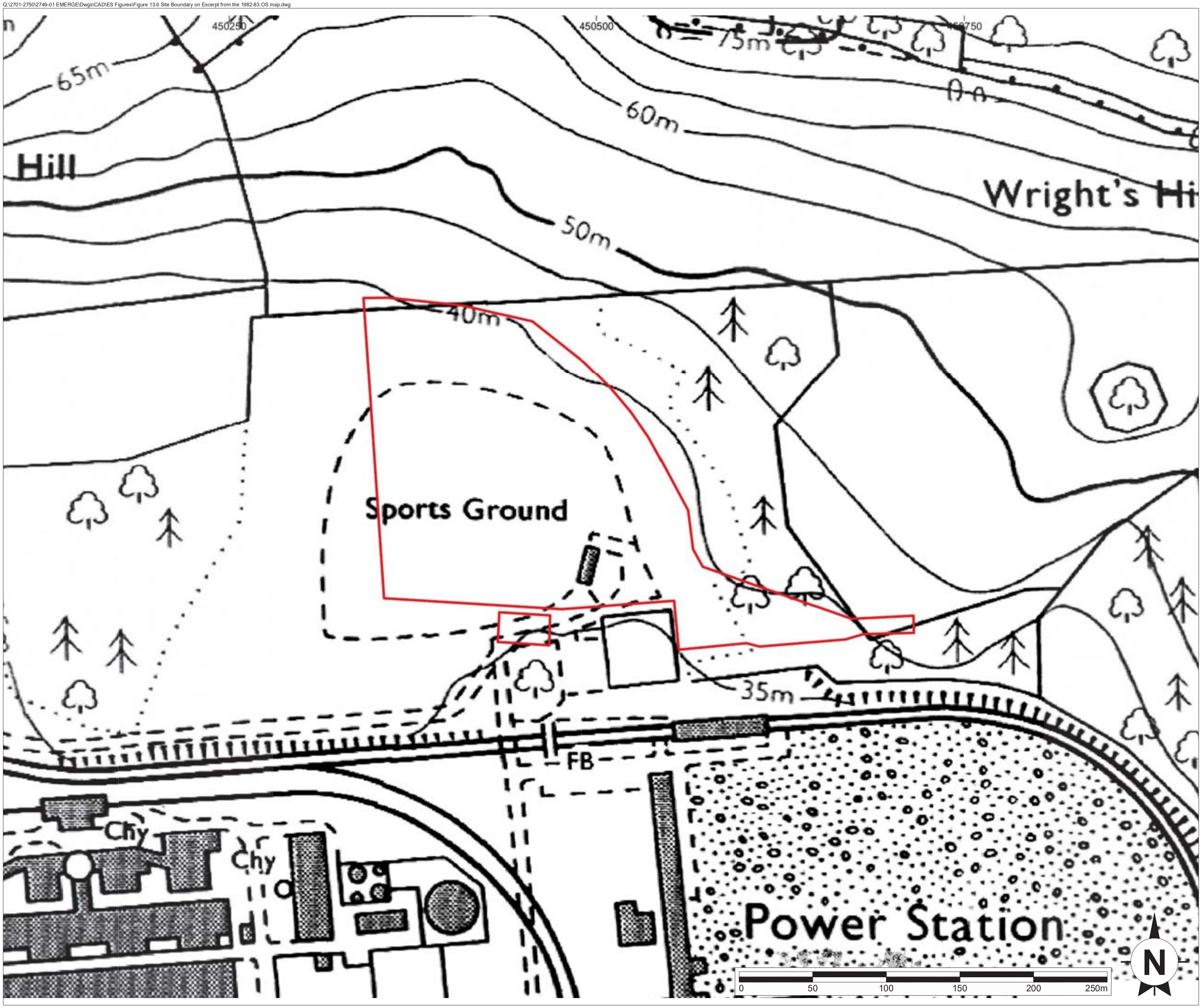
Figure 13.5

Site Boundary Overlain on Excerpt from the 1971-73 OS Map

Scale	Date
1:2500@A3	May 2020

NCC received 16.07.2020

Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 13.6 Site Boundary on Excerpt from the 1982-83 OS map.dwg



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axis

Legend
Site Boundary

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Figure 13.6

Site Boundary Overlain on Excerpt from the 1982-83 OS Map

Scale	Date
1:2500@A3	May 2020

NCC received 16.07.2020

Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 13.7 Location of Boreholes used for Deposit Modelling.dwg

axis

Legend
- Site Boundary
- Borehole

EMERGE Centre	
Figure 13.7	
Location of Boreholes used for Deposit Modelling	
Scale Not to Scale	Date May 2020

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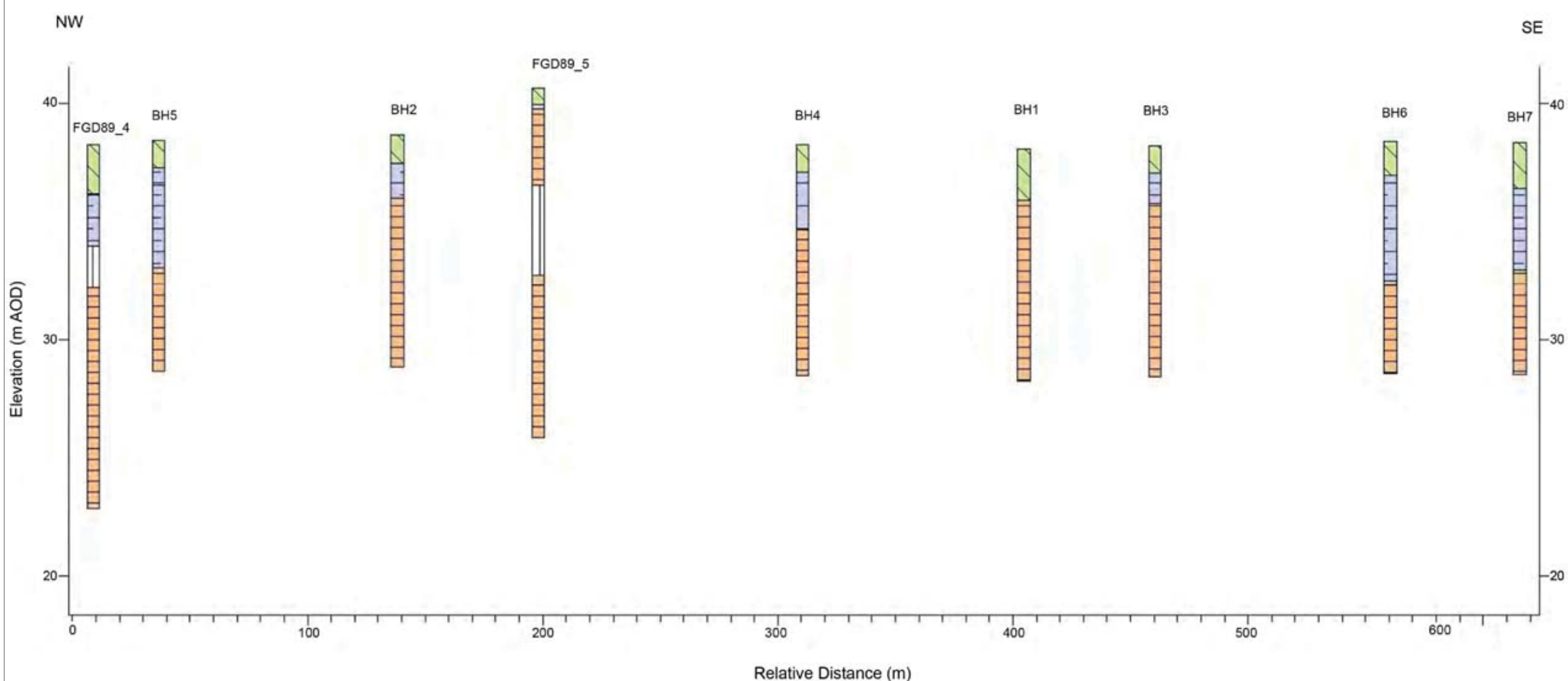
Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 13.8 Striplogs of Boreholes within the Site.dwg



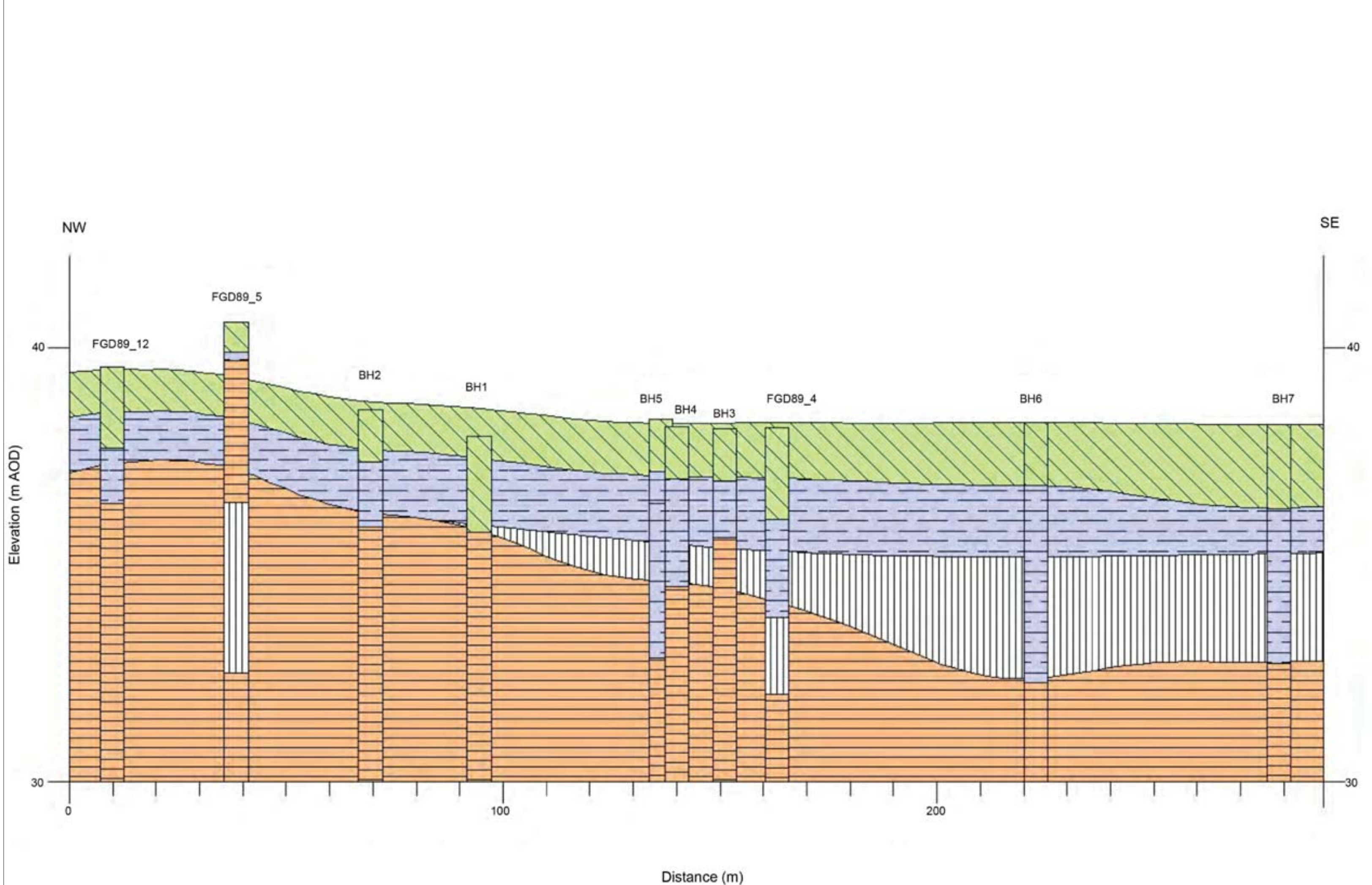
axis

Legend
- Made Ground
- Clay
- Mudstone
- Gypsum

EMERGE Centre	
Figure 13.8	
Strip Logs of Boreholes within the Site	
Scale NA	Date May 2020

NCC received 16.07.2020

Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 13.9 North to South Section Showing Indic Boreholes.dwg



axis

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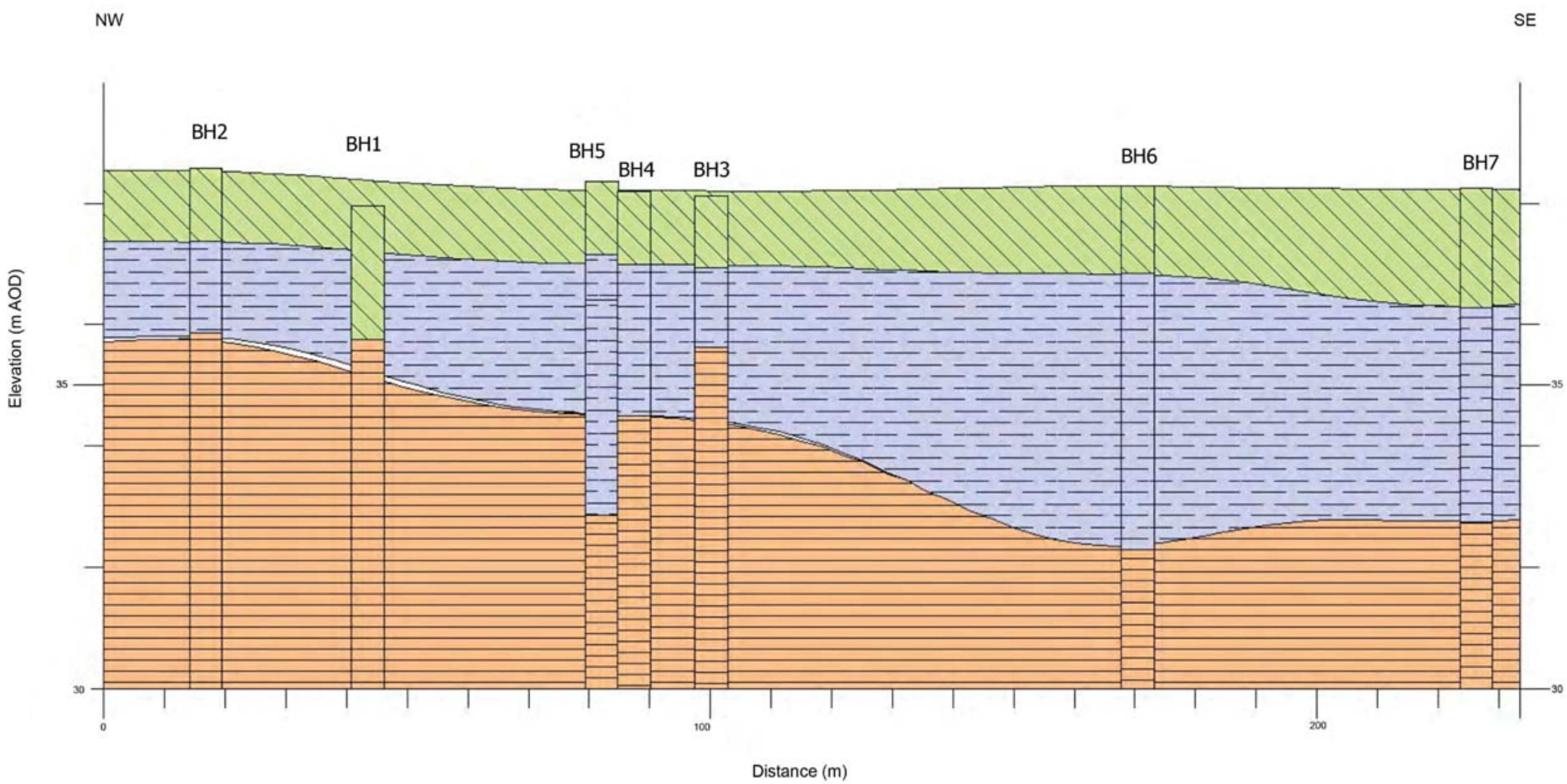
Figure 13.9

North to South Section through the Site Showing Indicative Borehole Locations including 1989 FGD Boreholes

Scale	Date
NA	May 2020

NCC received 16.07.2020

Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 13.10 North to South Section Showing Indic 2007 Boreholes Only.dwg



axis

Legend
- Made Ground
- Clay
- Mudstone
- Gypsum

EMERGE Centre	
Figure 13.10	
North to South Section through the Site Showing Indicative 2007 Borehole Locations Only	
Scale NA	Date May 2020

NCC received 16.07.2020

Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 13.11 Elevation Plan Showing Modelled Surface Elevation.dwg

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Legend

Site Boundary

Borehole

Elevation (m AOD)

44

29

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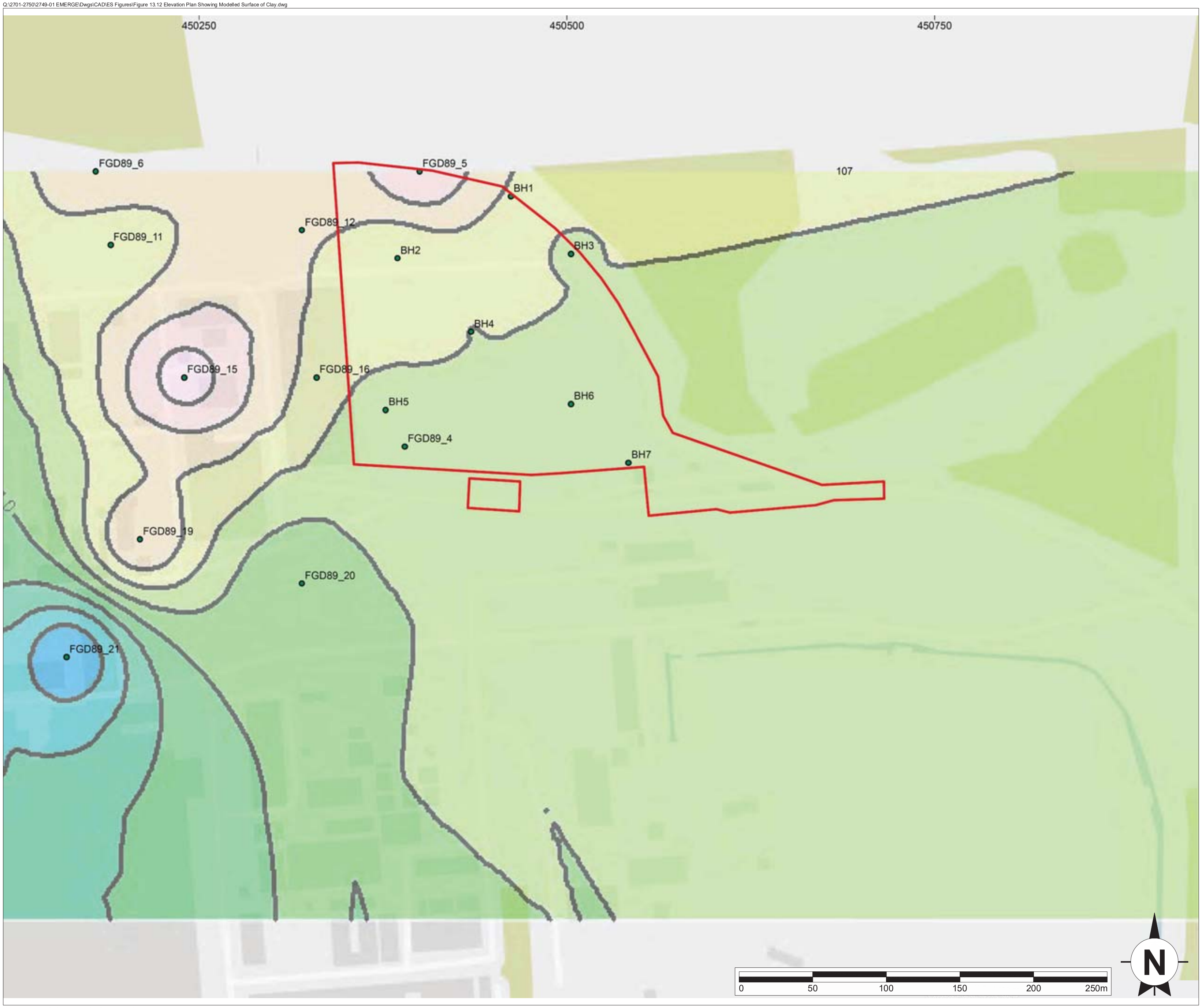
Figure 13.11
Elevation Plan Showing Modelled Surface Elevation

Scale	Date
1:2500@A3	May 2020

NCC received 16.07.2020

Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 13.12 Elevation Plan Showing Modelled Surface of Clay.dwg



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axis

Legend
- Site Boundary
- Borehole

Elevation (m AOD)
41
29

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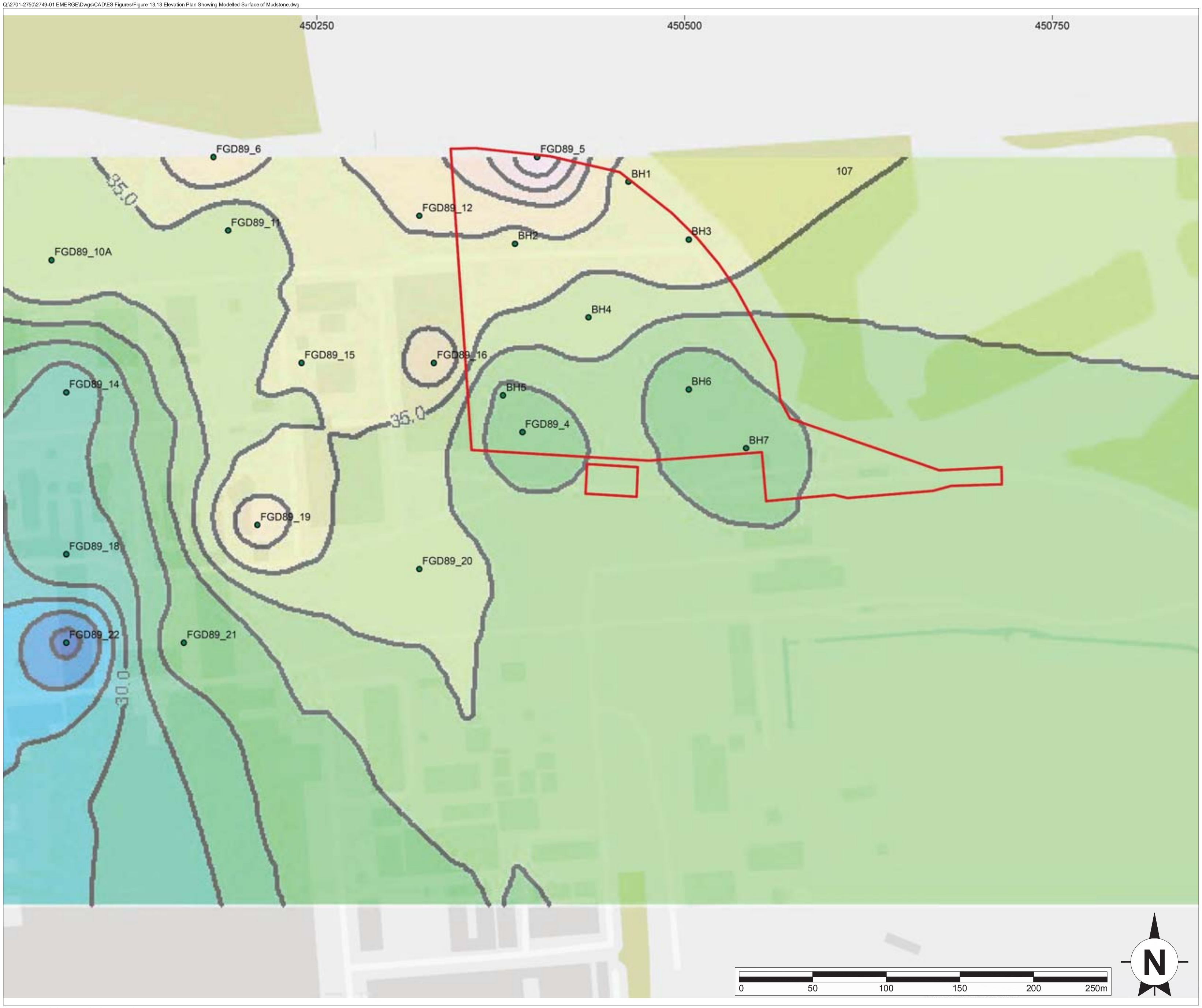
Figure 13.12

Elevation Plan Showing Modelled Surface of Clay

Scale	Date
1:2500@A3	May 2020

NCC received 16.07.2020

Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 13.13 Elevation Plan Showing Modelled Surface of Mudstone.dwg



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axis

Legend
- Site Boundary
- Borehole

Elevation (m AOD)

40

25

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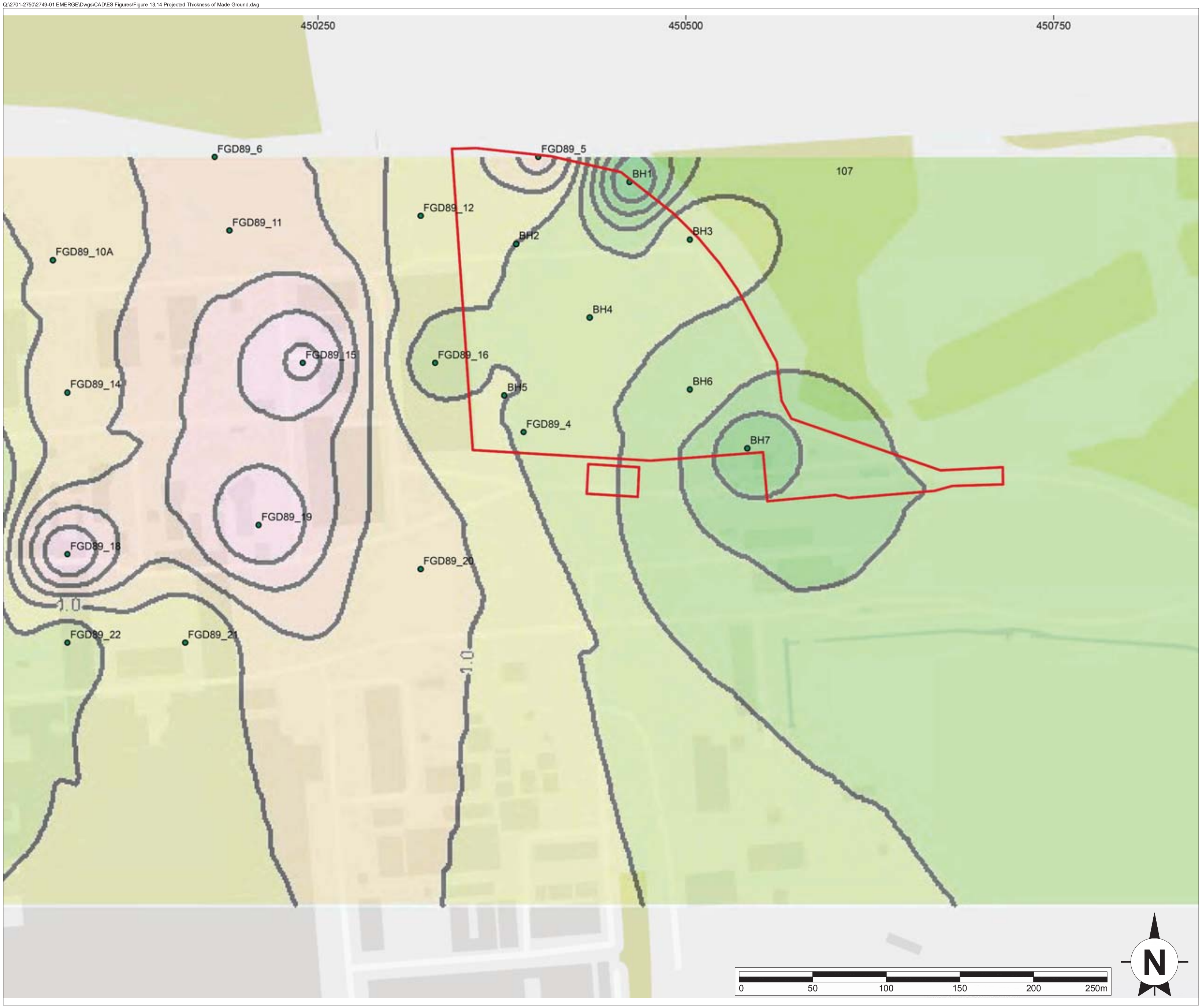
Figure 13.13	
Elevation Plan Showing Modelled Surface of Mudstone	
Scale 1:2500@A3	Date May 2020

NCC received 16.07.2020

Q:\2701-2750\2749-01 EMERGE\Dwgs\CAD\ES Figures\Figure 13.14 Projected Thickness of Made Ground.dwg



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axis

Legend
Site Boundary
Borehole
Thickness (m)
4
0

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Figure 13.14

Projected Thickness of Made Ground

Scale	Date
1:2500@A3	May 2020

NCC received 16.07.2020

APPENDIX 4-1: R1 EFFICIENCY CALCULATIONS NOTE

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FICHTNER
Consulting Engineers Limited

Uniper UK Limited

EMERGE Centre

R1 Efficiency Calculations

1 Introduction

Within this technical note it is intended to demonstrate that the design of the EMERGE Centre (Proposed Facility) will achieve R1 status and can be classified as a recovery operation under the requirements of the Waste Framework Directive (WFD).

2 Background

In accordance with the WFD, incineration facilities for municipal solid waste (MSW) can be regarded as "Recovery" operations if the energy efficiency of the plant is greater than 0.65 (for plants permitted after January 2009). This is referred to as achieving "R1 status". In the UK, R1 status can only be formally granted by the relevant Competent Authority (for the Proposed Facility this will be the Environment Agency) when the facility has been in operation for more than 12 months. Plants which do not meet the energy efficiency criterion are classed as "Disposal" operations and therefore are considered as being equivalent to landfill in terms of the waste hierarchy.

The European Commission has published guidance titled 'Guidelines on the Interpretation of the R1 Energy Efficiency Formulae for Incineration Facilities Dedicated to the Processing of Municipal Solid Waste According to Annex II of Directive 2008/98/EC on Waste'. Within the European Commission guidance the formula to calculate the efficiency of a facility is explained as follows:

$$\text{Energy Efficiency} = \frac{\left(E_p - \left(E_f + E_i\right)\right)}{\left(0.97 \times \left(E_w + E_f\right)\right)}$$

where:

- E_p means annual energy produced as heat or electricity. It is calculated with energy in the form of electricity being multiplied by 2.6 and heat produced for commercial use multiplied by 1.1 (units of GJ/yr)
- E_f means annual energy input to the system from fuels contributing to the production of steam (units of GJ/yr)
- E_w means annual energy contained in the treated waste calculated using the lower calorific value of the waste (units of GJ/yr)
- E_i means annual energy imported excluding Ew and Ef (units of GJ/yr)
- 0.97 is a factor accounting for energy losses due to bottom ash and radiation.

NCC received 16.07.2020

3 R1 Assessment

The formula within the European Commission guidance has been used to assess the energy efficiency of the Proposed Facility. The calculation is based on predicted design figures and predicted levels of fuel consumption and electricity usage, and assumptions on the design of the facility.

For the purposes of the calculations, the following assumptions have been made regarding the design of the Proposed Facility:

- It consists of two streams with an annual availability of 90.00 %, equating to 7,884 hours per annum.
- The waste throughput per stream will be 29.94 tonnes per hour.
- The waste processed will have an average NCV of 10 MJ/kg.
- It will generate 49.9 MW_e, with a parasitic load of 6.49 MW_e.
- During start-up and shutdown of the Facility, it will consume 6.49 MW_e.
- Electricity used during non-availability (i.e. excluding start-up and shutdown) would be 20 % of the parasitic load.
- The auxiliary burners will have a capacity of 60 % of the boiler thermal input.
- The average auxiliary burner consumption during start-up would be 50%[1] of the burner duty.
- Number of start-ups and shutdowns per year per line would be 2 and each start up and shut down would take a period of 16 hours and 1 hour respectively. 50% of the fuel used in the start-up would be used for steam production and therefore generate electricity.
- It has been assumed that no heat would be exported from the Proposed Facility. This is considered to be conservative, as the export of heat would result in a higher efficiency.

Taking the above into consideration, the R1 efficiency of the Proposed Facility has been calculated as **0.76**. A table setting out the calculation is presented in Appendix A.

[1] The average auxiliary burner duty during a full cold start is assumed to be 50%. The burners always have to start on low fire and ramp up slowly. All EfW boilers have a warm up curve. The rate of temperature increase in the boiler must be strictly and carefully controlled to avoid damaging the boiler. This is why it takes 16 hours for full cold start up.

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4 Conclusions

The design of the Proposed Facility has been assessed in accordance with the European Commission guidance for R1 facilities. As demonstrated within this Technical Note, the R1 efficiency of the Proposed Facility has been calculated as 0.76. Taking this into consideration the design of the Proposed Facility would be able to achieve the R1 status and it would be classified as a recovery operation under the terms of the Waste Framework Directive.

The Facility will commit to obtain design stage approval from the Environment Agency prior to commencement of commissioning.

Yours sincerely

FICHTNER Consulting Engineers Limited

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Associate Senior Consultant

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NCC received 16.07.2020

Appendices

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A Waste Framework Directive energy efficiency calculation

R1 formula		**Unit**
Number of streams	2	-
Average through-life availability	90.00%	%
Equivalent full load operating hours per year	7,884	h/y
Feed stock calculations		
Waste throughput per boiler	29.940	tph
Waste NCV	10.00	MJ/kg
Waste throughput	472,094	t/y
Waste Energy input	166.33	MW
Waste Energy input	1,311,372	MWh/y
Waste Energy input	4,720,939	GJ/y
Electric exported		
Gross electricity production	49.90	MW
Gross electrical efficiency	30.00%	
Total electricity produced	393,412	MWh/y
Total electricity produced	1,416,282	GJ/y
Parasitic load	6,490	kW
Parasitic load	51,167	MWh/y
Parasitic load	184,202	GJ/y
Net electrical output	43.4	MW
Net electrical efficiency	26.10%	
Heat exported		
Heat exported	-	MWh/h
Heat efficiency	0.00%	
Heat exported	-	MWh/y
Heat exported	-	GJ/y
Heat used internally (a)		
Heat used internally	-	MWh/y

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R1 formula		Unit
Heat used internally	-	GJ/y
Total heat produced		
Total heat produced	-	MWh/y
Total heat produced	-	GJ/y
Fuel used		
Auxiliary Burner capacity	60%	
Auxiliary Burner capacity per stream	49.90	MW
Average auxiliary burner duty during start up	50%	
Number of start ups per year per stream	2	
Start up time	17	hrs
Annual time for start ups	68	hrs/y
Total Fuel consumed	1,697	MWh/y
Energy in fuel consumed by start-up burners	6,108	GJ/y
Electricity imported		
Electricity consumption during start-up per steam	3,245	kW
Electricity imported during start-up	221	MWh/y
Electricity imported during start-up	794	GJ/y
Electricity consumption during non-availability	1,298	kW
Electricity imported during non-availability	1,137	MWh/y
Electricity imported during non-availability	4,093	GJ/y
Electricity imported during start-up and non-availability	1,358	MWh/y
Electricity imported during start-up non-availability	4,888	GJ/y
WFD Calculation		
Ew	4,720,939	GJ/y
Ep (electricity)	3,498,216	GJ/y
Ep (heat)	-	GJ/y
Ep total (electricity + heat)	3,498,216	GJ/y
Ef ([1])	3,053.88	GJ/y
Ei (electricity)	12,708	GJ/y
Ei (heat)([2])	3,054	GJ/y
Ei total (electricity + heat)	15,762	GJ/y

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R1 formula		Unit
WFD ratio		
WFD ratio	0.7593	-
Pass or fail?	pass	-
Climate Change Factor		
Heating Degree Days	3,350	
Old Plant or New Plant	New	
Climate Change Factor	1.000	
Adjusted WFD ratio	0.76	
Pass or fail?	pass	

1. The input data is based on a single design point, a reduction factor of 0.95 has been used to include partial load operation, boiler fouling and high air temperature during the summer.
2. It is assumed that only 50% of fossil fuel used by the start-up burners generates steam and therefore only 50% of fuel energy is included as Ei (heat).

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APPENDIX 4-2: COMBINED HEAT & POWER: SCOPING RESPONSE

NCC received 16.07.2020

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EAST MIDLANDS ENERGY RE-GENERATION (EMERGE) CENTRE

Appendix 4-2

Combined Heat and Power: Scoping Response

May 2020

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CONTENTS

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1 INTRODUCTION

1.1 Background

Ratcliffe-on-Soar Power Station (the Power Station) has been supplying reliable electricity to the UK energy market for over 50 years. The UK is now moving away from coal to lower carbon energy solutions and the Government has committed to end the generation of electricity from coal-fired power stations by October 2025. A decision on a closure date for the Power Station has yet to be made, but this will be in line with Government policy. In the meantime, the power station continues to contribute to Britain's energy supply security.

Uniper is proud of the contribution the Power Station makes to the East Midlands regional economy. Although closure is imminent, Uniper is actively exploring and developing options for future sustainable development at the 273 hectare site. The site location is well served by road, rail and air links, presenting an ideal location for new businesses. The approach to development is being done in collaboration with key stakeholders, including the East Midlands Development Corporation, local councils and universities. Uniper's intention is for the redeveloped site to create employment based around modern industrial and manufacturing uses. At the core of this is sustainable onsite energy generation, provided by the East Midlands Energy Re-Generation (EMERGE) Centre.

1.2 Project Description

The EMERGE Centre will be the first new development at the Power Station site, providing sustainable heat and power. The project forms part of the wider vision for the site, moving towards becoming a zero carbon technology and energy hub for the East Midlands region.

The project will also bring direct benefits to the environment and local community, including:

- Generating up to 49.9 MW of low carbon electricity – enough to power around 90,000 homes;
- Preventing approximately 500,000 tonnes of residual waste going to landfill or being exported outside of the UK each year;
- Creating up to 600 temporary construction jobs, and around 45 permanent jobs on the site, once operational; and
- Helping the East Midlands region meet its landfill diversion targets.

The ability to extract heat from the EMERGE Centre will be facilitated by the proposed two-line design, with each line having a dedicated steam turbine. This provides a level of redundancy in the provision of heat and power, so that both can still be supplied during maintenance and repair activities. It should also be noted that Uniper has a district heating business that is currently evaluating opportunities and options for the EMERGE Centre. This evaluation will be used to identify and develop viable future opportunities.

Subject to the grant of planning permission, construction is planned to start in January 2022, with a 3-year construction period resulting in the facility being operational in December 2024.

1.3 This Document

Uniper submitted a Scoping Report to Nottinghamshire County Council (NCC) in February 2020 to enable adoption of a Scoping Opinion for the EMERGE Centre Environmental Impact Assessment (EIA). The Scoping Opinion was received in April 2020 and requested further information in a number of areas. One of these was in relation to the potential to export heat from the proposed development. Uniper's

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Scoping Report states that combined heat and power (CHP) infrastructure would be provided to enable heat provision at the earliest opportunity, with the plant being CHP-ready. However, reflecting the government's 2014 Energy from Waste document [1], which encourages energy recovery facilities to be sited close to local heat and power users, four specific items were requested to be addressed as part of the EIA process:

- An explanation of the factors and constraints which are likely to determine the geographical area that a CHP could viably serve;

- Explain the type/character of development which a CHP scheme could normally anticipate providing heat to and the factors which normally restrict CHP development/expansion;

- Applying the above, identify a geographical area which could potentially be served by the EMERGE Centre and within this area identify potential viable users for the take-up of CHP and confirm whether any identified CHP users can be secured as part of this application, including timetabling; and

- Provide evidence of any approaches or expressions of interests that have been made from surrounding land users/development in the area surrounding the EMERGE Centre.

Each of these aspects is discussed in Section 2 of this report.

It should be noted that a full CHP study, describing how heat could be taken off the EMERGE Centre, will be necessary as part of the regulatory submission to the Environment Agency for an environmental permit. This will be conducted using Environment Agency guidance [2], as part of the demonstration of Best Available Techniques (BAT) at the EMERGE Centre.

[1] Defra (2014) Energy from Waste. A Guide to the Debate. Available [April 2020] from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/284612/pb14130-energy-waste-201402.pdf.

[2] Environment Agency (2013). CHP Ready Guidance for Combustion and Energy from Waste Power Plants. Available [April 2020] from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/296450/LIT_7978_e06fa0.pdf.

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2 SCOPING RESPONSE

2.1 Geographical Limitations

The NCC Scoping Opinion requests: An explanation of the factors and constraints which are likely to determine the geographical area that a CHP could viably serve.

Figure 1 illustrates the location of the EMERGE Centre (outlined in red) within the Power Station site (outlined in blue).

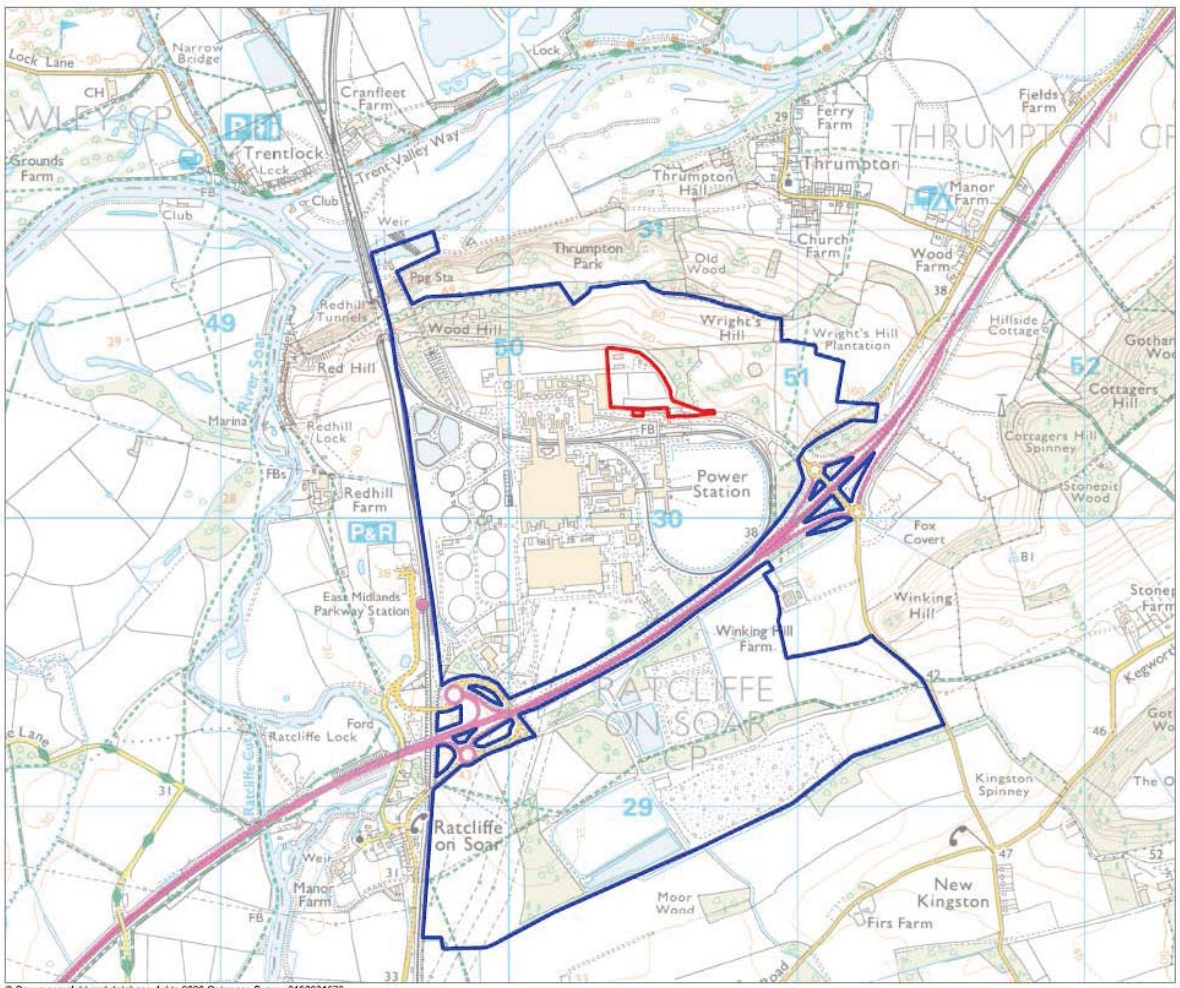

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Figure 1 Site Location

This area of land outlined in red is approximately 4 hectares and is broadly at 30–38 m AOD. Although it has never been developed for power plant operational purposes, it has been utilised as a laydown area and car parking for contractors working on the site. As a consequence of this activity, it is surfaced with a mixture of tarmac and compacted stone hardstanding. The application site is effectively level and bounded to the north and east by the electrified Power Station security fence and to the south and west by a combination of Power Station related large-scale development, and a further open area formerly used by contractors.

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Beyond the immediate confines within the Power Station grounds, the site is bounded by:

- Wood Hill and Wright's Hill to the north, which extend to a height of circa 75 m AOD, beyond which is the village of Thrumpton and the River Trent;
- The A453 to the east, beyond which, on rising land, is a mixture of agricultural land and woodland;
- The A453 to the south, beyond which, at broadly the same level as the site, is the southern Power Station site followed by a mixture of agricultural land and woodland, which also contain the pylons and overhead transmission lines from the Power Station; and
- Immediately to the west, the main East Midlands railway line and Parkway Station (including its associated Park and Ride facility), beyond which is more agricultural land containing the River Soar, a tributary of the Trent, and a marina. Further west still, at just over 2 km distance, is the M1 and its junctions 24 / 24a.

The various features around the site are helpful for minimising the visual impact of the development, but do provide significant challenges when trying to export heat from the site. Large physical obstacles, such as waterways and associated floodplains (e.g. River Trent and River Soar), railway lines, and major trunk roads, separate the site from potential users to the north and the west. To the south lies the A453, but there are underpasses in close vicinity to the site, which do provide potential export routes. There are fewer obstacles to the east, but the local topography presents significant changes in height that will need to be overcome to reach viable heat users. Whilst technically achievable, this would result in substantial pumping costs for a supply and return system. This would only be economically viable for users with a high demand.

The geographical scope of a CHP scheme is thus considered to be within the boundary of the Power Station site itself, the area to the south of the site, and the area extending from the Power Station in a north-easterly direction towards Nottingham. Options arising elsewhere would be considered on a case by case basis.

2.2 Typical CHP Scheme Users

The NCC Scoping Opinion request: Explain the type/character of development which a CHP scheme could normally anticipate providing heat to and the factors which normally restrict CHP development/expansion.

CHP schemes service a variety of end users, subject to available temperature and pressure of steam / hot water and how early in the development process a user can sign on to an agreement. Energy recovery facilities can achieve boiler outlet / steam turbine inlet conditions of around 40–45 bar and 380 °C to 400 °C.[3] These temperatures are too low for traditional energy-intensive industries, such as steel, cement, glass and ceramics, which typically require direct firing to reach temperatures from around 1,000 °C to 1,500 °C.

[3] European Commission (2019) Best Available Techniques (BAT) Reference Document for Waste Incineration. Available [April 2020] from https://eippcb.jrc.ec.europa.eu/sites/default/files/2020-01/JRC118637_WI_Bref_2019_published_0.pdf.

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Industries with large demands for steam include refineries, paper production and major food and drink processes. Steam requirements are typically in the region of 10 bar to 40 bar, at temperatures of 200 °C to 400 °C. These temperatures and pressures are a good match for the EMERGE Centre.

Cold storage, agriculture (greenhouses, fish farms, aquaponics), pharma-chemical production and, increasingly, data centres, also have significant heat demands, for both heating and cooling, via absorption chillers. A combination of these industries would help to smooth seasonal demand. The overall benefit of these industries is that substantial and stable anchor heat loads could be available, thereby increasing the overall environmental and economic benefit of the scheme. This could also be a drawback, as the turbine designs might need to be tailored for a specific demand. Nevertheless, if users can be identified before construction, the turbine can be configured before manufacture, providing the lowest cost solution to both parties.

CHP schemes are also used to provide heat for space heating and hot water, in both domestic and commercial settings. The UK government is currently funding a major initiative on district heating schemes in England and Wales through the Heat Networks Investment Project (HNIP), designed to decarbonise heat. This runs until 2022, hence is too early for the EMERGE Centre project, but Uniper understands that follow-on schemes could be available.

Large buildings with significant space heating requirements, such as government offices, warehouse storage or leisure centres, are ideal users for heat arising from energy recovery facilities, which is typically provided at a lower temperature and pressure (e.g. 90 °C to 110 °C). Similarly, large new-build housing developments, preferably densely populated, such as apartment blocks, are ideal consumers. The challenge here, however, is developing a scheme early enough with the housebuilders to ensure that they have buy-in to the scheme. Many large developments often involve multiple housebuilders, each with their own ideas and solutions, and developing a common consensus on district heating can be challenging. Reasons typically raised by developers are that district heating schemes increase complexity and cost, introducing development delays and reliability issues for the end consumer. These concerns are gradually being addressed by the district heating industry, and the support of planning authorities and government drives for decarbonised housing are facilitating changes. However, the issue of obtaining developer buy-in at an early stage to get commitment from all parties does remain challenging.

2.3 CHP Scheme Range

The NCC Scoping Opinion Request: Applying the above [Sections 2.1 and 2.2], identify a geographical area which could potentially be served by the EMERGE Centre and within this area identify potential viable users for the take-up of CHP and confirm whether any identified CHP users can be secured as part of this application including timetabling.

The Environment Agency's CHP Ready guidance recommends a search area of 10 km radius, for generating sites with an electrical output of less than 300 MW. Using the BEIS CHP Development Tool [4], Uniper has undertaken a search to identify existing large industrial heat loads within 10 km of the Ratcliffe site, which are marked on Figure 2.

[4] BEIS CHP Development Tool. Available [May 2020] from https://chptools.decc.gov.uk/developmentmap.

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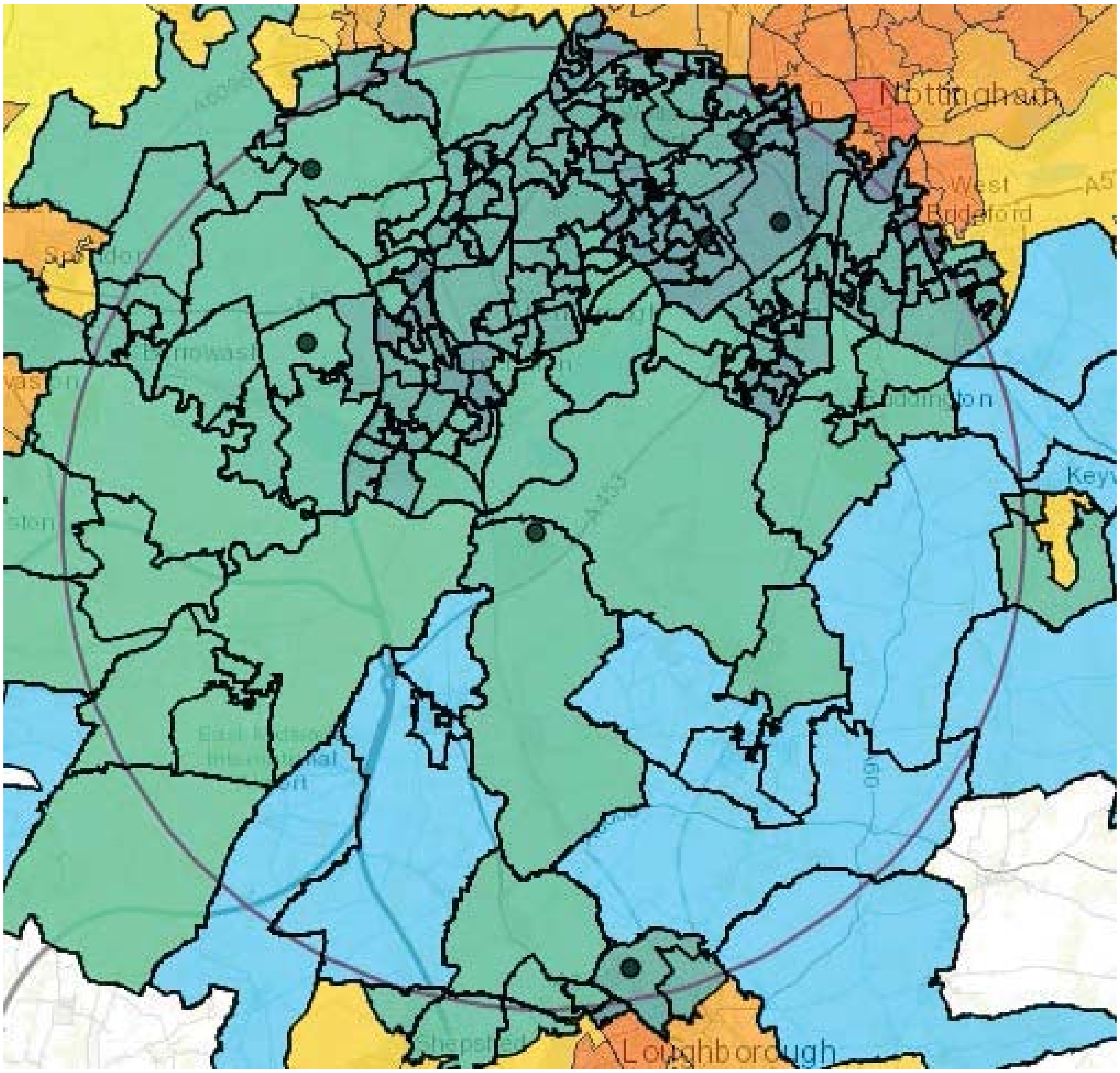

Figure 2 CHP Search Area

The results indicate that there are seven large industrial loads within the 10 km radius. The largest is identified as the Power Station itself. The others are identified as being either near Loughborough, or on the north side of the River Trent. Both locations would require substantial new infrastructure to reach the loads, either through extensive trenching networks and / or river crossings, which would be prohibitively expensive.

Taking into account the constraints imposed by the physical location of the site, as described in Section 2.1, Uniper has identified a more focussed target area extending 5 km from the Power Station, predominantly in a southerly and easterly direction, heading towards Nottingham. This reflects the topography of the surrounding area, such as the flood plains to the north and west and the rising elevation to the east. The target area is a mostly rural area, comprising small villages and associated amenities. The extent of this search area is shown as the yellow shaded area in Figure 3.

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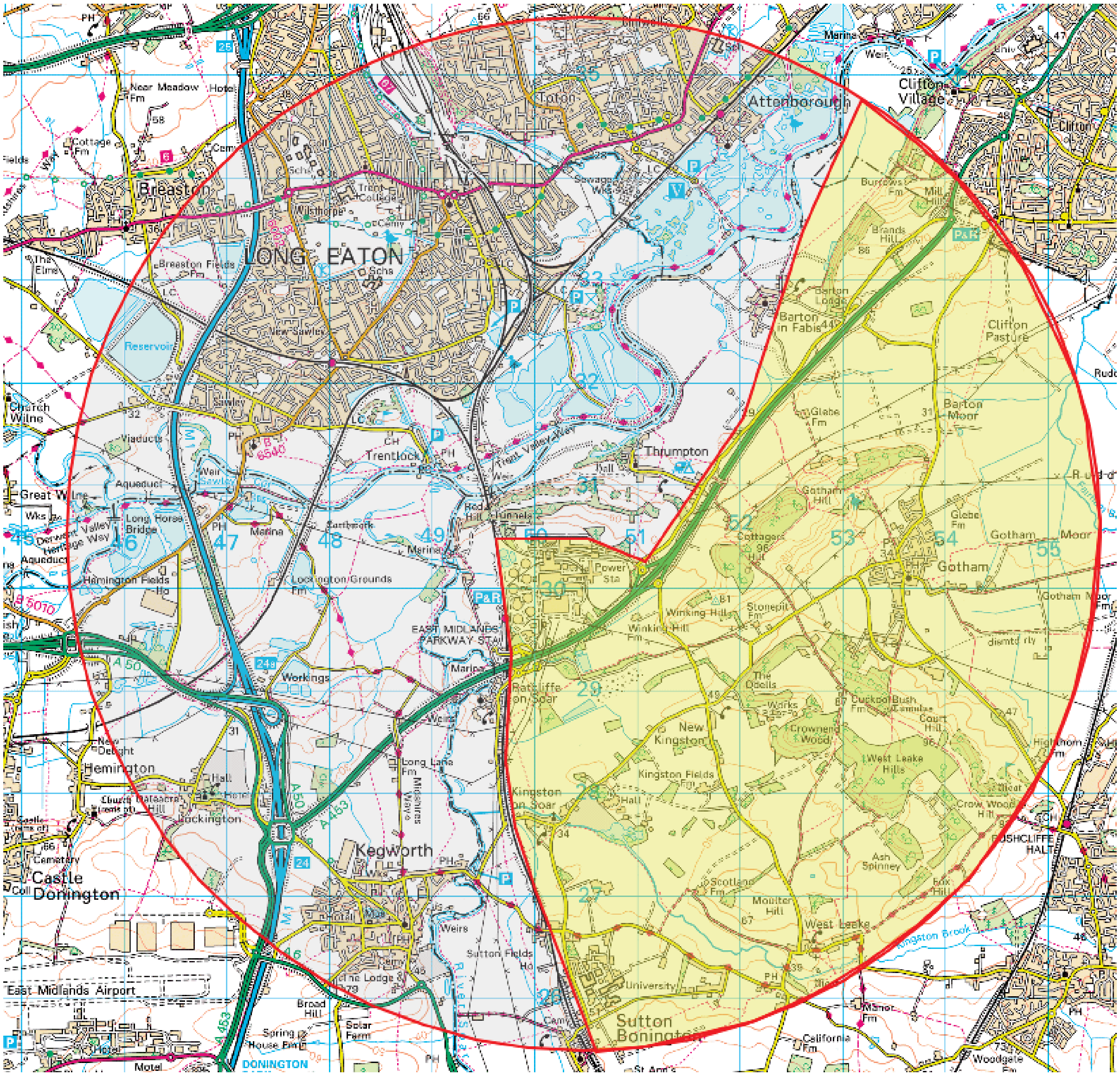

Figure 3 CHP Target Area

Whilst there are no current anchor loads within the target area, Uniper is aware of a 3,000 dwelling and 20 hectares of employment development along the A453 corridor towards Nottingham, on the edge of Clifton. When fully built out, the heat demand is anticipated to be approximately 3.5 MW_{th}.[5] Construction is anticipated to commence in 2025, with a build out over a 10-year period. Uniper is seeking opportunities for engagement with the developers to explore the potential for heat provision from the EMERGE Centre.

The best opportunities for heat provision lie with the overall intention of the EMERGE Centre, to provide heat and power directly to industries on the redeveloped Power Station site. This will be a key advantage

[5] Based on data from Ofgem (Decision for Typical Domestic Consumption Values for 2020) on "low" housing demand of 8000 kWhr per year and assumed 20 % thermal losses during transmission. Available [May 2020] from https://www.ofgem.gov.uk/publications-and-updates/decision-typical-domestic-consumption-values-2020.

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and attraction, as it is known that supplies of gas and power in the area are limited. The EMERGE Centre is being designed with this in mind, which will significantly increase the overall efficiency of the plant and play a significant role in developing low-carbon solutions for potential future users of the Power Station site.

Although outside of the main target area, Uniper has also considered potential links to large heat demands towards Nottingham. Specifically this might be a heat export scheme linked to manufacturing sites or academic establishments, and the existing district heating scheme, run by Nottingham City Council. The challenge, however, is providing a significant heat load over a long distance to sites and locations that already have centralised heating solutions. The distance to the Beeston Nottingham University campus is around 8 km and it is a similar distance to the district heating scheme. The capital costs of running supply lines into existing systems is high, but there is also the technical challenge of meeting the temperature and pressure requirements of the existing system, which would be exacerbated by the high expected heat losses en-route to the connection. On this basis, the EMERGE Centre is not considered to offer viable alternatives to the large central Nottingham schemes currently in operation. Nevertheless, Uniper will continue to look for new substantial heat use opportunities outside of the target area towards Nottingham, particularly those involving new build activities.

2.4 Engagement with Prospective End Users

The NCC Scoping Opinion Request: Provide evidence of any approaches or expressions of interests that have been made from surrounding land users/development in the area surrounding the EMERGE Centre.

Uniper has not started to actively promote the site to prospective end users, preferring to wait until the planning application has been submitted and the East Midlands Development Corporation vision is clearer, identifying the true scale and intentions for the site. Despite this, Uniper has already received several separate approaches for use of land, one of which included a significant supply of CHP steam. This speculative approach was made under commercial confidentiality so cannot be described at the present time.

Uniper is also actively developing further site options to follow the EMERGE Centre, including waste recycling and reuse technologies, agriculture, data centres and further energy hub developments. These include technologies that would benefit from steam supply from the EMERGE Centre. It is therefore entirely possible that the first CHP customer for the EMERGE Centre could be a Uniper development.

3 CONCLUSIONS

The EMERGE Centre is being developed as the first stage of an overall regeneration scheme for the Power Station, post coal operation. The new plant will provide a low carbon heat and power source that is intended to attract new modern industrial and manufacturing uses to the site. Additionally, there are opportunities to export heat beyond the site as and when new developments come forward. Uniper is actively reviewing these options and will develop the EMERGE Centre to ensure that they can be realised, where practicable, and in line with the overall site intent.

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APPENDIX 5-1: LVIA METHODOLOGY

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Appendix 5-1: Landscape and Visual Impact Assessment Methodology

1.0 Introduction

1.1 Landscape and Visual Impact Assessment (LVIA) is a tool used to systematically identify and assess the nature and significance of the effects of a proposed development upon the landscape and upon views and visual amenity. The purpose of the LVIA is to identify the level and nature of effect arising from a proposed development and if necessary, through an iterative design process, to inform changes to the development and evolution of mitigation strategies which minimise significant effects wherever possible.

1.2 The methodology for this LVIA is informed by guidance contained within the *Guidelines for Landscape and Visual Impact Assessment* (The Landscape Institute and Institute of Environmental Assessment, 3rd Edition, 2013), often referred to as 'the GLVIA'. The LVIA aims to establish the following:

- A clear understanding of the development site and its context, in respect of the physical and perceived landscape and of views and visual amenity;
- An understanding of the proposed development in terms of how this would relate to the existing landscape and views;
- An identification of likely significant effects of the proposed development upon the landscape and upon views, throughout the life-cycle of the development, including cumulative interactions with other developments;
- Those mitigation measures necessary to reduce or eliminate any potential adverse effect on the landscape or views arising as a result of the proposed development; and
- A conclusion as to the residual likely significant effects of the proposed development.

1.3 Professional judgement is a very important part of the LVIA process at every stage of the assessment. This judgement must be exercised within an assessment framework that transparently sets out the steps in the assessment process which have led to the overall conclusions. This is emphasised in Box 3.1 (page 37) of the GLVIA, which advocates a structured approach that considers the sensitivity of the receptor and magnitude of the effect when determining if an effect is significant or not.

1.4 To ensure the transparency of the assessment and professional judgements made, the LVIA follows a standard approach, namely:

- The establishment of the baseline conditions, against which the effects of the proposed development will be assessed;
- The determination of the nature of the receptor likely to be affected, i.e. its sensitivity;
- The prediction of the nature of the effect likely to occur, i.e. the magnitude of change; and

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- An assessment of whether a likely significant effect would occur upon any receptor, by considering the predicted magnitude of change together with the sensitivity of the receptor, taking into account any proposed mitigation measures.

1.5 The GLVIA clarifies that the guidance concentrates on
[1.20] "*…principles while also seeking to steer specific approaches where there is a general consensus on methods and techniques. It is not intended to be prescriptive, in that it does not provide a detailed 'recipe' that can be followed in every situation. It is always the primary responsibility of any landscape professional carrying out an assessment to ensure that the approach and methodology adopted are appropriate to the particular circumstance.*"

1.6 As set out above, use of professional judgement within a structured assessment framework is a very important element of the assessment of landscape and visual effects. As discussed in the GLVIA:
[2.23] "*…Whilst there is some scope for quantitative measurement of some relatively objective matters, …much of the assessment must rely on qualitative judgement, for example about what effect the introduction of a new development or land use change may have on visual amenity, or about the significance of change in the character of the landscape and whether it is positive or negative.*"
[2.24] "*…In all cases there is a need for the judgements that are made to be reasonable and based on clear and transparent methods so that the reasoning applied at different stages can be traced and examined by others…*"
[2.26] "*…In carrying out an LVIA the landscape professional must always take an independent stance, and fully and transparently address both the negative and positive effects of a scheme in a way that is accessible and reliable for all parties concerned.*"

1.7 Landscape and visual matters are separate issues, although closely related and interlinked, are dealt with as such throughout the LVIA. The methodologies for assessing both are outlined separately below.

2.0 Landscape Assessment

2.1 The landscape assessment considers the potential effects of the proposed development on the components of the landscape as an environmental resource. Landscape receptors which could be affected by a proposed development may include:

- Individual constituent elements and features of the landscape (sometimes referred to as landscape fabric);
- Specific aesthetic and perceptual qualities of the landscape; and
- The overall character and key characteristics of the landscape as experienced in different areas (e.g. landscape character areas or types).

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Sensitivity

2.2 The nature of a landscape receptor likely to be affected, i.e. its **sensitivity** is determined by considering two factors, namely:

- Susceptibility to change; and
- Value.

Susceptibility to Change

2.3 Susceptibility to change is defined in the GLVIA as follows:

[5.40] "*This means the ability of the landscape receptor (whether it be the overall character or quality/condition of a particular landscape type or area, or an individual element and/or feature, or a particular aesthetic and perceptual aspect) to accommodate the proposed development without undue consequences for the maintenance of the baseline situation and/or the achievement of landscape planning polices and strategies.*"

[5.41] "*The assessment may take place in situations where there are existing landscape sensitivity and capacity studies, which have become increasingly common. They may deal with the general type of development that is proposed, in which case they may provide useful preliminary background information for assessment. But they cannot provide a substitute for the individual assessment of the susceptibility of the receptors in relation to change arising from the specific development proposal.*"

2.4 To understand susceptibility to change, the various characteristics/factors that make up a particular landscape must be identified and consideration given as to how these will be affected by the proposed development. Consideration is given to physical and perceptual factors which are considered together to derive an overall susceptibility to change. Factors influencing the susceptibility of a landscape to change resulting from an *Energy from Waste facility* are set out below:

- **Scale:** A larger scale landscape (relative to the development proposed) will typically be less susceptible than a smaller scale landscape;
- **Pattern/Complexity:** The susceptibility of a receiving landscape to change will be influenced by the specific pattern of features and elements present and by the complexity of this pattern;
- **Development/Human Influence:** A landscape that includes obvious alterations to natural ground levels, contemporary development, or that is clearly functional/utilitarian in land use will typically be less susceptible than one where development is more traditional in style, or where natural influences and natural or long-established landforms are predominant;

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- **Connections with adjacent areas:** A landscape which has a clear relationship with other surrounding landscapes, for example in relation to views in and out, will typically be more susceptible than one where such relationships are not present; and
- **Visual Interruption:** A landscape where views are frequently interrupted by screening features, for example vegetation cover or variations in landform, will typically be less susceptible than one where there are few / no screening features.

2.5 A particular landscape may have different characteristics that are more or less susceptible to change. As such, the overall susceptibility to change is allocated using professional judgement based upon consideration of the various factors outlined above and the relative weight attached to these (which will vary from landscape to landscape). The assessment of susceptibility is expressed using a three point verbal scale of high, medium or low. Where appropriate, intermediate levels such as medium/high or low/medium are used to refine the assessment. The rationale in support of the assessment of susceptibility is set out for each receptor in the assessment, so that it is clear how each judgement has been made.

Value

2.6 The value of the landscape receptor is independent of any development proposal. The absence of a formal landscape designation does not necessarily imply that a landscape is of lower value. Value is defined in the GLVIA as:

[5.19] "*…the relative value that is attached to different landscapes by society, bearing in mind that a landscape may be valued by different stakeholders for a whole variety of reasons…Landscapes or their component parts may be valued at the community, local, national or international levels…*"

2.7 Factors that can help in identifying valued landscapes include:

- Presence/absence of statutory landscape designations;
- Presence/absence of local landscape designations and associated policies;
- Landscape quality/condition;
- Scenic quality;
- Rarity of particular elements/features;
- Representativeness;
- Conservation interest;
- Recreation value;
- Perceptual aspects; and
- Cultural associations.

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2.8 The assessment of value is expressed on a similar basis to that described for susceptibility of change above. Table 2.1 indicates how the above factors have been used to determine landscape value.

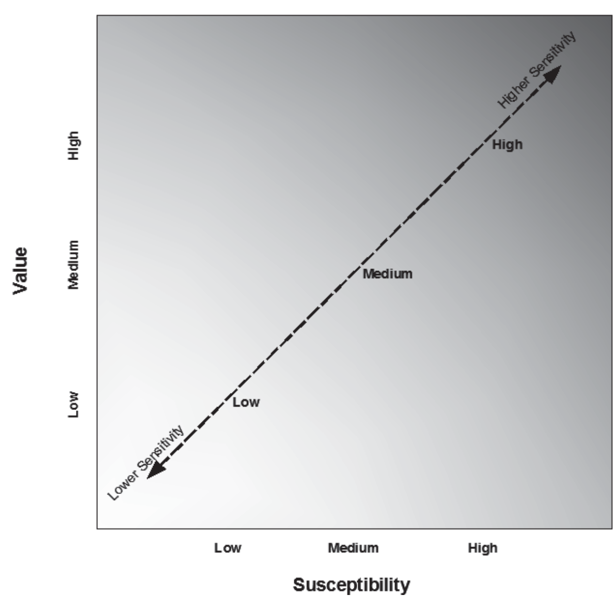
Table 2.1: Landscape Value Criteria

	Criteria tending towards higher or lower value	
	Higher ←	→ Lower
Value	Unique, and/or strongly positive landscape character, often with strong associations or (non-landscape) environmental designations. Nationally designated landscape (protected by statute).	Widespread or common landscape character. Negative character. Lack of other environmental qualities. Landscape without formal designation and with limited positive contribution to the locality

Sensitivity

2.9 Susceptibility to change and value are considered together to determine the sensitivity of the receptor. It should be noted that the relationship between susceptibility to change and value can be complex and is not linear. For example, a highly valued landscape (such as a National Park) may have a low susceptibility to change, due both to the characteristics of the landscape and the nature of the change proposed. Figure 2.1 (below) provides a guide as to how susceptibility and value can be combined to assess sensitivity (with the grey shading indicative of the increasing sensitivity of receptors with increasing susceptibility and / or value). However, the final assessment of sensitivity is one of professional judgement based on consideration of the susceptibility and value assessments.

Figure 2.1: Indicative Sensitivity Assessment



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Magnitude

2.10 The nature of the effect that is likely to occur, i.e. its **magnitude**, is determined by considering four separate factors, namely:

- Size / scale;
- Geographical extent;
- Duration; and
- Reversibility.

2.11 The size and scale of an effect is determined by considering the amount of change experienced by a receptor, including:

- The extent of existing landscape elements that would be lost, the proportion of the total extent that this represents and the contribution of that element to the wider character;
- The degree to which aesthetic or perceptual aspects of the landscapes are altered by the removal, or introduction of new landscape components; and
- Whether change affects the key characteristics of a landscape.

2.12 The geographical extent of an effect is the area over which effects will be experienced. It is not the same as size / scale, as a small-scale change may be experienced over a wider area, or vice versa.

2.13 The duration of an effect simply relates to the length of time for which it would be experienced, as follows:

- Long-term: 10+ years or the change could not reasonably be considered temporary in nature;
- Medium-term: 3–10 years; and
- Short-term: 0–3 years.

2.14 The reversibility of an effect relates to the prospects and practicality of an effect being able to be wholly or partially reversed, or whether the change cannot realistically be reversed, i.e. it is permanent.

2.15 These four factors are then considered together to derive an overall magnitude of change for each receptor, which is determined by use of professional judgement. The assessment of the magnitude of change is expressed using a four point verbal scale of large, medium, small or negligible. Where appropriate, intermediate levels such as medium / large or small / medium are used to refine the assessment. Table 2.2 (below) indicates how the above factors have been used to inform magnitude of change. As the circumstances of each specific receptor will vary, a reasoned narrative is set out in the LVIA in order to justify the particular magnitude of change allocated to each receptor.

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Table 2.2: Magnitude of Landscape Change Criteria (indicative)

Magnitude	Description
Large	A substantial change in landscape characteristics and/or over extensive geographical area and/or which may result in an irreversible landscape impact.
Medium	A moderate change in landscape characteristics and/or which may be over a large geographical area, and/or which may be reversible over a long duration of time.
Small	A small change in landscape characteristics and/or which may be over a relatively localised geographical area, and/or which may be reversible over a short duration of time.
Negligible	A barely perceptible change in landscape characteristics and/or which is focused on a small geographical area, and/or which is almost or completely reversible.

3.0 Visual Assessment

3.1 A visual assessment is concerned with the potential effects upon the population likely to be affected (i.e. the views experienced by people). As for landscape effects (Section 2.0), the sensitivity of the receptor affected is identified, as is the magnitude of the change that would occur. These are then considered together to determine the level and significance of effect.

3.2 A key part of the visual assessment is the assessment of effects from a number of predetermined viewpoints, which reflect views available to different groups of people. The viewpoint itself is not the receptor; rather it is the people that would be experiencing the view. These people will generally have different responses to a change in view depending upon their location, their activity and other factors, including the weather and time of day or year. Viewpoints fall into three categories (as set out in the GLVIA):

- Representative viewpoints (which represent the experience of different types of receptors in the vicinity);
- Specific viewpoints (a particular view, for example a well-known beauty spot); and
- Illustrative viewpoints (which illustrate a particular effect or issue, which may include limited or lack of visibility).

3.3 Private viewpoints, such as from specific residential properties are not typically included in the LVIA. It is often impractical to visit all affected properties and access to private land may not be granted. Representative or specific viewpoints from nearby publicly accessible locations can often give an impression of what effects from private land would be.

Sensitivity

3.4 The nature of a visual receptor likely to be affected, i.e. its **sensitivity** is determined by considering two factors, namely:

- Susceptibility to change; and
- Value.

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Susceptibility to Change

3.5 The GLVIA identifies susceptibility to change in view / visual amenity as:

[6.32] "*...mainly a function of:*

- *The occupation or activity of people experiencing the view at particular locations; and*
- *The extent to which their attention or interest may therefore be focused on the views and the visual amenity they experience at particular locations.*"

3.6 Susceptibility to change is, in part, classified based upon the indicative criteria, provided in the GLVIA, as set out in Table 3.1.

Table 3.1: Typical Visual Susceptibility to Change Criteria (indicative)

Criteria Level	Description
	Susceptibility to Change
High	Residents at home; People engaged in outdoor recreation, whose attention/interest is likely to be focused on the landscape or particular views, including from public rights of way; Visitors to heritage assets or other attractions, where views of the surroundings are an important contributor to the experience; Communities where views contribute to the landscape setting enjoyed by residents; and Travellers on scenic routes.
Medium	Travellers on road, rail, or other transport routes.
Low	People engaged in outdoor sport or recreation which does not involve or depend upon appreciation of views of the landscape; and People at their place of work whose attention may be focused on their work / activity and not their surroundings.

3.7 It is important to note that the examples set out in GLVIA and Table 3.1 only address the first bullet point and part of the second bullet point in paragraph 3.5 (which are focussed on the occupation or activity of the people and the extent to which their attention is focussed on the view).

3.8 As such, the assessment of susceptibility in Table 3.1 and GLVIA (pages 113 &114) needs to be adjusted to reflect the requirements of the final part of the second bullet point, namely the visual amenity that people currently experience. GLVIA identifies clearly that the division between categories of susceptibility to change:

[6.35] "*…is not black and white and in reality there will be a gradation in susceptibility to change. Each project needs to consider the nature of the groups of people who will be affected and the extent to which their attention is likely to be focused on views and visual amenity…*"

3.9 For example, the presence of existing detracting features in any given view may reduce the visual amenity of those experiencing the view. This may therefore reduce their susceptibility to certain types of change and ultimately their sensitivity.

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3.10 The assessment of susceptibility to change is made on the same basis as for landscape effects (Section 2.0). A three-point scale (with intermediate levels where appropriate) is used, supported by a reasoned narrative that explains the judgement made.

Value

3.11 In accordance with paragraph 6.37 of the GLVIA when considering the value of a view experienced, this should take account of:

- Recognition of the value attached to particular views, for example in relation to heritage assets or through planning designations; and
- Indicators of the value attached to views by visitors, for example through appearances in guidebooks or on tourist maps, provision of facilities for their enjoyment and references to them in literature or art.

3.12 For this reason, whilst not specifically referenced in the current edition of GLVIA, the number of people likely to be affected can influence the value assigned to a particular view.

3.13 The assessment of value is made on the same basis as the assessment of susceptibility to change.

Sensitivity

3.14 Susceptibility to change and value are considered together as discussed above for landscape sensitivity and illustrated above in Figure 2.1. Again, professional judgement determines the final judgement of sensitivity, due to the non-linear and complex relationship between susceptibility and value. A reasoned narrative is set out in the LVIA in order to justify the particular sensitivity assessed for each receptor, so that it is clear how each judgement has been made.

Magnitude

3.15 The nature of the visual effect that is likely to occur, i.e. its **magnitude**, is determined by considering four separate factors, namely:

- Size / scale;
- Geographical extent;
- Duration; and
- Reversibility.

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3.16 The size and scale of an effect is determined by considering the following:

- The scale of change in view, in respect of the loss of or addition of features, and change in composition, including the proportion of the view occupied by the development;
- The degree of contrast or integration of new features or other changes; and
- The nature of the view, namely the relative amount of time it would be experienced for and whether the views would be full, partial or glimpsed.

3.17 The geographical extent of an effect will vary from viewpoint to viewpoint and will reflect the following:

- The angle of view in relation to the main activity of the receptor;
- The distance from the proposed development; and
- The extent over which change in view would be visible.

3.18 The duration of an effect simply relates to the length of time for which it would be experienced, as follows:

- Long-term: 10+ years or the change could not reasonably be considered temporary in nature;
- Medium-term: 3–10 years; and
- Short-term: 0–3 years.

3.19 The reversibility of an effect relates to the prospects and practicality of an effect being able to be wholly or partially reversed, or whether the change cannot realistically be reversed, i.e. it is permanent.

3.20 These four factors are then considered together to derive an overall magnitude of change for each receptor, which is determined by use of professional judgement. The assessment of the magnitude of change is expressed using a four point verbal scale of large, medium, small or negligible. Where appropriate, intermediate levels such as medium/large or small/medium are used to refine the assessment. Table 3.2 indicates how the above factors have been used to inform magnitude of change. As the circumstances of each specific receptor will vary, a reasoned narrative is set out in the LVIA in order to justify the particular magnitude of change allocated to each receptor.

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Table 3.2: Magnitude of Visual Change Criteria (indicative)

Magnitude	Description
Large	A change affecting a large proportion of a view, which may be seen across an extensive area or experienced from a long section of a route, and/or a longer-term effect, and/or contrasting with the existing view.
Medium	A change affecting a moderate proportion of a view, which may be seen across a wider area or experienced from a section of a route, and/or a medium-term effect, and/or broadly compatible with the existing view.
Small	A change affecting a smaller proportion of a view, which may be seen from a limited area or experienced from a short section of a route, and/or a shorter-term effect, and/or compatible with the existing view.
Negligible	A change which is barely perceptible in the view, and/or which is only glimpsed from a route.

4.0 Level and Significance of Effect

4.1 The purpose of Environmental Impact Assessment (EIA) is to determine the likely significant effects of a development proposal. Not all landscape and visual effects arising as a result of a particular proposal will be significant. Furthermore, a significant effect does not necessarily mean that such an effect is unacceptable to decision-makers. This is a matter to be weighed in the planning balance alongside other factors. What is important is that the likely effects of any proposal are transparently assessed and described in order that the relevant determining authority can bring a balanced and well-informed judgement to bear as part of the decision-making process.

4.2 *The State of Environmental Impact Assessment Practice in the UK* (Institute for Environmental Management and Assessment 2011) identifies a range of different factors that should be considered when evaluating the significance of an effect, including:

- Knowledge and experience of significance from previous assessments;
- Details of the development proposal, such as construction and operational activities, and the nature of the effect associated with such activity;
- Details about the environmental sensitivity of the area that will be affected;
- Feedback from scoping and consultation; and
- The wider legal and policy context, which offers protection to the environment and community.

4.3 The level of effect can only be defined in relation to each particular development and its specific location. It is for each LVIA to determine how judgements about receptor sensitivity and the magnitude of change should be combined to derive the level of effect and to clearly explain how this assessment has been made, and if the level of effect is considered significant.

4.4 Figure 4.1 (below) provides a guide as to how sensitivity and magnitude can be combined to identify the level of effect upon a receptor (with the grey shading indicative of the increasing

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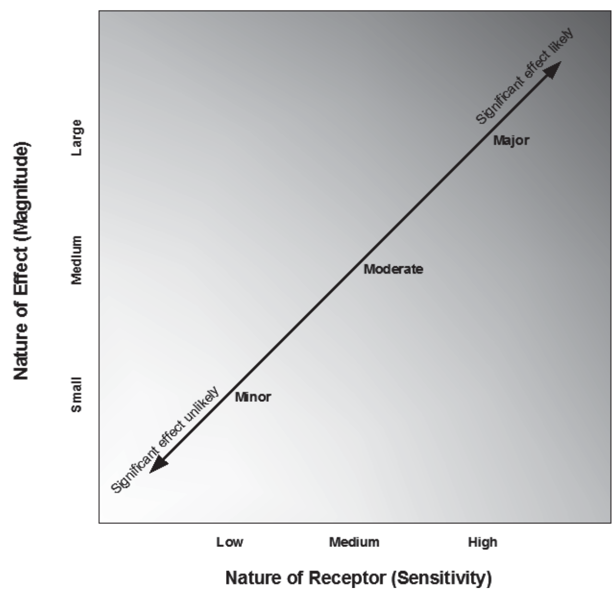
level of effect with increasing sensitivity and/or magnitude). However, the final assessment of the level of effect and whether this is significant for decision makers is one of professional judgement.

4.5 Where magnitude of change is identified as 'negligible', then effects are automatically considered not to be significant due to the minimal level of change from baseline (which would often not be perceptible).

4.6 The judgement for this particular assessment is that greater than 'moderate' effects are more likely to be significant. This is because they would generally result from larger magnitudes of change on higher sensitivity receptors. This does not preclude a 'moderate' effect or lower being significant or a greater than 'moderate' effect not being significant. This judgement will depend on the specific circumstances being considered.

Figure 4.1: Level of Effect Matrix (indicative)



4.7 The GLVIA identifies that:

[3.32] "*The Regulations require that a final judgement is made about whether or not each effect is likely to be significant. There are no hard and fast rules about what effects should be deemed 'significant' but LVIAs should always distinguish clearly between what are considered to be significant and non-significant effects…*

[3.33] *It is not essential to establish a series of thresholds for different levels of significance of landscape and visual effects, provided that it is made clear whether or not they are considered significant. The final overall judgement of the likely significance of the predicted landscape and visual effects is, however, often summarised in a series of categories of significance reflecting combinations of sensitivity and magnitude. These tend to vary from project to project but they*

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should be appropriate to the nature, size and location of the proposed development and should as far as possible be consistent across the different topic areas of the EIA."

[5.56] & [6.44] "*There are no hard and fast rules about what makes a significant effect, and there cannot be a standard approach since circumstances vary with the location and [landscape]* [1] *context and with the type of proposal.*"

4.8 It should be noted that effects may be either adverse (negative) or beneficial (positive). An effect can be significant and adverse, or significant and beneficial. If change occurs, with no obvious deterioration or improvement resulting, this can be said to be neutral.

[1] The word landscape is present in paragraph 5.56 of the 3rd edition of GLVIA only. Otherwise, the sentence quoted from paragraphs 5.56 and 6.44 is identical.

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APPENDIX 5-2: VISUALISATION METHODOLOGY

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APPENDIX 5-2: VISUALISATION METHODOLOGY

1.0 Introduction

1.1.1 The purpose of this methodology is to provide an understanding of how visualisation material prepared to support the planning application for the EMERGE Centre (the Proposed Development) has been produced. The methodology addresses the production of Zone of Theoretical Visibility mapping and viewpoint visualisations.

1.1.2 It should be recognised that production of visualisations is only one component of a Landscape and Visual Impact Assessment (LVIA), which will consider a range of other factors when identifying and assessing changes to the landscape and to views. The use of visualisations is a useful aid when undertaking LVIA, but the assessment process is not dependent on them. LVIA may be undertaken without use of visualisation material, although for major developments the inclusion of visualisations is accepted practice.

1.1.3 Current good practice regarding the production of visualisations is set out in:

- Landscape Institute and Institute for Environmental Management and Assessment (3rd edition, 2013), *Guidelines for Landscape and Visual Impact Assessment*. This document is referred to hereafter as 'the GLVIA'; and
- Landscape Institute (2019), *Visual Representation of Development Proposals. Technical Guidance Note 06/19*. This document is referred to hereafter as 'TGN 06/19'.

1.1.4 The remainder of this Methodology document is structured as follows.

1.1.5 Section 2.0 addresses the production of the ZTV mapping that informs the LVIA.

1.1.6 Section 3.0 gives details of how Viewpoints were selected for inclusion in the LVIA, and includes the details required as part of the 'Visualisation Types Methodology' that forms part of the Technical Methodology specified in Appendix 10 of TGN 06/19.

1.1.7 Section 4.0 gives details of how the viewpoint visualisation material was produced, and includes the remaining details required by the Technical Methodology specified in Appendix 10 of TGN 06/19.

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2.0 Zone of Theoretical Visibility

2.1.1 Zone of Theoretical Visibility (ZTV) maps have been generated in order to better understand the likely extent of the surrounding landscape across which the Proposed Development would be visible.

Data Source

2.1.2 ZTVs were produced using 2 m Digital Surface Model (DSM) data available from the Environment Agency, under the terms of the Open Government Licence. This is captured via LIDAR survey undertaken in 2017, and does take account of screening features such as building and vegetation.

2.1.3 This data consists of a series of spot levels at 2 m intervals. The declared 'root-mean-square error' (RMSE) of this dataset is between approximately 5 cm and 15 cm, i.e. the degree of error between the actual on-the-ground height of any particular location and the height as indicated by the DSM is between approximately 5 cm and 15 cm.

2.1.4 The extent of the DSM within the Site boundary was then amended to remove all those structures at the Ratcliffe-on-Soar Power Station ('the Power Station') which would be demolished post-2025. The ZTV therefore shows the worst-case, long-term theoretical visibility of the Proposed Development.

ZTV Creation

2.1.5 The ZTV was calculated and created using QGIS open source software. The ZTV calculation process takes account of the curvature of the earth's surface and light refraction. The eye height of the receptor in the computer model was set at 1.7 m above ground level in accordance with guidance set out in GLVIA.

2.1.6 The ZTV were generated to illustrate the theoretical visibility of the proposed stack (height 110 m), of the proposed boiler house roof (height 49.5 m), and of the existing gas turbines stack (height 95 m) and the existing 199 m stack (which would be removed post-2025).

2.1.7 The ZTVs are displayed on Figure 5.2 of the Environmental Statement (ES).

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Limitations

2.1.8 A ZTV, as use of the term theoretical implies, is not an absolute indication of the extent of visibility, but rather a computer-generated aid that utilises available relative data to indicate areas of inter-visibility and screening in relation to a specific modelled object. ZTVs are tools to assist the LVIA. The technique aims to give a better understanding of the areas where visibility is likely and unlikely, but imperfections in data are such that it must only be seen as an aid to understanding. This limitation needs to be recognised when interpreting the ZTVs.

2.1.9 A further caveat is that the ZTVs simply illustrate that part of a structure would be theoretically visible. As such, it makes no distinction between a clear view of all or most of a proposed feature and a view of a very small proportion of a feature (for example one corner of a building roof, or the top of a stack). This is especially relevant in the case of the Proposed Development, where views from the surrounding area are often limited by localised changes in vegetation cover and landform.

2.1.10 The ZTV produced using the DSM does reflect the presence of screening features in the landscape. However, it should be recognised that the DSM reflects a single moment in time. In reality, the extent and / or height of vegetation cover is dynamic and changes as vegetation inevitably increases in stature over time and / or is planted, trimmed or removed. Similarly, there is potential for buildings to have been erected, demolished or modified, subsequent to the data being captured.

2.1.11 The DSM does not distinguish between the ground surface and the surface of structures and vegetation. As a consequence, the ZTV output may indicate visibility from areas known to be occupied by woodland and buildings. Whilst in theory it may be possible for people to experience the views from such locations (by climbing onto roofs, or into the tops of trees), this is not representative of typical day to day visibility, and as such there is the potential to overstate the actual visibility of the Proposed Development.

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3.0 Viewpoint Selection

Introduction

3.1.1 The aim of this Section is to present, in a transparent format, the process that has been followed in arriving at an appropriate number and range of viewpoints.

3.1.2 When considering which viewpoints to include as part of an assessment it is important to not assess too few or too many viewpoints. A proportionate approach to viewpoint selection is necessary, in line with the recommendations of the GLVIA.

3.1.3 The absence of a viewpoint from any location does not imply that there would be no view of a proposed development, nor that views from such a location have not been considered in the LVIA.

Viewpoints

3.1.4 Viewpoint locations were identified following an initial site visit, and pre-application consultation with Nottinghamshire County Council and their landscape advisors. The precise location of each viewpoint was determined in the field, as part of the site visit to shoot the photography.

3.1.5 Ten viewpoints have been included in the LVIA. Details of these are set out in the main body of the LVIA (ES Chapter 5.0). The locations of all the viewpoints are illustrated on Figures 5.1 to 5.3 of the ES.

3.1.6 Appendix 10 of TGN 06/19 sets out details of what should be included in the Technical Methodology for Viewpoint Visualisations (i.e. in this Methodology document). The list of required information is stated to be indicative.

3.1.7 Part of the required information is a 'Visualisation Type Methodology', including:

- The anticipated purpose / users of the viewpoint visualisations;
- The indicative assessment of sensitivity and magnitude, and resulting likely indicative overall degree or level of effect; and
- Other factors influencing the selection of the visualisation type.

3.1.8 The purpose of the Viewpoint Visualisations is to inform the LVIA and the decision-making process. Users are likely to be landscape professionals, other environmental professionals and planning officers, consultee bodies and interested members of the public.

3.1.9 On the basis that the LVIA includes a detailed assessment of visual effects from each viewpoint, including a description of the sensitivity of receptors, the magnitude of change in view that would occur, and the resultant effect, it is considered that there is little benefit in providing an indicative assessment in this Methodology document.

3.1.10 The LVIA Chapter of the ES and the accompanying Appendix 5-5 that addresses effects on Viewpoints, include details of the type of receptors that each viewpoint seeks to represent, and a brief description of the viewpoint location. It is considered that this information should be sufficient to indicate the factors that have influenced the selection of the viewpoint.

3.1.11 Baseline photography is provided from each viewpoint, which is annotated where deemed appropriate to highlight key features. Photomontages illustrating how the Proposed Development would appear are also included from selected viewpoints.

4.0 Viewpoint Visualisations

Photography

4.1.1 All photography for this assessment was taken using a Canon EOS 5D Mark II digital single lens reflex (DSLR) camera with a full-frame sensor, using a 50 mm lens. The camera was mounted on a tripod to ensure a stable support and minimise camera shake. The camera was mounted on a panoramic tripod head with built-in spirit level (Nodal Ninja 3 MkII), which allows for the rotation of the camera at fixed intervals around a fixed point in vertical alignment with the camera lens, thereby eliminating parallax error. The camera was levelled using an auto-leveller device (Nodal Ninja EZ-Leveler II). Camera height was generally 1.5 m above the ground.

4.1.2 Photographs were taken over a full 360 degree sweep from each viewpoint location. The precise location of each photograph was recorded using a hand-held Garmin Oregon 600 GPS device (which has an accuracy of approximately 3 m). A photograph was also taken of the tripod location (these photographs are included in

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Annex A). Following the Site visit, the GPS data was loaded into Google Earth, and the GPS waypoints were moved manually where necessary to reflect the tripod location. A spreadsheet was completed recording information about the viewpoint.

3D Model

4.1.3 A digital model of the Proposed Development was created using industry standard software (Autodesk 3DStudioMax), along with the viewpoint data recorded on Site (as discussed above). This enables a series of 'camera' points to be created within the model, reflecting the view from each viewpoint towards the Proposed Development.

4.1.4 A series of markers were added to the model, representing real-world locations such as topographic features, electricity pylons, vegetation and buildings. The locations of these markers were determined via the use of aerial imagery (e.g. Google Earth) and by the Environmental Agency 1 m Digital Surface Model (DSM) LIDAR data.

4.1.5 At each viewpoint, the models were then lined up with the individual photographs that focus on the Site. The markers were used to ensure that the model lines up both horizontally and vertically as accurately as possible with the photograph (by matching the markers with the real-world equivalent). The markers were also used to assist with identifying which features in the photograph would appear 'in front' of the Proposed Development, which would appear 'behind' and which, if any would be removed, at those viewpoint where photomontages were produced.

4.1.6 Once the models are lined up as accurately as possible, the Proposed Development was rendered, having regard to the particular materials and colours that are to be used, and to reflect light conditions typical of the time and date of the photography.

Photo Stitching

4.1.7 The full sweep of photos taken from each viewpoint were stitched together using the software package PTGui. The software reads the exchangeable image file format (EXIF) data attached to each individual photograph file to identify the specifications of the camera and lens, ensuring accurate production of the stitched panoramic image.

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Photomontages

4.1.8 Photomontages are computer generated images, showing images of the Proposed Development superimposed upon the existing photography, with the aim of producing a visualisation that should give a realistic impression of how the Proposed Development would appear within the landscape. Photomontages have been produced from three of the LVIA viewpoints, these being locations where the Proposed Development would be most clearly visible.

4.1.9 The resulting stitched viewpoint image was loaded into Adobe Photoshop. Any parts of the Proposed Development that would not be visible from an individual viewpoint due to the presence of intervening features were cropped out.

Limitations

4.1.10 It should be understood that viewpoint visualisations can never provide an exact match to what is experienced in reality. Visualisations are tools in the assessment process but independent from it. They illustrate the likely change in view in the context of a specific date, time and weather conditions, that would be seen within a photograph and not as seen by the human eye. As such, visualisations need to be used in conjunction with site visits and should be considered in the context of the totality of views experienced from the viewpoint and not just focussed on the Proposed Development.

4.1.11 Photography was taken in March 2020. The photographs reflect the level of foliage present at that time of year.

4.1.12 The software (3DStudioMax) used to produce the model of the Proposed Development from each Viewpoint does not take account of the curvature of the earth's surface, and assumes a flat horizon. The effects of the earth's curvature do influence what is visible, especially in longer range views. If a flat horizon is assumed, then a feature located approximately 5 km away from any viewpoint would appear approximately 1.7 m higher than in reality. As such the model slightly exaggerates the height that the Proposed Development would appear in each view. As all of the viewpoints are located within 2.5 km of the Proposed Development, it is considered that this is not material to the conclusions of the LVIA.

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Presentation & Viewing

4.1.13 Once the final viewpoint images have been produced, they are inserted into a figure template, which also includes information about the viewpoint, including the date and time of photography, details of the camera used, and British National Grid coordinates.

4.1.14 In relation to the viewpoint visualisations presented on Figures 5.4a-j of the ES, these are displayed as follows.

4.1.15 The approach to visualisations was agreed with NCC as part of post-scoping consultation. In order to produce photomontages reflecting the post-2025 baseline with many existing structures removed, the structures in question would have to be edited out of the baseline photographs, with further editing then required to reflect what might be visible behind them. There is no way to do this with any accuracy – a guess would have to be made as to what the skyline would look like, and what if any vegetation or structures are present behind the removed structures. Any photomontages produced this way would not be of the required degree of quality and accuracy necessary to inform an ES.

4.1.16 Photomontages have been prepared from Viewpoints 2 and 10, where the Proposed Development would be clearly visible prior to the removal of existing structures at the Power Station.

4.1.17 At the other eight Viewpoints, an outline of the Proposed Development has been superimposed onto the baseline photograph to give an indication of its height and mass. These have been produced to the same degree of accuracy as the photomontages but do not include a rendered image of the new facility.

4.1.18 For each figure, the existing baseline view is displayed as the first sheet, annotated with the location of notable features. The second sheet also shows the baseline view, zoomed in to focus on the Site of the Proposed Development.

4.1.19 The third sheet shows either the photomontage or wireframe outline of the Proposed Development.

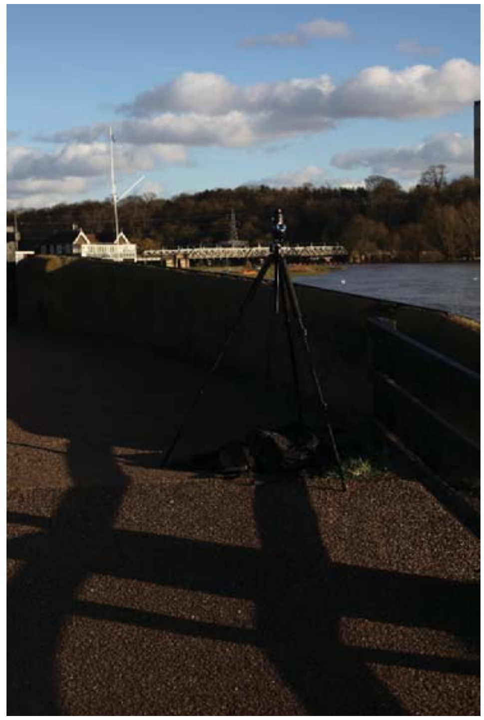
NCC received 16.07.2020

4.1.20 The images presented on each sheet are typically displayed at the enlargement factor in accordance with the guidance set out in TGN 06/19. The enlargement factor is stated on each sheet.

4.1.21 Each sheet should be printed at the size stated on it. In some instances, this may require unconventional paper sizes (e.g. A1 width and A3 height). All printed sheets should be viewed **held flat at a comfortable arm's length**.

NCC received 16.07.2020

ANNEX A: Tripod Location Photographs



Viewpoint 1

Viewpoint 2

NCC received 16.07.2020

Viewpoint 3

No tripod photo. Camera location was immediately south of the bench at the crossroads

Viewpoint 4

Viewpoint 5

NCC received 16.07.2020

Viewpoint 6

Viewpoint 7

NCC received 16.07.2020

Viewpoint 8

Viewpoint 9

NCC received 16.07.2020

Viewpoint 10

NCC received 16.07.2020

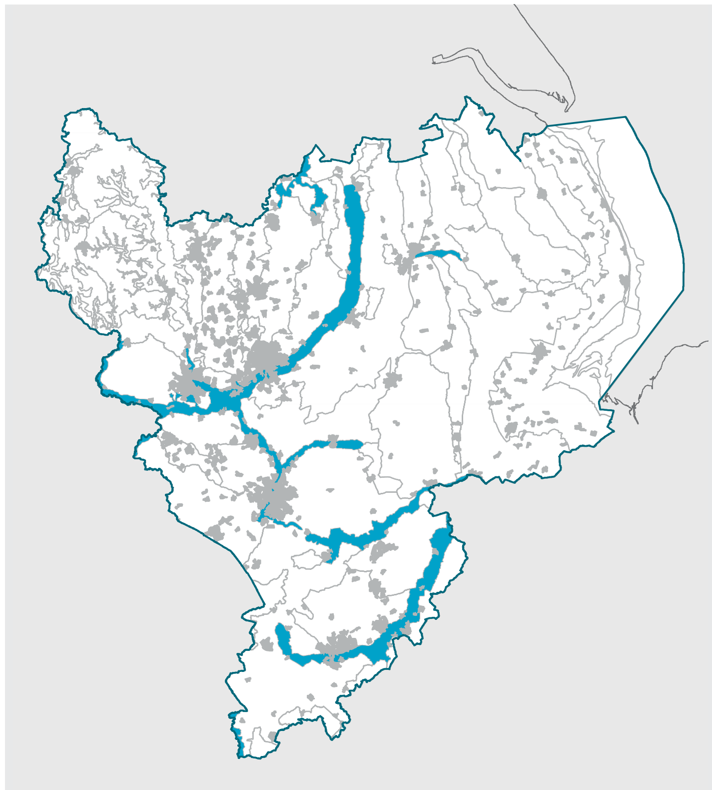
APPENDIX 5-3A: EXTRACTS FROM GREATER NOTTINGHAM LANDSCAPE CHARACTER ASSESSMENT

NCC received 16.07.2020

3A:

FLOODPLAIN VALLEYS

Pastoral farming along river channels (© Nottinghamshire County Council)



KEY CHARACTERISTICS

- Deep alluvium and gravel deposits mask underlying bedrock geology to create wide, flat alluvial floodplains surrounded by rising landform of adjacent Landscape Character Types;
- River channels, often along managed courses, bordered by riparian habitat;
- Predominance of pastoral land use, with cereal growing increasing in some areas. 'Warping' areas subject to more intensive cereal growing;
- Limited woodland cover; however, steep riverside bluffs and areas close to settlement or on former gravel extraction sites notable for a higher level of woodland cover;
- Regular pattern of medium to large fields defined by hedgerows or post and wire fencing, breaking down and becoming open in some areas;
- Hedgerow and riverside trees important component of landscape. Alder, Willow and Poplar are typical riverside trees;
- Limited settlement and development in rural areas;
- Sewage Treatment Works and power stations common close to larger settlements that fringe the floodplains;
- Roads and communication routes often define the outer edges of the floodplain; and
- Restoration of sand and gravel extraction sites to open water creates new character across many areas.

NCC received 16.07.2020

LANDSCAPE CHARACTER

The Floodplain Valleys Landscape Character Type is found throughout the region, along the broad valleys of the Trent, Nene, Welland, Wreake, Soar and Dove, and short stretches of the Derwent and Witham. Despite occupying different parts of the region, and therefore contrasting bedrock geologies, the broad flat belts of alluvium and gravel terrace deposits flanking the river channels are a strong unifying characteristic.

Historically, the floodplains would have shared common land use characteristics with a predominance of permanent pasture on riverside meadows and arable fields on drier gravel terraces. Whilst many stretches of permanent pasture and riverside meadows remain, increasing arable and silage production, and the influence of large urban areas and sand and gravel extraction creates significant contrasts in local landscape character.

Whilst the floodplains themselves are generally devoid of settlement, the rivers and neighbouring gravel terraces have been a focus for settlement for several thousands of years. As such, many areas are noted for their rich and varied archaeological deposits. The majority of the region's major towns are located adjacent to the floodplains and exert a strong but localised influence on their character. Elsewhere, the floodplains constitute some of the most remote and peaceful terrestrial lowland areas in the East Midlands.

Floodplain Valley (© Carol Paterson, Natural England)

PHYSICAL INFLUENCES

The various major rivers of the East Midlands traverse different geology. However, great unity of character is derived from the characteristics of the succession of river-borne superficial deposits, consisting mainly of flood gravels of varying age, and more recently deposited alluvial clays and silts. Peat may also be common.

Alluvial deposits form wide, flat floodplains fringing the meandering river channels. Many of the major rivers flood regularly, and as a consequence, considerable stretches of river have been modified to control flooding and also canalised to facilitate navigation. However, many of the rivers across much of the region appear to retain natural characteristics such as meanders.

The gravels tend to form low terraces along the fringes of the floodplain and on the adjacent valley sides as well as islands within the floodplain itself. The gravel terraces and islands are usually slightly raised above the alluvial floodplain and provide areas of dry land, and as such are sometimes identified by arable fields or settlement.

There are a number of features within the landscape type that are of geodiversity interest. In particular the river valleys provide an important geodiversity resource with the many continual exposures in working sand and gravel quarries together with a range of geomorphological features associated with the rivers, notably meanders, ox-bow lakes, abandoned channels and terrace features. While the application of practices for the care, maintenance and management of features of geodiversity interest within the landscape type are important, and the promotion of their educational and interpretational value, the long term preservation of sand and gravel faces in quarries is not easy.

NCC received 16.07.2020

Soils developed on the floodplain have a predominantly coarse loamy texture, with local variations in the nature of superficial deposits having a strong influence on their drainage and agricultural capacity. In general, soils with higher clay content have impeded drainage and are better suited to grazing. As such, land bordering the main channel tends to be used for grazing cattle and sheep with arable land typically occupying more elevated gravel terraces. Historically permanent pasture would have been more widespread in the floodplains; remnants of flood meadow systems indicating the widespread management of river water to ensure an early flush of grass in the spring. However, recent decades have seen greater emphasis on flood management with river straightening and construction of sluices and flood banks. This has prompted a greater use of the floodplain for cereal production. In some areas, notably north of Gainsborough in the Trent Valley, the level of the land surface has been raised by the addition of sediment transported from elsewhere in a process known as 'Warping' to create highly fertile and well drained soils that are well suited to cereal production.

The Floodplain Valleys tend to be sparsely wooded, and indeed no substantial ancient woodland sites are noted throughout the region's major floodplain river valleys. However, steep wooded bluffs at the fringes of the river channel and small broadleaved copses are characteristic of some areas, and notably close to areas of settlement on the fringes of the floodplain. Wet woodlands within or adjacent to floodplain meadows are also notable and form important remnants of once much more extensive semi-natural habitat, and are sometimes the remnants of osier beds. In recent decades, significant woodland planting has become established around former gravel workings adding to the planned character of these newly created landscape features. Part of the Floodplain Valleys farmland that lies within the Trent Valley is located in The National Forest.

Despite low woodland cover, trees along rivers and in field boundaries add to the overall perception of a well treed landscape, particularly when viewed at ground level. Of particular significance are wetland species, such as willow, poplar and ash which contribute to the overall pastoral character of the floodplain landscape.

CULTURAL INFLUENCES

The region's major river valleys have been important transportation routes throughout history. Indeed, before canals, rail lines and metalled and well maintained roads were common, river boats and barges would have been the quickest and most reliable form of transport. The free draining gravel terraces, close to reliable sources of water, would also have been the focus of settlement and farming from the earliest times. Therefore, the alluvial soils and gravels contain widespread archaeological remains. In some areas, where the alluvial clays are permanently wet, they may be peaty. Organic remains survive, such as seeds, pollen, wood and leather and offer a unique insight to palaeoenvironments and elements of material culture that do not typically survive in drier conditions.

Settlement is most typically located at the edges of the floodplain. Indeed many of the region's larger towns are located immediately adjacent to the Floodplain Valleys Landscape Character Type. The majority of these large riverside settlements have ancient origins, and were often originally established to control strategic river crossings. As the towns have grown, they have tended to avoid encroaching onto the floodplain and as such, have either developed in a linear fashion, along the edge of the river valley, or wrapped around and 'captured' large areas of floodplain within the urban envelope. Occasionally urban areas, predominantly consisting of Victorian terraces, post war industrial development and sports stadiums, extend into and across the floodplain, as at Northampton, Nottingham, Leicester and Melton Mowbray.

NCC received 16.07.2020

Where urban areas are located adjacent to the floodplain, they exert a strong influence on local landscape character. Sewage treatment works, power stations, industrial parks and transport or energy infrastructure features are common urban fringe land uses across the floodplains and gain visual prominence in the otherwise flat and open landscape. Wide areas of degraded landscape are also evident in the urban fringes, with scrub and horse pastures noticeable in the floodplain around several towns. In more recent decades, and in recognition of the aesthetic and recreational value of the river, riverside areas are being redeveloped, and as such new blocks of flats are being constructed to overlook the floodplain landscape and riverside parks created or enhanced.

In rural areas, the regular inundation of the floodplain generally precludes widespread settlement. Therefore, built development is restricted to scattered dwellings and farmsteads. Despite this, small villages and hamlets are evident within the rural floodplain landscape, albeit located on areas of slightly elevated ground or protected by flood embankments. In many instances villages in the floodplain landscape are linear, stretching out along roads parallel to the main river channel, or at right angles to it when associated with a bridge crossing.

Beyond these villages the character of the floodplain landscape contains fewer direct cultural influences. Field boundaries, largely in geometric patterns dating to parliamentary enclosure, divide the floodplain into medium to large fields, with the pattern breaking down in some places to create open areas of farmland. In areas of permanent pasture, ridge and furrow and former flood meadow systems are preserved and are an important remnant of former farming practices. Other commonly occurring historic sites of interest include mill sites and races and canalised sections of rivers and associated locks and sluices constructed in order to control the rivers through canalisation. A range of features associated with transport infrastructure, notably bridges, canals and stretches of dismantled railway line are evocative of the importance of the river valleys for travel and communication.

Large areas of the floodplain landscape are significantly influenced by sand and gravel extraction. Whilst some extraction sites have been restored to farmland, the general pattern since the 1970s, particularly in the Nene Valley, has been to flood old workings and create artificial landscape features, typically characterised by large tracts of open water adjacent to the main river channel surrounded by blocks of native woodland. In contrast to this, other gravel pits, particularly in the Trent Valley, have been backfilled with fly-ash or domestic refuse and not flooded. Many tracts of the Nene and Trent floodplains are now characterised by woods, lakes, open drainage ditches and wetlands, which form a stark contrast to areas of open pasture elsewhere. These areas are highly valued for their recreation potential and nature conservation interest, notably for overwintering birds. Indeed, several former mineral sites are designated as Sites of Special Scientific Interest (SSSI).

AESTHETIC AND PERCEPTUAL QUALITIES

The nature of local land cover and land use has a profound influence on the very varied aesthetic and perceptual qualities of the Floodplain Valleys.

Vast stretches of floodplain landscape retain an intact and traditional character. Here the predominance of permanent grazing land interspersed with meandering river channels fringed by riparian habitats and riverside trees creates a visually coherent and intimate pastoral landscape. The general absence of built development enhances the quiet, rural character of the landscape, which is only occasionally interrupted by roads crossing the river, or views to farms and villages on drier, more elevated land. Hedgerows and rising landform fringing the floodplain enclose views and create an intimate, human scale landscape fringing the more open floodplain.

NCC received 16.07.2020

Occasionally increased occurrence of cereal cropping or silage production and declining hedgerow networks creates a less distinctive landscape that merges with rural areas beyond the edge of the floodplain. Elsewhere, and notably in the Warp lands of north Nottinghamshire, intensive cereal farming creates a highly distinctive floodplain landscape of large fields which are in stark contrast to the intimate riverside pastures evident elsewhere.

In close proximity to the region's major towns, urban fringe land uses are evident across wide areas of floodplain landscape. Here, the visual prominence of sewage treatment works, power stations, pylons and transport infrastructure are set against a backdrop of urban development and create a degraded peri-urban landscape. Despite this, their proximity to urban populations, open character and accessibility of the river combine to make these popular areas for walking and informal recreation.

Former gravel workings represent a marked contrast to more typical pastoral floodplains elsewhere. Wide open expanses of open water, surrounded by extensive tree belts, are wholly artificial but are gradually assimilating into their surroundings to create areas of entirely new character. Whilst some areas are remote and tranquil, others which offer recreational facilities are active and increasingly popular for informal recreation and nature watching.

Floodplain Valley (© Carol Paterson, Natural England)

LANDSCAPE CHANGE AND MANAGEMENT

BUILT DEVELOPMENT

Forces for Change

Development on settlement margins is damaging the character of the landscape, creating visual intrusion and extending the urban edge into the Floodplain Valleys. In particular the edges of Leicester, Nottingham and Derby, and also Northampton and Wellingborough in the Nene Valley, need to be carefully considered as these are identified Growth Points that will receive significant levels of new mixed use development in the short and longer term. Large-scale industrial developments, such as sewage treatment works and power stations are particularly prominent in this otherwise flat and open landscape.

Shaping the Future Landscape

The aim should be to protect the open and unsettled character of the landscape and limit the visual impact of any new structures by locating development on previously developed land or close to existing settlement and avoiding development on greenfield sites. The siting of new development should also avoid floodplain areas, in accordance with government planning policy. Best practice innovative architectural ideas and planning solutions that minimise impact on local landscape and townscape character and utilise eco-friendly high quality design should also be encouraged, along with tree planting around settlement fringes to help integrate new development into the landscape and contribute to the overall perception of a well treed landscape.

NCC received 16.07.2020

INFRASTRUCTURE

Forces for Change

In response to flood risk, engineered solutions, such as concrete flood walls and embankments, have been installed in many locations along the river channels. This has resulted in the canalisation of rivers and loss of riverside vegetation, meadows and pastures, changing the natural character of the Floodplain Valleys, although historic structures can contribute to the character of the river. In some instances, the height of the defences screens the river from view, reducing the sense of openness and sense of place.

There is also the potential for the river landscapes to change due to shifting river channels, cutting off of meanders and the creation of features such as ox-bow lakes. This may result from flooding or other influences, and with the effects of climate change, there is a high potential for this to happen in the medium and long term.

Shaping the Future Landscape

The aim should be to manage flood risk, implementing land management practices to control run-off and make more space for water. Specific mechanisms include restoring floodplains and creating flood storage areas. Promotion will also be necessary to ensure landowners along river channels are encouraged to develop appropriate methods of land-use and land management.

MINERALS AND WASTE

Forces for Change

Sand and gravel extraction is commonplace along river channels. Due to large-scale projected housing growth in the UK, there is continued demand for sand and gravel and therefore new extraction sites. Such sites are in marked contrast to more typical pastoral floodplains, creating short to medium term visual intrusion during the extraction period and reducing the sense of tranquillity in more remote areas.

Shaping the Future Landscape

The aim should be to protect the open character of the landscape by siting extraction sites away from visually prominent locations or intact floodplain landscapes. The impact on long distance views from surrounding villages and towns should also be considered. Where extraction does occur, it will be necessary to plan for site restoration and after-use. In the Nene Valley in particular, the general pattern has been to flood old workings and create entirely new landscape features, typically characterised by large tracts of open water. Elsewhere , many have been backfilled with fly-ash or domestic rubbish.

The preference should be for the creation of wetland habitats such as meadows, reedbeds and marshland which maximise biodiversity benefits, and which have typically been lost due to the erection of flood defences and agricultural intensification. In producing restoration plans for former extraction sites, a diversity of uses needs to be considered, as full restoration to a dry site may not always be an option due to restrictions on the volumes of inert fill.

NCC received 16.07.2020

AGRICULTURE AND LAND MANAGEMENT

Forces for Change

There is marked evidence of agricultural intensification, accompanied by a move from pastoral towards arable farming. This has resulted in the loss or damage of many typical landscape features, including riverside meadows, which would have traditionally defined the river channels and distinguished them from the surrounding farmland. Of those river meadows that remain, many have been agriculturally improved by herbicides and fertilisers, reducing species diversity and visual interest.

Shaping the Future Landscape

The aim should be to protect existing river valley features, whilst encouraging positive management of those features lost or under threat. In particular the restoration of meadows should be given priority, strengthening the character of river channels and providing a diverse range of habitats. Such proposals may be supported by Environmental Stewardship grants.

Floodplain Valley (© Carol Paterson, Natural England)

FORESTRY AND WOODLAND

Forces for Change

Small woodland blocks and remnants of wet woodland are common on the fringes of the floodplain, contributing to the overall perception of a well treed landscape. Significant woodland planting has also become established around former gravel workings as part of their restoration. However, woodland cover is generally sparse, and unless carefully sited, new planting can introduce inappropriate and visually intrusive elements in this open landscape.

Shaping the Future Landscape

The aim should be to protect the open character of the landscape by ensuring the type and location of new woodland and tree planting is appropriate. Large-scale tree planting should generally be avoided, with priority for wet vegetation and riverside trees, strengthening the character of river channels and providing a diverse range of habitats. However, limited native tree planting may be appropriate to soften the impact of built development on settlement margins and as part of the future restoration of sand and gravel workings.

For those areas in the Trent Valley that lie within The National Forest, design guidance for woodland creation should be in accordance with the National Forest Strategy, 2004-14 that has been consulted on and endorsed at the national level. The aim should be to plant small-scale woodlands and linear riverine belts of planting or associated with lakes and pools within the pastoral floodplain with larger scale farm woods within more open agricultural landscapes.

NCC received 16.07.2020

ENVIRONMENTAL PROCESSES AND CLIMATE CHANGE

Forces for Change

The effects of climate change has the potential to lead to increased flooding, and changing river channels and summer desiccation of wetlands

Shaping the Future Landscape

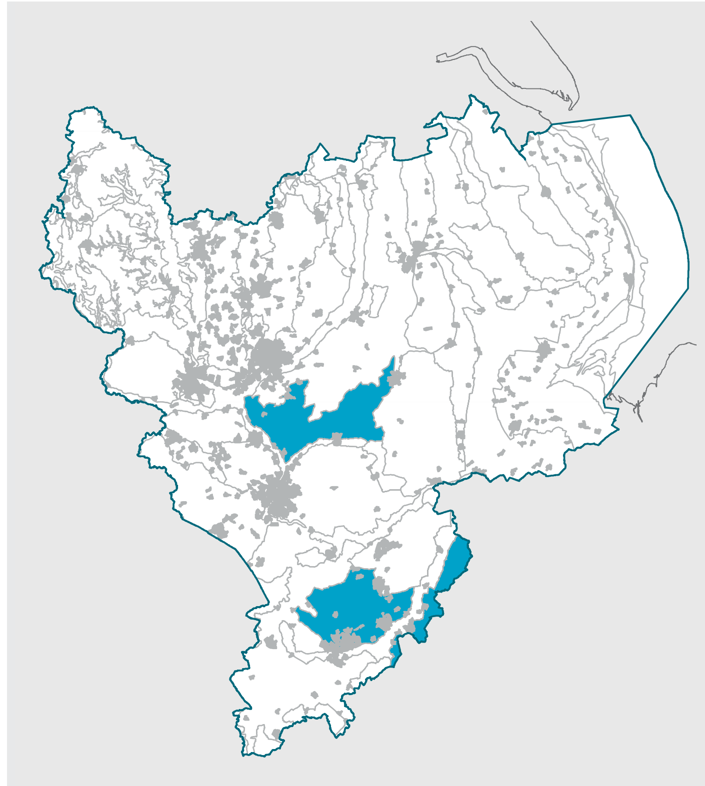
The aim should be to adapt agricultural land management practices to accommodate the projected effects of flooding and desiccation.

NCC received 16.07.2020

8A:

CLAY WOLDS

Well treed character from hedgerows, hedgerow trees, copses and small woodlands (© River Nene Regional Park/M Williams)



KEY CHARACTERISTICS

- Broad plateaux overlain by thick mantle of till surrounded by undulating ridges and valleys, and prominent scarp slopes;
- Clay plateaux drained radially by streams occupying arrow valleys creating rolling landform;
- Mixed farming but with mainly arable on the plateau tops and pasture on steep sloping land and along valleys; hedged fields generally medium to large scale, with some evidence of amalgamation;
- Well treed character from hedgerows, hedgerow trees, copses and small woodlands despite limited areas of large woodland;
- Sparse settlement pattern of small villages and farms with little modern development;
- Ironstone and limestone churches and vernacular buildings, but brick the most abundant and -widespread building material;
- Frequent and prominent ridge and furrow close to villages;
- Quiet and remote, often empty character with expansive views contrasting with more intimate and intricate areas close to villages; and
- Damming of several valleys to create reservoirs which have localised impact on landscape character.

NCC received 16.07.2020

LANDSCAPE CHARACTER

The Clay Wolds Landscape Character Type represents a distinctive elevated plateau farmland landscape across thick belts of boulder clay separated by rolling valleys. Historically, the intractable clays of the plateau appear thinly settled, with settlements generally gravitating to the more easily worked soils on the neighbouring slopes and valleys. Remnants of this pattern of settlement remain evident in the modern landscape, and many of the elevated clays are sparsely settled, and retain a remote, sometimes empty character, enhanced by panoramic views over the surrounding landscape possible from their fringes. The valleys drain radially from the uplands and form a major component of the River Nene and several tributaries of the Trent. Here the landscape is more intricate and intimate, with long distance views obscured by landform and vegetation. Villages remain small and rural, although their built character is dominated by the use of brick.

The historic character of the landscape is dominated by hedged fieldscapes dating to the 18th and 19th centuries, albeit overlain onto a much older pattern of sinuous boundaries and routes across the hills. Other influences are limited to occasional rail routes winding through the landscape and reservoirs. In more recent decades, the removal of hedgerows and increased reversion to cereal farming has had a subtle influence on landscape character.

Clay Wolds, Nottinghamshire near East Leake.
(© Martin Banham, Natural England)

PHYSICAL INFLUENCES

The Clay Wolds Landscape Character Type occupies various bedrock geology formations, including Lias Group mudstones, Ooidal limestones and the Marlstone Rock and Northampton Sand Formations, the latter two of which have been used extensively as a building stone and are represented in the local vernacular of buildings within many of the villages. Jurassic mudstones are also extensive to the east of the Nene, stretching into neighbouring Cambridgeshire. Whilst influencing the elevation and main landform features, such as the escarpment and outliers that rise above the Vale of Belvoir, the surface expression of the bedrock is often subdued by a thick mantle of glacial till which also softens landform features to create a smooth, gently undulating landscape, interspersed with often steep sided valleys. The steep slopes in mudstone may be subjected to landslides.

The clay wolds to the south and east of Nottingham and east of Northampton offer only limited potential for features of geodiversity interest with very few exposures but some geomorphological features. The area to the north of Northampton offers much more potential. With the many former ironstone and building stone quarries and more pronounced geomorphological features, it is important that practices are in place for their care, maintenance and management, and the promotion of their educational and interpretational interest.

The streams that rise on the elevated plateaux flow into the surrounding river valleys in a radial drainage pattern. The influence of these valleys on landscape character is significant; the streams having eroded convex sloped valleys that are, in part, responsible for creating the undulating landform.

NCC received 16.07.2020

The superficial covering of till was deposited by glacial ice and is formed from unlithified rocks, sands and clays that have their origins as far north as Yorkshire, Lancashire and beyond. The covering was once more extensive, but has since been eroded by the numerous streams draining these low hills and deposited in the valleys of the major rivers, first as gravels and then as muds and silts. As such, the clay mantle now occupies only the more elevated areas and watersheds between the valleys, allowing the underlying geology to emerge at the fringes of the landscape.

On the plateaux and other more elevated areas, the soils derived from the till are lime-rich, loamy and clayey with impeded drainage. They are characteristically stony and contain a wide range of pebbles and rock fragments, indicating that the underlying tills have diverse geological origins. Where the clay overburden has eroded to expose the underlying Marlstone Rock and Northampton Sand Formations, soils are free draining, slightly acid but base-rich.

Despite the impeded drainage of the clays, cereal cultivation predominates across the fertile soils and gentle topography of the plateaux and gently sloping hills and valleys. Indeed, some areas are particularly intensively farmed through field amalgamation and the cultivation of single crops across wide areas. However, pastures are conspicuous on steeply sloping topography along valleys and close to villages. Here, field patterns tend to be more intricate and a wider range of land uses combine to create a more colourful and textured character than that of the simpler and more expansive plateau tops.

Widespread improvement and cultivation has diminished the nature conservation interest of the agricultural landscape. However, isolated areas of species rich grassland remain and are noted for their biodiversity value. Woodlands are also locally important, although not generally a dominant feature. Ancient woodlands are limited in scale and tend to be located on the thick clays. Evidence also suggests that these are often at the edge of parishes, perhaps indicating they were retained as communal resources at the fringes of the best and most readily cultivated land. Elsewhere, larger woodlands are a feature of parklands, valley sides and steep sloping scarps overlooking the Vale of Belvoir. Small geometric broadleaf copses and coverts are also an important landscape feature, providing cover for game and other farmland species.

Hedgerow trees, notably oak and ash, and lines of trees fringing watercourses also add to the wooded character of the landscape. Whilst the scale of fields, and therefore the distance between boundaries limits their ability to reduce the open character of the landscape, hedgerows are also locally important, providing visual containment and networks of habitat through the agricultural landscape.

CULTURAL INFLUENCES

Evidence of prehistoric settlement and activity on the Clay Wolds is limited. It is possible that the intractable clays would have been a constraint to the early exploitation as a consequence of primitive plough technology. However, the intensive arable farming of the past few decades may have removed evidence of prehistoric and Roman fields and farms.

Early Anglo Saxon occupation may also have been limited, and it is unclear whether the Saxon and Scandinavian place names evident represent consolidation of pre-existing farms and settlements or mark a new phase of occupation in the mid to late Saxon period. The repeated reference to 'Wolds' in place names, almost all of which occur on the till deposits, is indicative of open hill pastures, perhaps interspersed with woodland. Such resources would have been carefully managed as communal grazing and timber reserves. The distribution of settlements is also of note. The majority of villages appear to have been established at the edges of the thick till mantle, indicating that the elevated areas were managed as communal grazing, with open fields on the free draining soils of the slopes and lower lying areas. Remnants of ridge and furrow also support this, with most surviving areas lying on the fringes of the clay and where the clay mantle has been removed to expose the underlying bedrock.

NCC received 16.07.2020

Parish boundaries, established in the late Saxon period, and perhaps indicating much older divisions, also allude to this pattern of settlement and system of land management. Parish boundaries appear to show that valuable upland grazing resources were equitably divided amongst settlements on the lower ground. It is interesting to note that many ancient woodland sites survive on the fringes of several parishes, perhaps indicating that woodlands marked boundaries and were shared by neighbouring communities.

During the early medieval period, it is also possible that large areas of the landscape fell under forest law. For example Rockingham Forest once extended to Northampton, and would have included much of the landscape of the Clay Wolds west of Kettering. The Bromswold, mentioned in the 11th century tale of Hereward the Wake, once extended east from the Nene towards the River Great Ouse and is also significant. However, it is not clear to what degree such 'forest' areas were wooded, and evidence suggests that much of the land was cleared by the time of the Domesday survey.

There appears to have been piecemeal enclosure of the landscape from the 15th century onwards, and wide areas may have been thinly populated and dominated by sheep grazing. This goes some way to explain the thinly settled character of the landscape, small villages and few farms. Indeed it is possible that many areas remained unenclosed until the 18th and 19th centuries. During this time, the landscape was divided up as part of parliamentary and non parliamentary enclosures, resulting in today's pattern of rectangular hedged fields set within a more sinuous pattern of older enclosures, winding lanes and watercourses. Many village cottages and farms were also built or rebuilt in brick at this time. Whilst some limestone or ironstone buildings are evident, particularly in churches, brick is the dominant material.

During the 19th and 20th centuries agricultural improvement allowed arable cultivation to become more widespread and recent decades have seen hedgerow removal to create larger fields to accommodate modern farm machinery. Whilst industrialisation has not been a significant influence on the landscape, and villages have retained their rural character, the modern period has seen the construction of several rail lines across the Clay Wolds landscape, airfields and several reservoirs, notably in the valleys north of Northampton such as Pitsford Water, Hollowell and Thorpe Malsor.

Clay Wolds (© Graham Murray, Natural England)

AESTHETIC AND PERCEPTUAL QUALITIES

Despite being a productive agricultural landscape, in close proximity to several large towns, the absence of buildings and people across wide areas of the elevated clay landscape imparts a distinctive, albeit subtle, remote character. Where particularly long distance views are possible a sense of exposure prevails. This contrasts with the more settled character along river valleys. Here landform, small woodlands and hedgerow trees serve to limit views and create a more intimate landscape.

NCC received 16.07.2020

The predominance of brick in many farms and villages gives a unity of character, and implies relatively late settlement of the landscape. However, areas of ridge and furrow and ancient churches, as well as sinuous field boundaries and country lanes are suggestive of a much longer period of settlement and exploitation.

Colours and textures across the landscape are generally simple and muted, largely as a result of large fields of single crops. Where hedgerow removal or absence of management is in evidence, a declining character is perceived. More intact areas surrounding villages, perhaps displaying arable and pasture farming, wet meadows and areas of woodland, provide an important contrast, particularly where hedgerows are well maintained and form continuous unbroken networks.

LANDSCAPE CHANGE AND MANAGEMENT

BUILT DEVELOPMENT

Forces for Change

Large scale modern mixed-use development is evident on the fringes of larger settlements in the south of the Clay Wolds, such as Northampton, Wellingborough and Kettering, creating visual intrusion and extending the urban fringe. These settlements are targeted for further growth as they are located within the MKSM Growth Area. There is also pressure for residential development in the villages around the towns, which are popular with commuters, eroding architectural and historic character. The impact of the new development on the setting and views of churches is particularly important, as these are distinctive local landmarks.

Shaping the Future Landscape

The aim should be to protect the character of the countryside and consider the visual impact of any new development. Specific mechanisms include best practice innovative architectural designs and planning solutions and the planting of new trees, helping to integrate new development into the landscape.

In urban areas, care should also be taken to prevent coalescence, ensuring separation is maintained between the urban fringe and surrounding settlements. In rural areas, village expansion should generally be avoided in open, elevated areas where development would damage the sense of remoteness and expansive views. Many settlements would benefit from Village and Town Design Statements, guiding the design and scale of new development and ensuring the appropriate use of vernacular styles and building materials. As well as Village and Town Design Statements, Conservation Area Appraisals can also be important tools.

ENERGY PROVISION

Forces for Change

Given the Government's commitment to renewable energy provision, elevated areas of the Clay Wolds Landscape Character Type may be under pressure for wind farm development. Such development can create visual landmarks and reduce the sense of remoteness and isolation.

Shaping the Future Landscape

The aim should be to protect the character of the landscape by appropriately siting and designing new wind energy installations. There is potential for strategic regional and sub regional level guidance on commercial wind energy schemes, including cumulative impact, informed by the EMRLCA and other studies. In addition, planning guidance should be produced at the county and/or district level where necessary, establishing the most appropriate sites for development and setting out the criteria against which new applications will be assessed.

NCC received 16.07.2020

AGRICULTURE AND LAND MANAGEMENT

Forces for Change

While the rural landscape retains a mixed land use, with areas of pasture and arable, there is evidence of agricultural intensification, resulting in the loss or damage of many typical landscape features. This includes loss of hedgerows and hedgerow trees and damage to areas of ridge and furrow and other earthworks. There is also proliferation of new, large scale agricultural buildings, reflecting the loss of smallholdings and the general increase in farm size.

Shaping the Future Landscape

The aim should be to protect the structure and unity of the landscape and consider the impact of changes to farming practices. Consideration should be given to the management of those features lost or under threat. In particular the restoration of hedgerows should be given priority, creating a stronger pattern of land use and reinforcing the well-treed character. Management plans may also be appropriate for areas of ridge and furrow and other earthworks, to identify those areas most at risk.

The aim should also be to manage new agricultural development, ensuring development is appropriate in terms of type, scale and location. New large scale agricultural buildings should be carefully sited, away from visually prominent locations and amongst existing buildings where possible. Specific design guidance for farmsteads may be appropriate, establishing the criteria for new development.

FORESTRY AND WOODLAND

Forces for Change

Woodland cover varies across the landscape, with generally more woodland within upland areas. New woodland planting would therefore generally be appropriate, reinforcing the character and increasing overall woodland coverage in the region. New woodland could also be used in and around settlements to integrate new development into the landscape and contain future growth. There is also a general neglect and lack of management, resulting in the decline of woodlands and hedgerow trees although where field sports, notably hunting, are practiced this will ensure the longer term management of woodlands as game coverts.

Shaping the Future Landscape

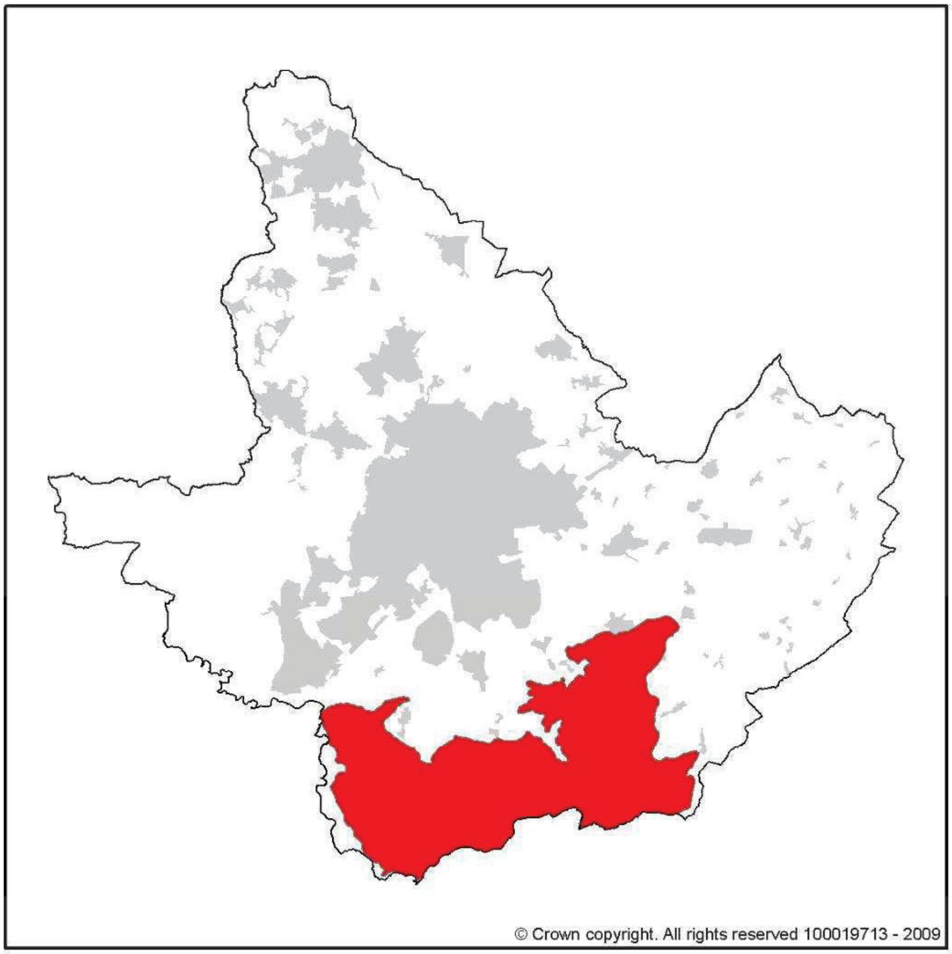
The aim should be to plan for new woodland creation in appropriate areas and around key settlements. The aim should also be to manage existing trees and woodland, encouraging new planting to ensure a diverse age and ecological structure. Consideration should also be given to the creation of woodland edge habitats, enhancing their contribution to landscape and biodiversity character, and strengthening links with restored hedgerows and grassland areas.

Such proposals should be undertaken in collaboration with the Forestry Commission and local landowners, and financial support may be available through the English Woodland Grant Scheme.

NCC received 16.07.2020

APPENDIX 5-3B: EXTRACTS FROM EAST MIDLANDS REGIONAL LANDSCAPE CHARACTER ASSESSMENT

NCC received 16.07.2020



DPZ within this Regional Character Area:

NW01	**Gotham and West Leake Wooded Hills and Scarps**
NW02	**East Leake Rolling Farmland**
NW03	**Widmerpool Clay Wolds**
NW04	**Cotgrave Wooded Clay Wolds**

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Key Characteristics

- Defined by a low boulder clay plateau traditionally known as 'wolds' (elevated tracts of open land);
- Closely associated with a dissected glacial plateau comprising variable thicknesses of boulder clay overlying Lower Lias and Rhaetic Beds;
- Broad area of low hills which extend to the Soar Valley thinning out to a series of hills in the north. Gotham and West Leake are the most prominent;
- Rhaetic beds provide a low steeply inclined escarpment which forms a continuous boundary above Cropwell Bishop broken only by the valleys of Fairham Brook and other minor streams;
- Soils are predominantly strong clayey matrix containing chalk stones and lenses of fine loamy material which are difficult to cultivate although loamy coarse soils are present to the west of the region;
- Erosion by streams has stripped away covering glacial drift to create a series of deep valleys separated by ridges of higher ground. The most prominent is Kingston Brook, a narrow corridor flanked by steeply rising hills;
- Most streams flow west towards the River Soar except Fairham Brook which flows north to the River Trent;
- Distinctive rural character and feeling of seclusion from urban centres;
- Small red brick and pantile roofed villages interconnected by narrow winding country lanes;
- Larger commuter settlements with residential estates on their fringes and small older centres within the northern and western parts of the region;
- Red brick and pantile roof farmsteads are common within the area although many farms contain larger modern buildings constructed in metal or timber;
- Industrial influences have a localised effect on the area such as Ratcliffe on Soar Power Station, and gypsum works at East Leake and Gotham;
- Narrow lanes bordered by hedgerows and frequent hedgerow trees (mostly ash with some oak);
- Extensive areas of continuous pasture and arable farming;
- Well defined and recognisable pattern of hedged fields and woodland;
- Medium to large scale regular and semi-irregular field pattern, this is less distinctive in arable fields; older smaller field patterns are present in pastoral fields close to village fringes;
- Ridge and furrow present within pastoral fields;
- Hedgerows are mostly hawthorn, most are well maintained and intact although around arable fields their condition is more variable;
- Broad-leaved woodland is variable across the area and ranges in size creating areas of high and low enclosure; the most prominent and mature is on high ground covering the hills to the north at Gotham and West Leake and around Cotgrave;
- Smaller woodland copses and coverts are common and exert a localised influence particularly where present on high ground;
- Hills characterised by large regular blocks of mature broad-leaved woodland, scarp grasslands and pasture and long arable fields which extend down the slopes;

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- Pockets of wooded parkland provide an element of formality and enclosure within the landscape such as Stanford Hall and Kingston Hall;
- Small streams notable through the presence of willows and riparian shrubs; and
- Willow pollards are common within this area.

Guidelines and Recommendations

- Enhance the broad-leaved character of existing woodlands;
- Identify opportunities for new woodland planting on suitable sites;
- Conserve the sparsely settled rural character of the landscape;
- Conserve the traditional built form character and pattern of rural settlements;
- Conserve all areas of permanent pasture particularly where present close to villages and along streams;
- Promote measures for conserving and enhancing the historic features such as ridge and furrow;
- Conserve the historic pattern of hedgerows along rural lanes;
- Conserve the semi-irregular small to medium scale field pattern around villages and medium to large scale field pattern throughout remainder of the area;
- Restore the traditional pastoral character and diversity of scarp grasslands;
- Promote measures to enhance the semi-natural appearance of scarp woodland;
- Conserve the balance of woodland and farmland on scarp hills;
- Conserve the riparian character of stream corridors through retention and replanting of streamside trees and scrub;
- Conserve willow pollards where present along stream corridors;
- Conserve the character of village side pastoral landscapes; and
- Promote measures for achieving a better integration of new and existing development in the countryside.

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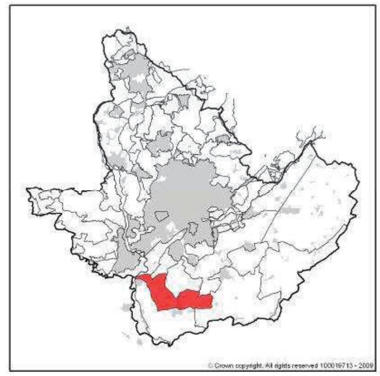
NW01 Gotham And West Leake Hills And Scarps

CONTEXT
Regional Character Area:
Nottinghamshire Wolds
LDU Reference: 113, 128, 66, 425, 251, 252 ,187, 258
DPZ Reference: NW01



CHARACTERISTIC FEATURES

- Series of prominent individual hills with steep sometimes scarp slopes and broad plateaus
- Hills are the dissected northern extent of a low boulder clay plateau extending from Leicestershire traditionally known as 'The Wolds'
- Rural character although urban elements such as villages, power station, industry and quarrying are frequent in the landscape
- Kingston Brook is a localised feature on low ground between hills characterised by riparian woodland and some grazing pasture at its margins
- Land use is a mixture of woodland, arable and pasture. Arable is on the lower and more gentle slopes, pasture close to rivers, settlements and scarp grassland where the land is steeply sloping precluding machinery from working the land
- Field pattern is mostly modern although pockets of older field systems such as irregular geometric and geometric and those reflecting open fields are present
- Field pattern in places sweeps down the slopes and is a distinctive feature
- Field boundaries are mostly hedgerows on the slopes with fences often present on higher ground
- Woodland is generally on high ground across the hills although there are smaller pockets of woodland on lower ground as establishing scrub and along village fringes/areas of former quarry
- Prominent extensive woodland plantation covers the slopes and high ground, often on steep scarps
- Rides and areas of open land are interspersed between plantation woodland
- Wooded tracks with spring flowering understorey planting along tracks up hills
- Large commuter settlements such as Gotham and East Leake and smaller settlements such as West Leake are nestled at the base of the hills on the fringes of the DPZ
- Infrequent individual farms within the character area often on the slopes or high ground. A row of individual modern houses is present along Ash Lane. One distinctive red brick and pantile roof farmstead on Bunny Hill is set within gardens with a small orchard
- Buildings are mostly red brick with older properties having red pantile roofs
- Church towers and spires are prominent within a uniform village skyline
- Overhead lines are prominent on low ground between hills
- Small former spring (Wheldon Spring) on Gotham Hill is a localised feature characterised by a depression in the ground and establishing scrub
- Enclosed channelled views on low ground between hills with extensive panoramic views across towards Nottingham City and beyond from high ground



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LANDSCAPE ANALYSIS

Condition

A series of distinctive wooded hills with arable fields on lower and gentler slopes and pasture and pockets of grassland on the steeper slopes. Views are extensive and often over long distances from the high ground although become more enclosed from lower ground. Urban elements are frequent with views of Ratcliffe on Soar Power Station and the gypsum works. Some villages such as Gotham village are characterised by modern edges and a small older core with a distinctive church spire. Others such as West Leake are small and distinctive focused along a single street with small working farms and lack of modern development.

Land use is a mix of plantation woodland, arable farming and pasture. Fields are mostly medium to large in size with the majority of arable farming being a modern field pattern; although at Gotham there is evidence of older irregular geometric patterns. Pockets of fields reflecting open field system and regular geometric patterns are present on lower slopes or pockets of high ground. Older field patterns are generally used for pasture.

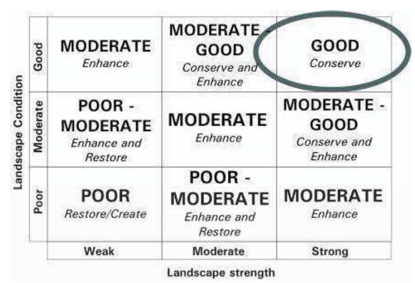
Woodland comprises large geometric field sized blocks of both broadleaved and conifer woodland. On West Leake Hill a large woodland is used for commercial forestry with rides and various belts of different species within woodlands. Other vegetation includes smaller frequent copses at the base of slopes and around settlements. Frequent hedgerow trees and intact hedgerows are present across the area. Pockets of regenerating scrub are often around village fringes or on the base of slopes.

The landscape condition is **GOOD**. Hedgerows and woodland are well managed, although there is some evidence of field boundary fragmentation in places. Where hedgerows have been replaced, the timber fencing is usually in good condition. The agricultural land is well managed and features are intact with little sign of decline.

Landscape Strength

This DPZ is a distinctive series of hills which are prominent within the surrounding area. They often form a backdrop to views from the southern edges of Nottingham. From high ground within the DPZ there are open expansive views to the centre of Nottingham and lower-lying farmland at Ruddington and Bunny.

The strength of character is **STRONG**. The hills are distinctive and consistent features across the landscape and exert their influence within the surrounding area. The pattern of arable, pasture and woodland is also consistent with moderate sized villages and some expanding commuter villages present on low ground.



The overall landscape strategy is **CONSERVE.**

LANDSCAPE ACTIONS

Landscape features

- Conserve the distinctive pattern of hills with large blocks of woodland on high ground
- Conserve the older field patterns within the character area such as those reflecting open systems and the irregular and regular geometric patterns
- Conserve the balance of arable farming on lower slopes and pasture on steeper and higher slopes
- Conserve field patterns which sweep down the hills
- Conserve the landform of the former Wheldon Spring
- Conserve the diversity of broadleaf and large-scale woodland plantations on hills
- Ensure new conifer planting includes belts of broadleaf woodland and woodland edge along its fringes
- Any new woodland planting should be small in scale along the base of slopes becoming larger and of field size on higher slopes
- Conserve the small rides and various ages of woodland within the character area
- Conserve the wooded tracks along the ridgelines
- Conserve hedgerows and encourage infill planting within gaps rather than erection of timber fencing
- Conserve areas of rough grassland where present on steeper scarp slopes

Built form

- Conserve the frequency of small farmsteads and outbuildings throughout the landscape; any new barn developments should be small scale and fit within the existing pattern and vernacular styles
- Conserve the small linear and vernacular character of West Leake
- Conserve the uniform roofline of villages with prominent church spires

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- Encourage the use of red brick and red pantile roofs for new buildings and extensions
- Conserve the nucleated character of larger villages
- Minimise the influence of larger settlements such as East Leake through small-scale woodland planting to reduce the scale and frequency of urban edges within views

Other development/ structures in the landscape

- Conserve the winding character of rural lanes with expansive channelled views between hills
- Ensure any new industrial development is nestled on low ground and has well wooded boundaries which integrate with woodland on higher ground to reduce its visibility

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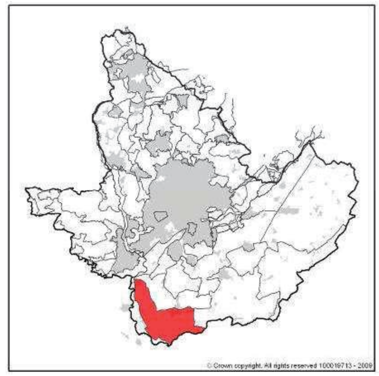
NW02 East Leake Rolling Farmland

CONTEXT

Regional Character Area: Nottinghamshire Wolds

LDU Reference: 268, 247, 186, 365, 364

DPZ Reference: NW02



CHARACTERISTIC FEATURES

- Rolling landscape which forms part of the wider glacial plateau of chalky boulder clay overlying lower lias and Rhaetic beds
- Undulations in the landscape are formed by small streams and tributaries which have cut through softer mudstones and clays; Kingston Brook is the most distinctive
- Localised man-made earthworks present around Ratcliffe Power Station which have a localised influence on character
- Frequent watercourses which are often demarcated by clusters of riparian willows along their course; where trees are not present watercourses are generally not visible in the landscape
- Rural character present across the area although there are views towards urban elements such as Ratcliffe on Soar Power Station visible above hills, a gypsum works and village fringes
- Land use is arable and some pasture. Pasture becomes more prominent around East Leake where it is mostly horse grazing and around Rempstone where sheep grazing is more common
- Field pattern includes small, medium and large-scale fields recognised within the Historic Landscape Characterisation as being a mix of ages including regular, semi-regular geometric and irregular field patterns. Arable field pattern tends to be of modern origin
- Oldest field enclosures are often concentrated around watercourses and smaller settlements
- Field boundaries are almost all hedgerows which are generally intact and comprise mostly hawthorn; around horse grazing areas electric and timber and wire fencing is present which has a localised influence in character particularly along the southern fringe of East Leake
- There are few hedgerow trees within the landscape; this in combination with low hedgerows creates an open character to fields. Hedgerow trees tend to be concentrated around smaller pastoral fields
- Relatively low level of woodland cover comprising prominent geometric blocks of woodland on high ground, infrequent hedgerow trees, and clumps along watercourses including willow pollards. The most significant blocks of woodland are at Stanford Hall and the formal lake and entrance at Kingston Hall around the parkland margins which includes ornamental species
- Parkland is a distinctive feature around Kingston Hall and Stanford Hall where permanent pasture and parkland trees are prominent
- Prominent halls framed by vistas of trees such as lime avenues. Formal brick wall boundaries define the edges of parkland
- Small estate cottages at Kingston on Soar and lodge houses are features in these areas
- One large nucleated commuter settlement is at East Leake; the southern edge of the village is prominent within views
- Costock is a small linear settlement with a pocket of prominent new development concentrated along the western edge
- New apartment buildings for Nottingham Trent University are a localised urbanising feature within the landscape and contrast with other smaller-scale buildings
- Network of farms each often contains a large red brick and pantile roofed farmstead with modern timber or metal outbuildings; older red brick barns are also frequent
- Views vary from enclosed and channelled views from lower ground along watercourses to open often expansive views from higher ground, particularly to the south and beyond the borough boundary
- Views are rural in character, with frequent dispersed villages and open farmland; small woodland blocks are a feature on high ground
- A sand and gravel quarry has a localised influence on the landscape character of the DPZ
- Roads through the area often have narrow grassed ditches on either side

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LANDSCAPE ANALYSIS

Condition

This area is characterised by its gently rolling landform with a prominent river corridor along Kingston Brook. It has a rural character with open views across mostly arable farmland with localised enclosure along smaller pastoral fields. Small villages, frequent farmsteads and two parkland estates are features.

Fields are a mixture of small fields close to watercourses and large-scale fields which are mostly arable with some pasture farming. These include both modern and older enclosures. Older enclosures are around the watercourse and village fringes.

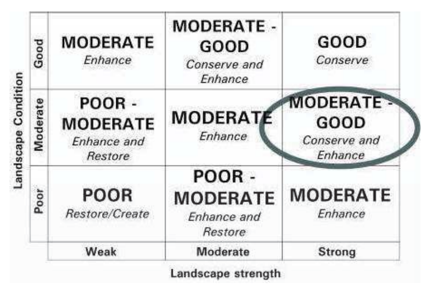
The area has a low level of woodland cover. Woodland tends to be small broadleaved geometric blocks on high ground which gives them greater prominence in the landscape. Other woodland is concentrated within parkland around the fringes of halls and contains coniferous and ornamental species. Parkland trees are also distinctive in these areas.

The landscape condition is **MODERATE.** Features are generally well maintained although there is evidence of fragmentation where fields have expanded and where fields are subdivided for horse grazing using electric tape and fencing. The man-made landform changes around the power station have an influence.

Landscape Strength

Views are often over quite long distances due to the undulating landform. On high ground views extend to Ratcliffe on Soar Power Station and the hills surrounding it and across rolling farmland towards Leicestershire. The character of this landscape extends into Leicestershire so when viewed from outside the area is seen in this context; it is screened to the north by Bunny Hill, Gotham Hill and West Leake Hill.

The strength of character of the area is **STRONG.** The area has a strong intact rural character with arable and pasture farming, prominent small woodlands, villages and a network of farmsteads key features. A minor amount of fragmentation is present in the north of the area where land has been altered adjacent to the power station.



The overall landscape strategy is **CONSERVE AND ENHANCE.**

LANDSCAPE ACTIONS

Landscape features

- Conserve the older field patterns within the character area such as those reflecting open systems and the semi-regular geometric patterns
- Conserve the prominence of woodlands on high ground
- Conserve and enhance the regular dispersal of small geometric broadleaved copses and woodlands often on high ground
- Conserve the rural character with built form infrequent in views
- Conserve hedgerows and where present ensure that infill planting is undertaken where gaps occur rather than infilling or replacement with fencing
- Enhance the distribution of hedgerow trees by encouraging greater planting of trees within hedgerows. Species used should be a mostly ash with some oak.
- Conserve the formal parkland and pasture within Kingston and Stanford Halls
- Conserve the ornamental broadleaved woodlands around the parkland fringes enclosed by red brick walls
- Conserve the framed vistas towards the halls from adjacent roads
- Conserve areas of permanent pasture where present in the DPZ and ensure that hedgerows and hedgerow trees at the boundaries are maintained
- Restore hedgerows and encourage planting of new hedgerow trees to provide unity between more open land at East Leake and the more enclosed and wooded pasture fields.
- Conserve and enhance the character of watercourses through retention of willow pollards and planting of new riparian vegetation
- Conserve and enhance the small scale field pattern present along watercourse fringes; where arable farming is present encourage new tree planting to integrate the fields with smaller pastoral fields

Built form

- Conserve the estate character of Kingston on Soar and the estate lodges at entrances to halls
- Conserve the regular distribution of built form and villages within the DPZ
- Enhance the fringes of the new apartment buildings at University of Trent through localised woodland planting
- Conserve the rural scale and vernacular style of buildings in smaller villages through restricting new development. Where development occurs it should make a positive contribution to the local vernacular, scale and massing of the

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village.

- Conserve the use of red brick and pantile roofs within farmsteads, barns and properties in villages
- Minimise the influence of larger settlements such as East Leake through small-scale woodland planting along fringes

Other development/ structures in the landscape

- Conserve and enhance the character of hedgerow trees lining roads through the landscape
- Ensure that on completion of quarrying that hedgerow trees, hedgerows and small woodlands are encouraged within the restoration proposals to ensure that the land integrates with the surrounding land
- Conserve grassed ditches along the edge of roads



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APPENDIX 5-4: EFFECTS ON LANDSCAPE CHARACTER

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Appendix 5-4: Effects on Landscape Character

RLCT 3a Floodplain Valleys (including GNLCA Policy Zones NC01, TSV01 and TSV02)

Susceptibility to Change: Low to Medium		Lower	⟺	Higher	**Value: Medium**
Scale	Large scale landscape. Typically open; localised enclosure from vegetation or structures. Views tend to be expansive. Many scale indicators present.	■			• No landscape designations; • Strong recreation interest concentrated along the rivers and at the adjacent waterbody; • Designated heritage interest is concentrated within settlements; • Designated nature conservation interest concentrated in the north-east of the Study Area at Attenborough Gravel Pits SSSI; and • Familiar to large numbers of people in the adjacent urban areas, and traveling through on the M1, A453, A50 and the Midlands Main Line.
Pattern / Complexity	Flat, low-lying landform. Varied pattern, with watercourses, waterbodies, settlement, industry and transport corridors superimposed onto the underlying agricultural mosaic. A mix of geometric and organic forms.	■			
Development / Human Influence	Very obviously the result on ongoing human activity. Contemporary agriculture. Major road and rail corridors. Settlements are a mixture of traditional and contemporary building styles. Large scale industry clearly visible at the Power Station. Pylons. Waterbodies in former minerals extraction sites. Contemporary warehouses / factories also visible.	■			
Connections with adjacent areas	A gradual transition into the more elevated areas that form the backdrop for the LCT. Forms part of the setting for the larger urban areas to the north.		■		
Visual Interruption	Views are typically open and uninterrupted, although localised screening can be significant. The Power Station is a prominent feature.		■		

Sensitivity:

The LCT is a large scale and typically open landscape. There are a range of influences present, including the proximity to a major urban area, the major road and rail corridors that pass through, and the prominence of the existing structures at the Power Station. Views tend be available across the LCT, meaning that change has potential to be widely apparent. Susceptibility to change is low to medium.

The LCT is not subject to any landscape designations. There is localised designated heritage interest, concentrated in settlements. Designated nature conservation interest is concentrated to the north-east. The recreation interest is strong, and is associated with the rivers and canals, and with the many artificial waterbodies that are adjacent to these. The landscape is familiar to large numbers of people due to the dense population nearby, and the presence of major transport routes passing through.

Overall, sensitivity is low to medium.

Size / Scale of Effect:	**Geographical Extent:**
• Initially there would be no appreciable change in character, with the Proposed Development largely hidden by either the existing structures at the Power Station, or by landform, and having no influence upon the surrounding landscape; • Post-2025, the removal of the majority of the existing structures at the Power Station would result in obvious change in character, with the long-established influence of the Power Station reducing;	• Change would be experienced most keenly in the Soar valley, where views towards the Power Station are largely unobscured; and • Change would be limited in the Trent valley, where intervening wooded ridges limit the influence of the Power Station.

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• The Proposed Development would be amongst the largest of the remaining structures; and • The presence of the Proposed Development would reflect the transition from older fossil fuel based infrastructure, to a modern renewable energy facility.	
Duration: • Long term (permanent development)	**Reversibility:** • Irreversible (permanent development)
Magnitude: Negligible (Current Baseline) **Small to Medium** (Future Baseline) Initially there would be no appreciable change in character, with the Proposed Development largely hidden by either the existing structures at the Power Station, or by landform, and having no influence upon the surrounding landscape. Post-2025, the removal of the majority of the structures at the Power Station would result in obvious change in character. The long-standing influence of the Power Station upon its surroundings would appreciably reduce. The Proposed Development would be amongst the largest of the remaining structures. The contemporary architecture of the Proposed Development would reflect the transition from older fossil fuel based infrastructure, to a modern renewable energy facility. The influence of electricity generating infrastructure upon the landscape would be maintained as a result of the presence of the Proposed Development, but would be less strong than previously. Change would be experienced in the main from the Soar valley, to the west and south-west, where views towards the Site are more open.	
Significant Effect: No (Current Baseline and Future Baseline) In the Current Baseline scenario, effects would be negligible. The Proposed Development would represent a limited addition to the existing assemblage of structures at the Power Station, and these, together with the wooded ridges to the north and east, would prevent any influence upon the wider landscape. Effects would not be significant. In the Future Baseline scenario, effects would be minor to moderate. The Proposed Development would maintain the long-established influence of electricity generating infrastructure upon the surrounding landscape, and would one of the largest structures remaining. The changes would reflect the transition to a low-carbon economy, and would also reflect changes in architectural style. Effects would not be significant.	
Adverse (Future Baseline) **/ Neutral** (Current Baseline) / Beneficial: In the Current Baseline scenario, the Proposed Development would neither enhance, nor detract from landscape character. As such, effects would be neutral. In the Future Baseline scenario, the presence of the Proposed Development would be adverse. This should, however, be considered in the context of the post-2025 removal of many very prominent existing structures, the benefits of which would far outweigh any limited adverse effects of the Proposed Development.	

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RLCT 4a Unwooded Vales (including GNLCA Policy Zones SN01 and SN02)

Susceptibility to Change: Medium		Lower	⟺	Higher	**Value: Low to Medium**
Scale	Large-scale, relatively open landscape. Localised enclosure. Vegetation, traffic and pylons are scale indicators. Views tend to be open.	■			• No landscape designations; • Very localised designated heritage interest; and • Sparse public rights of way network.
Pattern / Complexity	Low, lying and relatively flat landform. Parts seem to be drained wetland. Agriculture predominates, with typically medium-large, regular-shaped fields. A mix of geometric and organic influences. Pattern is consistent.		■		
Development / Human Influence	The landscape is clearly the result of ongoing agricultural intervention. Settlement is largely confined to the edges of the LCT, with occasional farm properties in the interior. Pylons cross the LCT. The A453 passes across the north-western edge. Existing Power Station structures visible above the western skyline. Remote feel in the local context.		■		
Connections with adjacent areas	Steep slopes define the transition into the wolds to the south. Clear contrast in land cover with the urban areas to the north.		■		
Visual Interruption	Views are typically open and uninterrupted, although localised screening can be significant.		■		

Sensitivity: Medium

The LCT is a large scale and typically open landscape. Agriculture is the predominant influence, with sparse built development. Views tend be available across the LCT, meaning that change has potential to be widely apparent. Susceptibility to change is medium.

The LCT is not subject to any landscape designations. There is very localised designated heritage interest, the public rights of way networks is sparse, limiting opportunities for people to experience the landscape. Value is low to medium.

Overall, sensitivity is medium.

Size / Scale of Effect:

- Localised visibility of the proposed stacks from the northern part of the LCT, where existing Power Station structures are already visible;
- The proposed new building is unlikely to be clearly visible from within the LCT;
- Post-2025, the removal of the existing Power Station structures would change the western skyline. The proposed stacks would remain visible, but would be far less prominent that the bulkier and taller removed structures. Pylons within the LCT would be the most prominent vertical structures; and
- Existing characteristics would remain unaffected.

Geographical Extent:

- The northern part of the LCT.

Duration:

- Long term (permanent development)

Reversibility:

- Irreversible (permanent development)

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Magnitude: Negligible (Current Baseline and Future Baseline) In the Current Baseline scenario, the Proposed Development would be visible from the northern part of the LCT, in a context where the existing Power Station structures are already visible. Existing characteristics would be unaffected. Post-2025, in the Future Baseline scenario, the proposed stacks would remain visible on the western skyline but would be relatively minor features, which would have no influence of note upon the wider character. Pylons within the LCT would be the most prominent vertical structures post-2025.
Significant Effect: No (Current Baseline and Future Baseline) In both the Current Baseline and Future Baseline scenarios, effects would be negligible and would not be significant. The presence of the Proposed Development would have no appreciable bearing upon the underlying characteristics of the landscape.
Adverse / **Neutral** (Current Baseline and Future Baseline) / Beneficial: In both the Current Baseline and Future Baseline scenarios, the presence of the Proposed Development would neither enhance, nor detract from character. As such, effects would be neutral.

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RLCT 5b Wooded Village Farmlands

Susceptibility to Change: Low		Lower	⟺	Higher	**Value: Low to Medium**
Scale	Medium-large scale landscape. Defined by the presence of built development.	■			• No landscape designations; • Designated heritage interest concentrated in Kegworth; and • Rights of way run through undeveloped areas.
Pattern / Complexity	Development, including presently unbuilt plots dominant the LCT.	■			
Development / Human Influence	The M1 passes through the LCT, with junction 24 at the northern boundary. The SEGRO Logistics Park is located west of the M1, including large functional buildings, several plots awaiting development (currently bare earth), and a new freight rail facility. Land east of the motorway is dominated by the village of Kegworth. Kegworth bypass road is a recent addition	■			
Connections with adjacent areas	Contrast with adjacent areas in terms of land cover and landform.		■		
Visual Interruption	The predominantly developed character, within the Study Area, limits the potential for outward views.	■			

Sensitivity: Low

The LCT is defined by the presence of development, including the M1, and large scale recent development at the SEGRO Logistics Park. Only a small part of the LCT is within the Study Area. Susceptibility to change is low.

The LCT is not subject to any landscape designations. There is designated heritage interest concentrated in central Kegworth. Public rights of way run through the undeveloped parts of the LCT, but any usage of these will be cognisant of the nearby development. Value is low to medium.

Overall, sensitivity is low.

Size / Scale of Effect:	**Geographical Extent:**
• Initially the Proposed Development would be largely hidden by the existing structures at the Power Station; and • Post-2025, whilst the Proposed Development would be visible, this would have no bearing on the underlying character of the LCT, which would continue to be defined by the development within it.	• Not applicable
Duration: • Not applicable	**Reversibility:** • Not applicable

Magnitude: No Change (Current Baseline and Future Baseline)

Initially the Proposed Development would be largely hidden by the existing structures at the Power Station. Post-2025, whilst the Proposed Development would be visible, this would have no bearing on the underlying character of the LCT, which would continue to be defined by the development within it.

Significant Effect: No Effect (Current Baseline and Future Baseline)

As there would be no change in character, there would be no effect.

Adverse/ Neutral/ Beneficial:

Not applicable

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RLCT 8a Clay Wolds (including GNLCA Policy Zones NW01 and NW02)

Susceptibility to Change: Low to Medium		Lower	⟺	Higher	**Value: Medium**
Scale	Medium-large scale landscape. Generally open, but with significant localised enclosure from woodlands and tree belts. Vegetation, buildings and traffic are all scale indicators. Views are often expansive, but can be significantly curtailed by screening vegetation and landform.		■		• No landscape designations; • Kingston Park Registered Park / Garden; and • Public rights of way cross the LCT.
Pattern / Complexity	Undulating landform. Regular-shaped fields of varying sizes. Predominantly agricultural land use, but with several small woodlands, historic parkland, the Power Station, a university campus and villages also present. A mix of organic and geometric influences.	■			
Development / Human Influence	Ongoing agricultural activity. Very prominent functional structures at the Power Station. The Midland Main Lane railway forms the western boundary.	■			
Connections with adjacent areas	Gradual transition into the Soar valley to the west. A series of wooded ridges form a clear boundary to the north.	■			
Visual Interruption	Views are typically open and uninterrupted, although localised screening can be significant. The Power Station is a prominent feature.		■		

Sensitivity:

The LCT is a medium-large scale landscape defined largely by the presence of agriculture, but with several other influences present, including the prominent Power Station. The undulating landform and the presence of woodland cover locally sometimes restrict views. Susceptibility to change is low to medium.

The LCT is not subject to any landscape designations. Kingston Park is a registered park and garden (non-statutory nationally designated heritage asset). Several public rights of way cross the LCT. Value is medium.

Overall, sensitivity is low to medium.

Size / Scale of Effect:	**Geographical Extent:**
• The Proposed Development would be added to the existing assemblage of built features at the Power Station, resulting in direct physical change; • The influence of the Power Station upon the LCT would not change as a result of the Proposed Development. Existing structures would remain far more prominent initially; • Post-2025, the removal of the majority of the existing structures at the Power Station would result in obvious change in character, with the long-established influence of the Power Station reducing; • The Proposed Development would be amongst the largest of the remaining structures, but would often be well screened by the tree cover in the southern part of the Power Station; and • The presence of the Proposed Development would reflect the transition from older fossil fuel based infrastructure, to a modern renewable energy facility.	• Change concentrated in the north-western part of the LCT.

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<table>
<tr><td>Duration:
• Long term (permanent development)</td><td>Reversibility:
• Irreversible (permanent development)</td></tr>
<tr><td colspan="2">Magnitude: Negligible (Current Baseline) Small to Medium (Future Baseline)
In the Current Baseline scenario, there would be no appreciable change in character, with the presence of the Power Station having little bearing upon the well-established and strong influence of the Power Station upon the landscape.

Post-2025 in the Future Baseline scenario, the removal of the majority of the structures at the Power Station would result in obvious change in character. The long-standing influence of the Power Station upon its surroundings would appreciably reduce. The Proposed Development would be amongst the largest of the remaining structures, but would often be well screened by tree cover within the Power Station boundary, limiting its wider influence. The contemporary architecture of the Proposed Development would reflect the transition from older fossil fuel based infrastructure, to a modern renewable energy facility. The influence of electricity generating infrastructure upon the landscape would be maintained as a result of the presence of the Proposed Development, but would be less strong than previously.</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td colspan="2">Significant Effect: No (Current Baseline and Future Baseline)
In the Current Baseline scenario, effects would be negligible. The Proposed Development would represent a limited addition to the existing assemblage of structures at the Power Station. There would be no change to the influence of the Power Station upon the character of LCT. Effects would not be significant.

In the Future Baseline scenario, effects would be minor to moderate. The Proposed Development would maintain the long-established influence of electricity generating infrastructure upon the surrounding landscape. However, this influence would reduce as a result of the removal of the existing structures, irrespective of the presence / absence of the Proposed Development. The changes would reflect the transition to a low-carbon economy, and would also reflect changes in architectural style. Effects would not be significant.</td></tr>
<tr><td colspan="2">Adverse (Future Baseline) / Neutral (Current Baseline) / Beneficial:
In the Current Baseline scenario, the Proposed Development would neither enhance, nor detract from landscape character. As such, effects would be neutral.

In the Future Baseline scenario, the presence of the Proposed Development would be adverse. This should, however, be considered in the context of the post-2025 removal of many very prominent existing structures, the benefits of which would far outweigh any limited adverse effects of the Proposed Development.</td></tr>
</table>

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APPENDIX 5-5: EFFECTS ON VIEWPOINTS

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Appendix 5-5: Effects on Viewpoints

Viewpoint 1: Trent Lock
Grid Ref: 449102, 331128

View looking south-east across the River Trent from a footpath on the northern bank, which forms part of the Trent Valley Way long distance route. The 114 m high cooling towers and 199 m high concrete stack at the Power Station are clearly visible on the skyline beyond the wooded ridge south of the river. The 95 m high gas turbine station stack is not visible. In the vicinity of the viewpoint there are several benches, interpretation panels, two pubs, a café and a public car park. To the south-east, there are buildings associated with water-based recreation (a rowing club and a sailing club), and the bridge that carries the Midlands Main Line Railway over the Trent. To the south-west, the land is flat and low-lying, with long views available.

Susceptibility to Change: High	Value: High
• Path and river users o People engaged in recreation and on public rights of way have higher susceptibility.	• No landscape designations; • Public right of way; • Promoted long-distance route; and • A range of visitor facilities.

Sensitivity: High

The viewpoint reflects the views available to users of the footpath and users of other leisure and recreation amenities including the river itself. Susceptibility to change is high.

The viewpoint is not subject to any landscape designations. It is, however, located along a public right of way that also forms part of a promoted long distance recreational route. There are a series of visitor facilities located close by, and the recreation / amenity value of this stretch of river is clearly well-established. Value is high.

Overall, sensitivity is high.

Size / Scale of Effect:	Geographical Extent:
• **Scale of Change in view:** o The Proposed Development would be largely screened from view by the intervening wooded ridge; o The very tops of the proposed stacks would be visible above the trees; o Plumes visible approximately 25 % of daylight hours; and o The visibility of the Proposed Development would not increase post-2025. It would remain a very limited background presence. • **Degree of contrast / integration:** Power Station structures are prominent. • **Nature of the View:** A clear view across the river.	• **Angle:** Direct. • **Distance to Proposed Development (stacks):** 1.5 km. • **Extent of area over which changes would be visible:** Approximately 250 m stretch of path either side of the Viewpoint.
Duration: Long-term (permanent development).	**Reversibility:** Irreversible (permanent development).

Magnitude: Small (at worst) (Current Baseline and Future Baseline)

In the Current Baseline scenario, the Proposed Development would be almost entirely hidden by the intervening wooded ridge north of the Site. The tips of the proposed stacks would be visible above the trees and would be a very small scale addition to the background of the view. The emissions plumes from the stacks would be visible for

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approximately 25 % of daylight hours, but would typically be short and their influence upon the view would be very limited. In the Future Baseline scenario, the Proposed Development would remain a very small scale background presence (albeit on a far less developed skyline), and would have little influence upon the views available.
Significant Effect: No (Current Baseline and Future Baseline) In the Current Baseline scenario, a minor level of effect would occur. The Proposed Development would be very well screened, and only the tips of the proposed stacks would be visible. The nature of the view would not be materially affected, and would remain a view dominated by the river, with existing Power Station structures prominent in the background. Effects would not be significant. Post-2025 in the Future Baseline scenario, effects would also be minor. The removal of the cooling towers and existing Power Station stack, which are very prominent elements of the southern part of the view, would change the nature of the background of the view, with the influence of development reducing considerably. Nevertheless, the Proposed Development would continue to have only a very small scale presence with little influence upon the character of the view. Effects would not be significant.
Adverse (Current Baseline and Future Baseline) / Neutral / Beneficial: The introduction of the Proposed Development would be adverse. This should, however, be considered in the context of the post-2025 removal of many very prominent existing structures, the visual benefits of which, as likely to be perceived by path and river users, would far outweigh any limited adverse effects of the Proposed Development.

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<table>
<tr><td colspan="2">Viewpoint 2: Footpath near Redhill Lock
Grid Ref: 449148, 330232

View east across the River Soar from a public footpath, through a gap in the bankside vegetation cover. Boats berthed at Redhill Marina are visible in the foreground. The 114 m high cooling towers and 199 m high concrete stack are prominent to the east of the river. Other structures at the Power Station are also visible, including a Storage building, and some of the Flue Gas Treatment infrastructure. Scattered development is present along the river to the south, including chalets, caravans and houses. The A453 is visible to the south, where it crosses over the river via a bridge. Pylons are visible in the background.</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td>Susceptibility to Change: Medium
Path and river users
People engaged in recreation and on public rights of way have higher susceptibility; and
The presence of functional structures immediately east of the marina, and also at the Power Station does not appear to deter visitors.</td><td>Value: Medium to High
No landscape designations;
Public right of way; and
Marina.</td></tr>
<tr><td colspan="2">Sensitivity: Medium
The viewpoint reflects the view available to walkers on the footpath, and to users of the river. The presence of functional structures immediately east of the marina, and at the Power Station does not make a positive contribution to scenic quality, but does not appear to deter visitors. Susceptibility to change is medium.
The viewpoint is not covered by any landscape designations. The viewpoint is located along a public footpath, close to a marina. The view available will therefore be familiar to relatively large numbers of people. Value is medium to high.
Overall, sensitivity is medium.</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td>Size / Scale of Effect:
Scale of Change in view:
Proposed Development introduced in the background of a view where existing Power Station structures would be far more prominent;
The Proposed Development would be partially screened by the Flue Gas Treatment infrastructure and the Storage building;
Views would be better screened in summer, when the foreground vegetation is in leaf;
Plumes visible approximately 25 % of daylight hours;
Boats and activities at the marina would remain prominent in the foreground;
Post-2025, the Proposed Development would be more clearly visible due to the removal of the Flue Gas Treatment infrastructure and the Storage building, but would remain a background feature; and</td><td>Geographical Extent:
Angle: Direct.
Distance to Proposed Development (stacks): 1.28 km.
Extent of area over which changes would be visible: Viewpoint only, due to vegetation cover. Similar views are likely to be available from boats on the river.</td></tr>
</table>

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o The Cooling Towers and 199 m high stack would also be removed, and this is likely to make the existing 95 m Gas Turbines Stack visible; • **Degree of contrast / integration:** Existing development, including structures at the Power Station, is prominent. • **Nature of the View:** A narrow view filtered through adjacent vegetation cover.	
Duration: Long-term (permanent development).	**Reversibility:** Irreversible (permanent development).
Magnitude: Small (Current Baseline) **Small to Medium** (Future Baseline) In the Current Baseline scenario, the Proposed Development would be introduced into the background of a view where the existing Power Station and other structures would be closer and far more prominent. The Proposed Development would be partially screened by the Flue Gas Treatment infrastructure and a Storage building. The proposed twin stacks would be visible above these screening features, but would be slender features, appearing far less bulky than existing tall structures. The emissions plumes from the stacks would be visible for approximately 25 % of daylight hours, but would typically be short and their influence upon the view would be very limited. In the foreground of the view, features at Redhill Marina would remain prominent beyond vegetation. The vegetation cover adjacent to the Viewpoint would provide a greater degree of screening during the summer months, when deciduous foliage is present. Post-2025, in the Future Baseline scenario, when the majority of the existing structures visible would be removed, the Proposed Development would be more clearly visible, but would remain a background feature. Views of the existing Gas Turbines Stack are also likely to become available due to the removal of existing structures.	
Significant Effect: No (Current Baseline and Future Baseline) Initially in the Current Baseline scenario, a minor level of effect would occur, with the Proposed Development comprising a small-scale addition to the well-established assemblage of features at the Power Station. Effects would not be significant. Post-2025 in the Future Baseline scenario, following the removal of the majority of the existing structures, a minor to moderate level of effect would occur. The Proposed Development would be more apparent. However, the view would remain a filtered view across the river, with boats and marina activities prominent on the foreground and with a major industrial site beyond. Effects would not be significant. Given the context of the removal of a range of very large and very prominent structures, which would clearly represent an improvement to the visual amenity, the retention of the far less conspicuous Proposed Development would be unremarkable.	
Adverse (Current Baseline and Future Baseline) / Neutral / Beneficial: The presence of the Proposed Development would be adverse. This should, however, be considered in the context of the post-2025 removal of many very prominent existing structures, the visual benefits of which, as likely to be perceived by path and river users, would far outweigh any limited adverse effects of the Proposed Development.	

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<table>
<tr><td colspan="2">Viewpoint 3: Midshires Way, Ratcliffe Lane
Grid Ref: 448607, 329230

An expansive view looking north-east from a public footpath, adjacent to the Midshires Way long-distance route (which runs along Ratcliffe Lane to the south). The view is across the low-lying valley of the River Soar towards the Power Station. The 114 m high cooling towers, 199 m high concrete stack, and the existing turbine hall / boiler house are all prominent. The existing 95 m high gas turbine stack can be seen to the rear of these structures. Pylons break the skyline further to the east. The A453 embankment (and traffic) is visible to the south-east. A small lay-by is present at the side of the road immediately south of the viewpoint, where walkers can park.</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td>Susceptibility to Change: High
• Walkers
o People using public rights of way have higher susceptibility.</td><td>Value: Medium to High
• No landscape designations;
• Public right of way;
• Promoted long-distance recreational route; and
• Adjacent informal car parking provision.</td></tr>
<tr><td colspan="2">Sensitivity: High
The viewpoint reflects the views available to walkers on the footpath. Views are available across the Soar valley. Susceptibility to change is high.
The viewpoint is not covered by any landscape designations. It is located along a public footpath, adjacent to a promoted long-distance route. The adjacent lay-by facilitates access. Value is medium to high.
Overall, sensitivity is high.</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td>Size / Scale of Effect:
• Scale of Change in view:
o Initially, the Proposed Development would be almost entirely screened from view by existing structures, with only glimpses of the new building available;
o Plumes visible approximately 25 % of daylight hours; and
o Post-2025, the Proposed Development would be far more clearly visible, in a view where the existing Gas Turbines Stack and existing Substation buildings are also more clearly visible. The new facility would appear appreciably smaller in scale than the removed structures.
• Degree of contrast / integration: Power Station is prominent.
• Nature of the View: A clear, expansive and unencumbered view.</td><td>Geographical Extent:
• Angle: Direct.
• Distance to Proposed Development (stacks): 2.16 km.
• Extent of area over which changes would be visible: Approximately 500 m stretch of footpath north-east of the Viewpoint.</td></tr>
<tr><td>Duration: Long-term (permanent development).</td><td>Reversibility: Irreversible (permanent development).</td></tr>
<tr><td colspan="2">Magnitude: Negligible (Current Baseline) Small to Medium (Future Baseline)
In the Current Baseline scenario, the Proposed Development would be almost entirely screened from view by existing structures, with only glimpses of the new building available. The emissions plumes from the stacks would be visible for approximately 25 % of daylight hours, but would typically be short and their influence upon the view would be very limited. The new facility would have no other appreciable influence on the view.</td></tr>
</table>

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Post-2025, in the Future Baseline scenario, the Proposed Development would be clearly visible, together with the existing Gas Turbines Stack and the existing Substation buildings. The Proposed Development would be the largest retained structure at the Power Station, and the collective influence of development upon the view would be greater than if it were not present. However, it would appear appreciably smaller in scale than the removed structures, and the overall influence of built development upon the view would be less than in the current baseline.
Significant Effect: No (Current Baseline and Future Baseline) In the Current Baseline scenario, visual effects would be negligible and not significant. The Proposed Development would be barely visible and would have no influence upon the views available. Post-2025 in the Future Baseline scenario, following the removal of the majority of the existing structures, a moderate level of effect would occur. The Proposed Development would be clearly visible and would be the most evident structure remaining within the Power Station. Its presence would increase the influence of the retained structures at the Power Station upon the view. However, it would appear significantly smaller in size than the removed structures, occupying a far lesser proportion of the view, both vertically and horizontally, and the *perceived* influence of large-scale industry upon the view, as experienced by path users (who are likely to simply see a reduction in the assemblage of visible structures) would notably reduce. Effects would not be significant.
Adverse (Future Baseline) / **Neutral** (Current Baseline) / Beneficial: Initially, in the Current Baseline scenario, the presence of the Proposed Development would neither enhance nor detract from the view, and effects would be neutral. Post-2025, in the Future Baseline scenario, the presence of the Proposed Development would be adverse. This should, however, be considered in the context of the removal of many very prominent existing structures, the visual benefits of which, as likely to be perceived by path users, would far outweigh any limited adverse effects of the Proposed Development.

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Viewpoint 4: New Kingston
Grid Ref: 451669, 328860

View looking north-west from a crossroads where two minor roads meet, immediately north of the hamlet of New Kingston. A bench is located at the viewpoint, facing in the opposite direction to the Power Station. The view is relatively expansive across an open foreground of fields and low hedges to a wooded horizon. The Power Station is a prominent feature occupying a wide arc of the view. The 114 m high cooling towers, 199 m high concrete stack, the 95 m high gas turbine stack, and the existing turbine hall / boiler house are all visible above the tree cover in the intervening landscape. The Flue Gas Treatment infrastructure is also visible, but is far better screened by vegetation. Glimpses of parts of less elevated structures were also faintly visible through the trees at the time of the February 2020 field visit. Pylons break the skyline to the west, north and east. Relatively frequent HGV traffic was observed on the adjacent roads at the time of the field visit (there is an HGV MOT centre located to the east of New Kingston, largely enclosed by woodland). There are approximately eleven houses located to the south of the viewpoint. Principal facades are oriented east-west and as such there are not direct views towards the Site. It is possible that some of the properties have very oblique views from main windows, and views from garden area to the rear of the houses.

Susceptibility to Change: Medium to High

- Residents
  - o The oblique nature of views from main windows reduces susceptibility.
- Road users
  - o Have a medium susceptibility.

Value: Medium

- No landscape designations;
- The bench at the viewpoint is located to take advantage of views in the opposite direction to the Site;
- People tend to value views from properties; and
- Not representative of predominant views from properties within New Kingston, which face east or west.

Sensitivity: Medium to High

The viewpoint reflects views from the properties at New Kingston to the south of the viewpoint. As views are oblique from main windows, this reduces the susceptibility to change to medium to high.

The viewpoint is not the subject of any landscape designations. There is a bench present, but this faces south-east, rather than north-west towards the Power Station. The settlement is located in a relatively open position with views in all directions available and as such the view towards the Site is one of a range of views available from New Kingston as a community, rather than reflecting the typical view. Value is medium.

Overall, sensitivity is medium to high.

Size / Scale of Effect:

- **Scale of Change in view:**
  - o The Proposed Development would be largely screened from view by intervening tree cover;
  - o The proposed stacks and the roof of the main building would be visible above the trees;
  - o The stacks would appear slightly taller than the pylon visible in the same arc of view;
  - o The horizontal spread of visible development at the Power Station would increase in the short term;

Geographical Extent:

- **Angle:** Direct to northbound traffic. Oblique from nearby properties. In the opposite direction to the south-east views from the bench.
- **Distance to Proposed Development (stacks):** 1.99 km.
- **Extent of area over which changes would be visible:** New Kingston and the adjacent road network.

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o Lower elevations of the building may potentially be glimpsed in winter; o Plumes visible approximately 25 % of daylight hours; o Post-2025, the Gas Turbines Stack would remain a notable skyline feature, but other large scale structures would be removed; and o The visibility of the Proposed Development would not increase post-2025, and it would remain a limited background feature. • **Degree of contrast / integration:** Power Station is prominent. • **Nature of the View:** A clear and unencumbered view.	
Duration: Long-term (permanent development).	**Reversibility:** Irreversible (permanent development).
Magnitude: Small (Current Baseline and Future Baseline) In the Current Baseline scenario, the Proposed Development would be largely screened from view by the intervening tree cover (which is located within the southern part of the Power Station site). The proposed stacks, and the top of the main facility building would be visible above the trees, but would be a relatively limited component of the view. The emissions plumes from the stacks would be visible for approximately 25 % of daylight hours, but would typically be short and their influence upon the view would be very limited. The stacks would appear slightly taller to pylon visible in the same arc of view. Existing Power Station structures would remain far more prominent. The introduction of the Proposed Development would, increase the horizontal spread of development visible from the Viewpoint. In the Future Baseline scenario, following the removal of the majority of the visible existing structures, the visibility of the Proposed Development would not increase. It would remain well screened and would continue to have only a limited presence in the background. The Gas Turbine Stack would remain visible, and the further presence of the Proposed Development would increase the influence of retained development at the Power Station. However, the overall influence of built development upon the view would be less than in the current baseline.	
Significant Effect: No (Current Baseline and Future Baseline) A minor level of effect would occur in both the current and future baseline scenarios, and such effects would not be significant. In the Current Baseline scenario, a minor level of effect would occur. The Proposed Development would be a small scale addition to the background of the view, in a context where a series of far larger structures are prominent. The nature of the view would not change to any appreciable degree. Effects would not be significant. In the Future Baseline scenario, the Proposed Development would remain well screened and would exert little influence upon the views across the adjacent field to the middle ground tree cover. Effects would not be significant. The removal of very prominent existing features at the Power Station would significantly reduce the influence of built development, irrespective of the presence/ absence of the Proposed Development.	
Adverse (Current Baseline and Future Baseline) / Neutral / Beneficial: The presence of the Proposed Development would be adverse. This should, however, be considered in the context of the post-2025 removal of many very prominent existing structures, the visual benefits of which, as likely to be perceived by residents and road users, would far outweigh any limited adverse effects of the Proposed Development.	

Viewpoint 5: Kingston on Soar
Grid Ref: 450008, 327889

View north from public footpath at the northern edge of a small village. The Power Station is prominent to the north, and pylons are prominent to the north-west. The 114 m high cooling towers, 199 m high concrete stack, the 95 m high gas turbine stack, and the existing turbine hall / boiler house are all prominent above the tree cover in the intervening landscape. A railway gantry is also evident to the north-west, and wooden telegraph poles run close to the viewpoint. Similar views are likely to be available from some of the properties to the south of the viewpoint, typically from windows in the rear elevation and/or from back gardens where there are gaps in garden vegetation.

Susceptibility to Change: High

- Walkers
  - o People using public rights of way have higher susceptibility.
- Residents
  - o Have direct views from rear windows and rear gardens, albeit typically well screened by vegetation.

Value: Medium

- No landscape designations;
- Public right of way;
- People tend to value views from properties; and
- Not a typical view from the village, views from which are generally well screened in this direction.

Sensitivity: High

The viewpoint reflects the views available to walkers on the footpath. The viewpoint also gives some indication of the views available from nearby properties; however, such views are expected to be relatively well screened by garden vegetation and are likely to be less clear than from the viewpoint itself. Susceptibility to change is high.

The viewpoint is not subject to any landscape designations. It is located along a public footpath. The viewpoint does not reflect typical views from Kingston-on-Soar, which tend to be well screened. Value is medium.

Overall, sensitivity is high.

Size / Scale of Effect:

- **Scale of Change in view:**
  - o The Proposed Development would be largely screened from view by the intervening tree cover;
  - o The proposed stacks would be visible above the trees;
  - o A limited increase in the horizontal extent of development visible at the Power Station site would result;
  - o Plumes visible approximately 25 % of daylight hours;
  - o Post-2025 the influence of built development would reduce appreciably, following the removal of existing structures; and
  - o The proposed stacks would remain one of several vertical structures visible, including the gas turbine stack and many pylons. The pylons would appear the tallest of these.
- **Degree of contrast / integration:** Power station is prominent.

Geographical Extent:

- **Angle:** Direct.
- **Distance to Proposed Development (stacks):** 2.55 km.
- **Extent of area over which changes would be visible:** Northern edge of village, and the adjacent stretch of village.

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• **Nature of the View:** A clear and unencumbered view.	
Duration: Long-term (permanent development).	**Reversibility:** Irreversible (permanent development).
Magnitude: Small (Current Baseline and Future Baseline) In the Current Baseline scenario, the Proposed Development would be largely screened from view by the intervening tree cover (which is located within the southern part of the Power Station). The proposed stacks would be visible above the trees, and their presence would result in a limited increase in the horizontal spread of development visible. The emissions plumes from the stacks would be visible for approximately 25 % of daylight hours, but would typically be short and their influence upon the view would be very limited Overall, limited change in the background. Post-2025 in the Future Baseline scenario, following the removal of the very prominent existing structures at the Power Station, the influence of built development would reduce significantly. The proposed stacks would be one of series of vertical structures present on the northern skyline, including the retained gas turbines stack and many pylons, with the pylons appearing the tallest and most prominent of these. The Proposed Development would continue to be a small scale background feature.	
Significant Effect: No (Current and Future Baseline) In the Current Baseline scenario a minor level of effect would occur. The Proposed Development would be a small scale addition to the background of the view, and would be well screened by existing vegetation cover. Its presence would have little or no appreciable influence upon the nature of the views available, with other built structures remaining more prominent. Effects would not be significant. In the Future Baseline scenario, a minor level of effect would occur. The removal of the larger structures at the Power Station would reduce the overall influence of development upon the view. However, the Proposed Development would continue to be a small scale background presence, and would remain less prominent than other retained structures visible on the northern skyline. Effects would not be significant.	
Adverse (Current Baseline and Future Baseline) / Neutral / Beneficial: The presence of the Proposed Development would be adverse. This should, however, be considered in the context of the post-2025 removal of many very prominent existing structures, the visual benefits of which, as likely to be perceived by residents and path users, would far outweigh any limited adverse effects of the Proposed Development.	

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Viewpoint 6: Kegworth
Grid Ref: 448981, 327276

Expansive view looking north from a public footpath at the edge of the village. The Power Station is a prominent feature, as are the pylons. The 114 m high cooling towers and 199 m high concrete stack are all prominent above intervening tree cover. The 95 m high gas turbine stack, and the existing turbine hall / boiler house and the 400 kV Substation are also visible. Similarly, open views are expected to be available from many of the properties at the edge of the village, which is to the south of the viewpoint.

Susceptibility to Change: High

- Walkers
  - o People using public rights of way have higher susceptibility.
- Residents
  - o Have direct views from rear windows and rear gardens.

Value: Medium

- No landscape designations;
- Public right of way; and
- People tend to value views from properties.

Sensitivity: High

The viewpoint reflects the views available to users of the footpath. The views available will be a major reason for any visit. The viewpoint also reflects direct views from the rear windows and rear gardens of adjacent properties. Susceptibility to change is high.

The viewpoint is not subject to any landscape designations. It is located along a public footpath close to properties.

Overall, sensitivity is high.

Size / Scale of Effect:

- **Scale of Change in view:**
  - o The Proposed Development would be partially screened by intervening tree cover, and by the existing turbine hall / boiler house;
  - o The proposed stacks and part of the main building would be visible, appearing adjacent to a an electricity pylon which is closer and appears taller;
  - o Very limited addition to the assemblage of built structures visible;
  - o Plumes visible approximately 25 % of daylight hours;
  - o Post-2025, the main building would be more visible, due to the removal of the existing Turbine Hall / Boiler House;
  - o The proposed stacks would remain one of several vertical structures visible, including the Gas Turbines Stack and many pylons. The pylons would appear the tallest of these;
  - o The 400 kV Substation would also remain visible; and
  - o Tree cover in the intervening landscape would continue to provide partial screening.
- **Degree of contrast / integration:** Power Station is prominent.

Geographical Extent:

- **Angle:** Direct.
- **Distance to Proposed Development (stacks):** 3.45 km.
- **Extent of area over which changes would be visible:** North-east edge of village, and adjacent stretch of footpath.

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<table>
<tr><td>

- **Nature of the View:** A clear and unencumbered view.

</td><td></td></tr>
<tr><td>Duration: Long-term (permanent development).</td><td>Reversibility: Irreversible (permanent development).</td></tr>
<tr><td colspan="2">Magnitude: Small (Current Baseline and Future Baseline)
In the Current Baseline scenario, the Proposed Development would be partially screened from view by tree cover, and also initially by the existing turbine hall / boiler house. The proposed stacks and part of the main building would be visible, located adjacent to an existing pylon that would appear a far taller structure. There would be a very limited addition to existing assemblage of structures visible. The emissions plumes from the stacks would be visible for approximately 25 % of daylight hours, but would typically be short and their influence upon the view would be very limited.

Post-2025, in the Future Baseline scenario, following the removal of the existing structures, the Proposed Development would become more visible, as the screening provided by the turbine hall / boiler house is no longer present. The proposed stacks would be one of series of vertical structures present on the northern skyline, including the retained gas turbines stack and many pylons, with the pylons appearing the tallest and most prominent of these. The 400 kV Substation building would also remain visible. Tree cover in the intervening landscape would continue to provide partial screening of the Proposed Development.</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td colspan="2">Significant Effect: No (Current Baseline and Future Baseline)
In the Current Baseline scenario, a minor level of effect would occur. The Proposed Development would be a small scale addition to view. Its presence would have little or no appreciable influence upon the nature of the views available, with other built structures remaining more prominent. Effects would not be significant.

In the Future Baseline scenario, a minor level of effect would occur. The visibility of the Proposed Development would increase slightly due to the removal of existing buildings, and the overall influence of development upon the view would reduce. The specific influence of the Proposed Development would not change greatly from the current baseline, with other retained structures remaining more prominent. Effects would not be significant.</td></tr>
<tr><td colspan="2">Adverse (Current Baseline and Future Baseline) / Neutral / Beneficial:
The presence of the Proposed Development would be adverse. This should, however, be considered in the context of the post-2025 removal of many very prominent existing structures, the visual benefits of which, as likely to be perceived by residents and path users, would far outweigh any limited adverse effects of the Proposed Development.</td></tr>
</table>

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Viewpoint 7: River Trent, Sawley Cut
Grid Ref: 447217, 330968

View looking east from the public footpath that runs along the northern side of the Sawley Cut. The Power Station is prominent in the centre of the view. The 114 m high cooling towers and 199 m high concrete stack are all prominent above intervening tree cover, and other structures at the Power Station are also visible (Turbine Hall / Boiler House and Flue Gas Treatment infrastructure). The view includes a number of urbanising features, including lighting columns along the Cut, the hard surface of the footpath / towpath, and utilitarian buildings and structures at Sawley Marina on the southern side of the Cut. A car park at the Marina is open to the public. Many boats are berthed at the Marina and along the Cut.

Susceptibility to Change: High

- Path and river users
  - People engaged in recreation and on public rights of way have higher susceptibility.

Value: Medium to High

- No landscape designations;
- Public right of way; and
- The recreational and amenity value is evidenced by the presence of the marina and moorings.

Sensitivity: High

The viewpoint reflects the view available to walkers on the footpath, and to users of the river. Susceptibility to change is high.

The viewpoint is not covered by any landscape designations. The viewpoint is located along a public footpath, close to a marina. The view available will therefore be familiar to relatively large numbers of people. Value is medium to high.

Overall, sensitivity is high.

Size / Scale of Effect:

- **Scale of Change in view:**
  - The Proposed Development would be largely screened from view by the wooded ridge to the north of the Site;
  - The proposed stacks and part of the roof of the main building would be visible above the trees;
  - The stacks are likely to be better screened in summer, when foliage is present on trees in the middle ground;
  - Plumes visible approximately 25 % of daylight hours; and
  - The visibility of the Proposed Development would not increase post-2025.
- **Degree of contrast / integration:** Power Station is prominent.
- **Nature of the View:** A clear and unencumbered view.

Geographical Extent:

- **Angle:** Direct.
- **Distance to Proposed Development (stacks):** 3.25 km.
- **Extent of area over which changes would be visible:** Approximately 250 m stretch of footpath.

Duration: Long-term (permanent development).

Reversibility: Irreversible (permanent development).

Magnitude: Small (Current Baseline and Future Baseline)

In the Current Baseline scenario, the Proposed Development would be largely screened from view by the wooded ridge to the north of the Site. The proposed stacks, and the roof of the main facility building would be visible above the trees, but would be a limited addition to the background of the view. The stacks are likely to be better screened in summer. The

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emissions plumes from the stacks would be visible for approximately 25 % of daylight hours, but would typically be short and their influence upon the view would be very limited. In the Future Baseline scenario, the Proposed development would remain well screened. The proposed stacks would be one of the principal vertical structures present on the skyline, but their slender form and distance from the viewpoint would mean that they would only be a small scale presence.
Significant Effect: No (Current Baseline and Future Baseline) In the Current Baseline, a minor level of effect would occur. The Proposed Development would be a small scale addition to the background of the view, and would be well screened by the intervening wooded landform. Its presence would have little or no appreciable influence upon the nature of the views available looking along the Sawley Cut, with waterside development close to the Viewpoint remaining more prominent. Effects would not be significant. In the Future Baseline scenario, a minor level of effect would occur. The overall influence of development would reduce as a result of the removal of many existing structures. This would not, however, increase the visibility of the Proposed Development, which would remain a small-scale presence in the background of a view where other existing development closer to the viewpoint would remain more prominent. Effects would not be significant.
Adverse (Current Baseline and Future Baseline) / Neutral / Beneficial: The presence of the Proposed Development would be adverse. This should, however, be considered in the context of the post-2025 removal of many very prominent existing structures, the visual benefits of which, as likely to be perceived by path and river users, would far outweigh any limited adverse effects of the Proposed Development.

Viewpoint 8: Pasture Lane
Grid Ref: 450457, 331910

View looking south from a minor road. The view is obstructed at short range by a recently erected security gate, which prevents views of the waterbody beyond. The 114 m high cooling towers, 199 m high concrete stack, and 95 m high gas station stack at the Power Station are prominent on the skyline to the rear of the wooded ridge south of the river. The surrounding area includes a series of waterbodies which are used for a variety of recreation activities. These are private and are not directly accessible to the general public. Views towards the Power Station from the water or water's edge are expected to be clearer than the lane (as there would be no gate or hedgerow present). There is a public footpath to the east of the road, running parallel to it. A dense hedge separates the road and the footpath, and clear views towards the Proposed Development are unlikely to be available from the path.

Susceptibility to Change: Medium • Road users o Have a medium susceptibility.	**Value: Medium** • No landscape designations; and • Within a wider area that has a strong recreation/ amenity function.

Sensitivity: Medium

The viewpoint is representative of the views available to road users. Susceptibility to change is medium.

The viewpoint is not subject to any landscape designations. It is located within a wider area, where there is a clear and promoted recreation/ amenity function. Value is medium.

Overall, sensitivity is medium.

Size / Scale of Effect: • **Scale of Change in view:** o The Proposed Development would be largely screened from view by the wooded ridge north of the Site; o Where visible, only the proposed stacks would be visible above the intervening vegetation; o The horizontal spread of development at the Power Station would increase; o The stacks would be a small scale addition to the skyline; o Plumes visible approximately 25 % of daylight hours; and o The visibility of the Proposed Development would not increase post-2025. The proposed stacks would remain visible on the skyline, as would the Gas Turbines Stack. • **Degree of contrast / integration:** Power Station structures are prominent. • **Nature of the View:** View interrupted at short-range by a solid security gate. Views from the road more generally are restricted by vegetation cover.	**Geographical Extent:** • **Angle:** Oblique to the direction of southbound travel. • **Distance to Proposed Development (stacks):** 1.5 km. • **Extent of area over which changes would be visible:** Viewpoint only.
Duration: Long-term (permanent development).	**Reversibility:** Irreversible (permanent development).

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Magnitude: Small (Current Baseline and Future Baseline) In the Current Baseline scenario, the Proposed Development would be largely screened from the view by the wooded ridge north of the Site. The proposed stacks would be visible, and their presence would increase the visible horizontal extent of the Power Station along the skyline. The emissions plumes from the stacks would be visible for approximately 25 % of daylight hours, but would typically be short and their influence upon the view would be very limited. In the Future Baseline scenario, the Proposed Development would remain a limited background presence (albeit on a less developed skyline). The proposed stacks would appear taller but notably less bulky than the Gas Turbine Stack, which would also be retained.
Significant Effect: No (Current Baseline and Future Baseline) In the Current Baseline scenario, a minor level of effect would occur. The Proposed Development would be a small scale addition to the background of the view, and would be well screened by the intervening wooded landform. Its presence would have little or no appreciable influence upon the nature of the views available. Effects would not be significant. In the Future Baseline scenario, a minor level of effect would occur. The removal of the cooling towers and existing Power Station stack would change the nature of the background of the view, with the influence of development reducing considerably. Nevertheless, the Proposed Development would continue to have only a limited presence on the skyline. Effects would not be significant. In both baseline scenarios, whilst views in the direction of the Site are clearer from the nearby waterbodies or from the water's edge, the influence of the Proposed Development upon such views would not differ.
Adverse (Current Baseline and Future Baseline) / Neutral / Beneficial: The presence of the Proposed Development would be adverse. This should, however, be considered in the context of the post-2025 removal of many very prominent existing structures, the visual benefits of which, as likely to be perceived by road users, would far outweigh any limited adverse effects of the Proposed Development.

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Viewpoint 9: Footpath, Barton in Fabis
Grid Ref: 452162, 332931

Expansive view looking south-east across the Trent valley from a public footpath at the edge of the village. The 114 m high cooling towers, 199 m high concrete stack, and 95 m high gas station stack at the Power Station are clearly visible on the skyline in beyond an intervening wooded ridge. Nearby properties are orientated with main views facing north-west and south-east, and direct views from these towards the Site are not available.

Susceptibility to Change: High • Walkers o People using public rights of way have higher susceptibility.	**Value: Medium to High** • No landscape designations; • Public right of way; and • Similar views are available from the southern edge of the village.

Sensitivity: High

The viewpoint reflects the views available to users of the footpath. Susceptibility to change is high.

The viewpoint is not subject to any landscape designations. It is located along a public right of way. The view available is relatively typical of views from other parts of the village, i.e. it reflects a community view. Value is medium to high.

Overall, sensitivity is high.

Size / Scale of Effect: • **Scale of Change in view:** o The Proposed Development would be largely screened by the intervening wooded ridge north of the Site; o The proposed stacks would be visible, at the edge of the existing visible Power Station structures; o The stacks would be a limited and distant addition to the view; o Plumes visible approximately 25 % of daylight hours; and o The visibility of the Proposed Development would not increase post-2025. The proposed stacks would be the tallest built feature on the southern skyline, but would appear less bulky than the Gas Turbine Stack. Tree cover located closer to the viewpoint would appear far taller than the stacks. • **Degree of contrast / integration:** Power Station is prominent. • **Nature of the View:** A clear and unencumbered view.	**Geographical Extent:** • **Angle:** Direct. • **Distance to Proposed Development (stacks):** 3.06 km. • **Extent of area over which changes would be visible:** Approximately 500 m stretch of path north-west of the Viewpoint.
Duration: Long-term (permanent development).	**Reversibility:** Irreversible (permanent development).

Magnitude: Small (Current Baseline and Future Baseline)

In the Current Baseline scenario, the Proposed Development would be largely screened from the view by the wooded ridge north of the Site. The proposed stacks would be visible, located at the edge of the existing Power Station. The emissions plumes from the stacks would be visible for approximately 25 % of daylight hours, but would typically be short and their influence upon the view would be very limited. Limited background change would occur.

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In the Future Baseline scenario, following the removal of the majority of the visible existing structures, the visibility of the Proposed Development would not increase (it would remain well screened). The proposed stacks would be the tallest built feature on the southern skyline, located in front of shorter but bulkier the Gas Turbine Stack. Tree cover located closer to the viewpoint would appear far taller than the stacks.
Significant Effect: No (Current Baseline and Future Baseline) In the Current and Baseline scenario, a minor level of effect would occur. The Proposed Development would be a small scale addition to the background of the view, and would be well screened by the intervening wooded landform. Its presence would have little influence upon the nature of the views available. Effects would not be significant. In the Future Baseline scenario, a minor level of effect would occur. The overall influence of development upon the southern skyline would reduce due to the removal of the larger Power Station structures. The Proposed Development would, however, remain a small scale presence on the skyline, relatively distant from the viewpoint. Effects would not be significant.
Adverse (Current Baseline and Future Baseline) / Neutral / Beneficial: The presence of the Proposed Development would be adverse. This should, however, be considered in the context of the post-2025 removal of many very prominent existing structures, the visual benefits of which, as likely to be perceived by path users, would far outweigh any limited adverse effects of the Proposed Development.

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Viewpoint 10: Bridleway, Cottagers Hill
Grid Ref: 451886, 330462

View looking west from the public bridleway that runs up the northern side of Cottagers Hill. The 114 m high cooling towers, 199 m high concrete stack, and 95 m high Gas Turbines Stack are prominent on the western skyline, and elements of the Flue Gas Treatment infrastructure are also visible. To the south of the viewpoint, the bridleway runs into dense woodland. Further localised tree cover screens views to the north and east. A single electricity pylon is present at close range to the north.

Susceptibility to Change: High

- Bridleway users
  - o People using public rights of way have higher susceptibility.

Value: Medium

- No landscape designations; and
- Public right of way.

Sensitivity: High

The viewpoint reflects the views available to walkers and riders using the bridleway. Susceptibility to change is high.

The viewpoint is not subject to any landscape designations. It is located along a public bridleway. Value is medium.

Overall, sensitivity is high.

Size / Scale of Effect:

- **Scale of Change in view:**
  - o Initially, the Proposed Development would be visible to the north of the existing Power Station structures;
  - o The proposed stacks would be far more slender and less prominent than existing structures;
  - o The horizontal extent of existing development visible would increase;
  - o Plumes visible approximately 25 % of daylight hours;
  - o Post-2025, the Proposed Development would remain clearly visible, as would the Gas Turbines Stack;
  - o Other structures at the Power Station would be removed from the view;
  - o The new building would have a relatively horizontal form which would limit its prominence on the now less developed skyline; and
  - o The proposed stack would continue to be less prominent than the bulkier Gas Turbines Stack.
- **Degree of contrast / integration:** Power Station is prominent.
- **Nature of the View:** A clear and unencumbered view.

Geographical Extent:

- **Angle:** Direct.
- **Distance to Proposed Development (stacks):** 1.46 km.
- **Extent of area over which changes would be visible:** The vicinity of the Viewpoint only, due to changes in vegetation cover and landform.

Duration: Long-term (permanent development).

Reversibility: Irreversible (permanent development).

Magnitude: Small to Medium (Current Baseline and Future Baseline)

In the Current Baseline scenario, the Proposed Development would be introduced to the north of the existing Power Station structures, and would increase the horizontal extent of development visible. The proposed stacks would be slender structures, appearing far less

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prominent than the existing structures. The emission plumes from the stacks would be visible for approximately 25 % of daylight hours, but would typically be short and their influence upon the view would be very limited. Post-2025 in the Future Baseline scenario, the Proposed Development would remain clearly visible, maintaining the established presence of industrial development in the view. The relatively horizontal form of the proposed building would limit its influence on the now less developed skyline. The proposed stack would continue to be less prominent than the bulkier Gas Turbines Stack.
Significant Effect: No (Current Baseline and Future Baseline) In both the current and future baseline scenarios, effects would be moderate and would not be significant. In the Current Baseline scenario, a moderate level of effect would occur. The Proposed Development would increase the spread of development present in a view where very prominent structures are well established. The nature of the view would remain similar to baseline, albeit with the well-established existing influence of development increased to a limited degree. Effects would not be significant. In the Future Baseline scenario, post-2025, the Proposed Development would remain clearly visible in the background, in a view where the overall influence of development would have reduced notably following the removal of the larger Power Station structures. The existing Gas Turbines Stack would be the most prominent vertical structure, by virtue of its appreciably greater bulk than the far more slender proposed stacks. Effects would not be significant. The Proposed Development would appear significantly smaller in size than the removed structures, occupying a far lesser proportion of the view, both vertically and horizontally, and the *perceived* influence of large scale industry upon the view would notably reduce.
Adverse (Current Baseline and Future Baseline) / Neutral / Beneficial: The presence of the Proposed Development would be adverse. This should, however, be considered in the context of the post-2025 removal of many very prominent existing structures, the visual benefits of which, as likely to be perceived by bridleway users, would far outweigh any limited adverse effects of the Proposed Development.

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APPENDIX 6-1: PRELIMINARY ECOLOGICAL APPRAISAL

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argus ecology

East Midlands Energy Re-Generation (EMERGE) Centre

Preliminary Ecological Appraisal

Technical Appendix 6-1

Prepared for Axis PED on behalf of Uniper UK Limited

Kevin Barry Honour MSc MCIEEM
Version 2.0 / Ref. 20-002
16/06/2020

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NCC received 16.07.2020

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East Midlands Energy Re-Generation (EMERGE) Centre

Preliminary Ecological Appraisal

Report Reference	Ref. 20-002
Date	16/06/2020
Date of survey/s	n/a

Issue	**Prepared by**	**Checked by**	**Approved by**	**Status**	**Date**
Final	Kevin Barry Honour MSc MCIEEM	Claire Gilchrist MSc	Paul Lupton MSc	FINAL	16/06/2020
	[redacted]				

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This report is not to be used for contractual purposes unless this approval sheet is signed and designated as 'FINAL'.

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Contents

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1 Introduction

1.1 This report provides a supplementary Preliminary Ecological Appraisal (PEA) of the proposed East Midlands Energy Re-Generation (EMERGE) Centre (the 'Proposed Development') on land at the Ratcliffe-on-Soar Power Station, Nottinghamshire (the 'Application Site' or 'Site'). The Application Site would occupy around 4 hectares (ha) of land and is centred on OS grid reference 450450, 330450.

1.2 A PEA was commissioned by Uniper in 2019 (Appendix 6-2), covering a larger area of interest than the currently proposed Application Site. This document builds upon the results of that survey, adding data searches from three local authority areas. The habitat survey has been modified to assess habitats within the Site, and converted to an appropriate habitat classification to enable assessment of net gain requirements using Biodiversity Metric 2.0.

1.3 The objectives of the supplementary PEA can be summarised as follows:

- To collate and gather ecological data on the Site, providing a preliminary evaluation of its ecological features;
- Identify and characterise sensitive ecological receptors to assist the Air Quality Assessment (AQA) and assessment of noise effects;
- Map habitats present on site, using Phase 1 Habitat Survey and UK Habitat Survey (UKHS) methodologies, in order to provide a baseline for calculation of Biodiversity Net Gain;
- Identify additi onal ecological surveys which may be necessary to fully assess ecological effects of the Proposed Development; and
- Provide a Technical Appendix to the Ecology and Nature Conservation Chapter of the Environmental Statement (ES), incorporating the results of the data search and habitat surveys.

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2 Scope and Methodology

2.1 Scope of Assessment

Data Search

Biological Records and Statutory Site Data

2.1.1 A data search, the area of which encompasses a 2 km buffer around the Site boundary, was requested from the three local environmental records centres within this area:

- Nottinghamshire Biological and Geological Records Centre;
- Derbyshire Wildlife Trust; and
- Leicestershire Environmental Records Centre.

2.1.2 The search area is shown in Figure 2.1.

2.1.3 The Nottinghamshire data search included locally designated conservation sites, protected and notable species records, as the Site is located within this area. Derbyshire and Leicestershire data searches were confined to locally designated sites, including information on habitats and reasons for designation, in order to identify sensitive ecological receptors for consideration of possible air quality effects.

2.1.4 Information on statutory designated sites and ancient woodlands was obtained from the Multi-Agency Geographic Information for the Countryside (MAGIC) database. The area of search included a 10 km radius for European and internationally designated sites, and a 2 km radius for UK statutory designated sites and ancient woodlands.

2.1.5 The sensitivity of habitats within statutory designated sites to air quality effects was assessed with reference to the Air Pollution Information Service (APIS) website, using the Site Relevant Critical Loads function. For locally designated sites, the most sensitive habitats present on the site were identified from the site descriptions, and the appropriate environmental quality standard identified with reference to advice on the APIS website.

Existing survey and Assessment Data

Ecological Survey

2.1.6 A PEA was commissioned by Uniper from Emec Ecology, Nottinghamshire Wildlife Trust's consultancy[1]. Fieldwork was undertaken in June 2019, and included an

[1] *EMEC Ecology (2019). Potential Energy Project at Ratcliffe Power Station Ratcliffe on Soar, Nottinghamshire. Preliminary Ecological Appraisal (PEA). Report to Uniper Technologies Ltd.*

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extended Phase 1 habitat survey, evaluation of habitat quality, and recommendations for mitigation. No data searches were undertaken. The document is provided in Appendix 6-2.

2.2 Methodology

Habitat Mapping

2.2.1 It was intended to undertake a verification survey of habitats within and around the Site in spring 2020; however, this was not possible due to the Covid-19 pandemic. As up to date (<1 year old) survey data exists for the Site and surrounding areas, these data have been used in conjunction with OS Mastermap aerial photography in order to produce a vegetation map of the Site.

2.2.2 In order to facilitate calculation of Biodiversity Metric 2.0, habitats were mapped using UK Habitat Classification (UKHC)[2] methodology.

Assessment Methodology

2.2.3 The report scope and assessment methodology is based on CIEEM *Guidelines for Preliminary Ecological Appraisal* (CIEEM, 2013[3]), with the exception of a legislation and policy section, which is included in the Ecological and Nature Conservation Chapter (6.0) of the ES. The identification of important ecological receptors follows CIEEM *Guidelines for Ecological Impact Assessment* (CIEEM, 2016[4]).

2.2.4 The value of habitats on Site was quantified using the methodology set out in Biodiversity Metric 2.0[5], in order to provide a baseline value for calculation of Net Gain requirements.

2.3 Personnel

2.3.1 The ecological assessment and PEA report was undertaken by Kevin Barry Honour MSc MCIEEM, a Director of Argus Ecology Ltd., with over 28 years' experience of habitat survey and assessment, bird surveys, and ecological impact assessment.

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[2] *UK Habitat Classification Working Group (2018). UK Habitat Classification. Habitat Definitions v1.0 – http:ecountability.co.uk/ukhabworkinggroup-ukhab*

[3] CIEEM (2013). *Guidelines for Preliminary Ecological Appraisal*. Chartered Institute of Ecology and Environmental Management, Winchester

[4] CIEEM (2016). *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal, 2nd edition*. Chartered Institute of Ecology and Environmental Management, Winchester

[5] Crosher, I.A., Gold, S.B., Heaver, M.D., Heydon, M.A., Moore, L.D., Panks, S.A., Scott, S.C., Stone, D.A. & White, N.A. (2019). *The Biodiversity Metric 2.0: auditing and accounting for biodiversity value. User guide (Beta Version, July 2019)*. Natural England Joint Publication JP029.

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3 Results

3.1 Ecological Context

Statutory Designated Sites

Natura 2000 and Ramsar sites

3.1.1 There are no Natura or Ramsar sites within 10 km of the Site.

UK Designated Sites

3.1.2 There is one Site of Special Scientific Interest (SSSI) within the 2 km screening buffer (see Figure 3.1). **Lockington Marshes SSSI** is located 1.2 km west of the Site at its nearest boundary.

3.1.3 SSSIs are sites of national importance for nature conservation, designated under the Wildlife and Countryside Act 1981 (as amended).

3.1.4 There is one Local Nature Reserve (LNR) within the 2 km screening buffer. **Forbes Hole LNR** is located 1.8 km north north-west of the Site at its nearest boundary.

3.1.5 LNRs are sites of local to County-level importance for nature conservation, designated under the National Parks and Access to the Countryside Act 1949.

Non-statutory Designated Sites

3.1.6 Local Wildlife Sites (LWS) are non-statutory sites of County-level importance for nature conservation, typically designated by partnerships of local authorities and Wildlife Trusts within an administrative area. They provide a comprehensive inventory of sites meeting defined quality standards; these standards are guided by central government advice (DEFRA, 2006[6]), but selection is based on local guidance (e.g. for Nottinghamshire, Nottinghamshire Local Sites Panel (2014[7])).

3.1.7 Table 3.1 lists the LWSs within 2 km of the Site boundary. Maps showing location and extent have been supplied by all three records centres, but for Nottinghamshire and Derbyshire reproduction is restricted by copyright and / or data confidentiality issues; only Leicestershire sites were supplied as shapefiles. Instead, OS grid co-ordinate locations are given in the table for the approximate nearest point to the Site, and used to calculate distance and direction. Note that some sites are just beyond the search area but have been identified for completeness.

[6] DEFRA (2006). *Local Wildlife Sites. Guidance on their Identification, Selection and Management.* https://webarchive.nationalarchives.gov.uk/20130402204735/http:/archive.defra.gov.uk/rural/documents/protected/localsites.pdf
[7] Nottinghamshire Local Sites Panel (2014). *Guidelines for the selection of Local Wildlife Sites in Nottinghamshire*. 1st edition – March 2014.

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Table 3.1: Local Wildlife Sites within 2 km buffer

Site Name	Biological records centre code	OS grid reference (nearest point)	Distance (km)	Direction
Thrumpton Park	5/266	450228, 330743	0.19	NNW
Red Hill, Ratcliffe on Soar	2/846	449602, 330653	0.74	WNW
River Soar, Loughborough Meadows to Trent	2/845	449194, 330435	1.16	W
Copse, Kingston-on-Soar	2/758	451200, 329200	1.45	S
Gotham Wood	2/45	452300, 329300	2.06	SE
Gotham Hill Woods	2/65	452300, 330700	1.28	ESE
Ratcliffe-on-Soar Flyash Grassland 1 & 2	5/3463 /4	450400,329300	1.00	S
Ratcliffe-on-Soar Flyash Track Grassland	5/3456	450300, 329000	1.30	S
Ratcliffe-on-Soar Pond	2/844	450600, 329750	0.65	S
Thrumpton Bank	5/2299	451400, 332000	1,75	ENE
Lockington Fen	72284	448354, 329947	2.05	WSW
Lockington Shooting Ground Marsh, Grassland	75966	449115, 330205	1.25	W
Rare Plant Register Mousetail Pasture	91110	449258, 330175	1.12	WSW
Redhill Marina Backwater	91109	449254, 330207	1.12	W
Lockington, swamp by SSSI	91881	448858, 330320	1.50	W
Lockington Confluence Backwater	91106	449252, 330925	1.14	NW
Ratcliffe Lane Pasture and Stream	91107	448911, 329581	1.65	SW
Soar Meadow near Ratcliffe Lock	73937	449037, 329325	1.69	SW
River Soar West Bank south of A453	72618	449174, 328957	1.85	SW
Trent Floodplain Wetland - Lock m07	68900	449303, 330850	1.07	WNW
Lockington Grounds, Pond and Marsh near Trent	11959	448400, 330800	2.00	W
Lockington Ash	71964	448980, 330400	1.45	W
Lockington Ash 2	71973	449000, 330400	1.42	W
Lockington Confluence Hedges	-	449000, 330700	1.50	W
Lockington Trentside Pools	68893	449100, 330900	1.30	WNW
Lower Soar Floodplain Wetland	68571	448900, 329600	1.70	SW
Pond in hedgeline between two improved grasslands	11945	449100, 329100	1.73	SW
Trent Floodplain Wetland Lock M13	68886	448500, 330400	1.90	W
River Trent	11949	449842, 331020	0.87	NW
River Trent North Bank	ER077	450329, 331603	1.02	N
Attenborough West Gravel Pits	ER078	450710, 332550	1.95	NNE
Trent Lock Marsh	ER062	448920, 331230	1.56	NW
Narrow Bridge Fish Pond	ER080	449260, 331520	1.43	NW
Sheetstores Junction Pond	ER081	449245, 331620	1.52	NW
Poplars Fish Pond	ER082	449370, 331760	1.54	NW
South Junction Pond	ER083	449390, 331925	1.64	NW
Meadow Lane Carr	ER133	449725, 332515	2.03	NNW
Erewash Canal	ER215	449050, 331205	1.43	NW
Cranfleet Farm Floodbanks	-	449700, 331500	1.17	NWN
Cranfleet Ponds (West Pond)	ER069/3	450000, 332000	1.40	NWN

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Protected Species Records

3.1.8 Protected species records received from Nottinghamshire records centre include the following in the wider vicinity of the Site. As locations are only provided to 1 km grid square resolution, records were extracted based on location name, including 'Ratcliffe on Soar', 'Thrumpton Park' and 'Thrumpton', as well as any references to the Power Station itself.

Table 3.2: Protected Species Records

Species	Status	Location	Date (most recent)
Soprano Pipistrelle	Annex IV, Habitats Directive (European protected species (EPS))	Ratcliffe-on-Soar	2014
Common Pipistrelle	EPS	Ratcliffe-on-Soar	2017
Brown Long-eared Bat	EPS	Ratcliffe-on-Soar	2017
Brown Long-eared Bat	EPS	Thrumpton	2017
Noctule Bat	EPS	Ratcliffe-on-Soar	2014
Otter	EPS	Thrumpton Park	2005
Bullhead	Annex II, Habitats Directive	Ratcliffe-on-Soar	2011
European Eel	Annex II, Habitats Directive	Ratcliffe-on-Soar	2011
Spined Loach	Annex II, Habitats Directive	Ratcliffe-on-Soar	-
Water Vole	Schedule 5, W&C Act 1981	Ratcliffe-on-Soar	1999

3.1.9 There were no records of great crested newt (*Triturus cristatus*) in the Nottinghamshire data search, which covers all areas within 500 m of the Site boundary. There are no more recent water vole records, which is likely to reflect the widespread decline and range contraction of this species.

3.2 Habitats and Vegetation

Summary of Habitats Present on Site

3.2.1 UKHC habitats present on site are mapped in Figure 3,2, and tabulated below.

Table 3.3: Summary of habitats

Code	UKHC habitat	Phase 1 equivalent	Area (ha)
c1b	Temporary grass & clover leys	J1.2. Amenity grassland	0.048
u1a	Open mosaic habitats on previously developed land	J1.3. Ephemeral – short perennial	0.164
u1b	Developed land; sealed surface	J4. Bare ground	2.352
u1b5	Buildings	J3.6. Buildings	0.014
u1c	Artificial unvegetated; unsealed surface	J4. Bare ground	1.387

3.2.2 The Site is almost entirely composed of unvegetated bare ground, including both sealed (hard standing) and unsealed (aggregate) surfaces. Parts of the aggregate surface

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support a sparse vegetation of scattered tall ruderal (disturbed-ground) species. As UKHC identifies this as a potential Priority Habitat, it is evaluated in greater detail in section 4 of this report. The only other vegetated habitat is a small strip of mown amenity grassland bordering the access road to the Site.

Boundary Features

3.2.3 The northern and eastern boundaries of the Site are formed by the Power Station perimeter fence. This is a tall fine-mesh, metal electrified security fence set in concrete foundations (see Appendix 6-2 p.11 for photograph). It extends eastwards along the boundary of the Site access road.

Adjoining Habitats

3.2.4 The western boundary of the Site adjoins industrial buildings forming part of the Power Station. To the north of this building is an internal access road with a tall boundary hedge; this extends westwards towards the western boundary of the Power Station. The unsealed aggregate surface with areas of sparse ruderal flora in the northern part of the Site also extend westwards. These areas were included in the habitat survey in Appendix 6-2; the hedgerow was described as ‘species-rich’, with 7 woody species recorded, although isolated within the Power Station grounds.

3.2.5 Further west, still within the Power Station boundary fence, is a bund which was described as supporting semi-improved neutral grassland, broadleaved plantation woodland, and scrub; the edge of this feature is located around 440 m west of the nearest Site boundary.

3.2.6 The southern boundary of the Site adjoins a strip of grassland around 20 m wide, beyond which are rail lines and coal unloading infrastructure associated with the Power Station; the main coal stocking area is located beyond this.

3.2.7 To the north of the Site, outside the Power Station security fence, is a tall hedgerow, beyond which is an arable field. The edge of Thrumpton Park LWS is located beyond this, around 200 m north of the Site boundary.

3.2.8 To the east of the Site is around 9 ha area of plantation woodland, scrub and unmanaged grassland / tall ruderal vegetation.

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3.3 Fauna

Protected Species

3.3.1 The June 2019 survey (Appendix 6-2) considered the tall electric fence surrounding the Power Station site presented a significant impediment to movement onto their survey area of terrestrial protected species, including amphibians, badgers and reptiles.

3.3.2 The vegetated bund around 440 m to the west of the Site was assessed as providing suitable habitat for foraging bats, with the possibility of roosting bats in the plantation woodland; the hedgerow to the west of the Site was also assessed as potentially supporting breeding birds and providing a bat foraging habitat.

3.3.3 Habitats within the Site, including the sparsely vegetated ephemeral – short perennial areas, were assessed as having little potential to support protected or notable species.

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4 Preliminary Identification of Important Ecological Features

4.1 Habitats and Vegetation

Value of Habitats and Vegetation in Proposed Development Area

Priority Habitats

4.1.1 The presence of priority habitats, listed as important for biodiversity conservation in England under Section 41 of the Natural Environment and Rural Communities Act 2006, was assessed for the Site.

4.1.2 The UKHC workbook spreadsheet includes a table of UKHC / Phase 1 correspondences. This does not convert the Phase 1 ephemeral – short perennial classification to a primary habitat in the UKHC system; the closest available mapping option is Open Mosaic Habitat on Previously Developed Land priority habitat. However, this is not directly equivalent to ephemeral – short perennial vegetation, and needs a number of other elements to be present in order to qualify as a priority habitat.

4.1.3 Open Mosaic Habitat on Previously Developed Land is the 'brownfield site' priority habitat, and is defined in the UK Priority Habitat descriptions[8] as habitats which meet all of the following criteria.

Table 4.1: Open Mosaic Habitat Criteria

	Criterion
1	The area of open mosaic habitat is at least 0.25 ha in size.
2	Known history of disturbance at the site or evidence that soil has been removed or severely modified by previous use(s) of the site. Extraneous materials/substrates such as industrial spoil may have been added.
3	The site contains some vegetation. This will comprise early successional communities consisting mainly of stress-tolerant species (e.g. indicative of low nutrient status or drought). Early successional communities are composed of (a) annuals, or (b) mosses/liverworts, or (c) lichens, or (d) ruderals, or (e) inundation species, or (f) open grassland, or (g) flower-rich grassland, or (h) heathland.
4	The site contains unvegetated, loose bare substrate and pools may be present.
5	The site shows spatial variation, forming a mosaic of one or more of the early successional communities (a)–(h) above (criterion 3) plus bare substrate, within 0.25 ha.

4.1.4 In the case of the Site, the plant community present is described in the 2019 survey as '*bare ground…becoming colonized by ephemeral – short perennial vegetation, including rosebay willowherb, Canadian fleabane, great willowherb, yellow wort, common centaury, prickly lettuce, bristly ox-tongue and black medick with occasional common knapweed, ox-eye daisy and salad burnet. Occasional scattered buddleia and dog rose*

[8] *BRIG (ed. Maddock, A.) (2008). UK Biodiversity Action Plan Priority Habitats. Open Mosaic Habitat on Previously Developed Land (updated July 2010).* http://jncc.defra.gov.uk/pdf/UKBAP_BAPHabitats-40-OMH-2010.pdf

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occurred throughout this area.' (first paragraph on page 11 of Appendix 6-2). The evaluation did not identify this as Open Mosaic habitat, stating it was '*currently rather sparse within the gravel areas and offers little potential for protected or notable fauna.'* (Table 5.2 on page 16 of Appendix 6-2)

4.1.5 It is clear from Table 4.1 that these areas fulfil some of the criteria, but they do not form a mosaic, being limited to sparse ruderal species. The classification within Biodiversity Metric 2.0, although based on UKHC, includes a 'Sparsely Vegetated Land – Ruderal / Ephemeral' category, which better describes the habitat present on this part of the Site. This is described as a habitat of low distinctiveness. Although not identified as an important ecological feature in the 2019 survey, this can be regarded as being of within-site importance for the purposes of ecological impact assessment. It also contributes to the assessment of existing biodiversity interest of the site using Biodiversity Metric 2.0; for this purpose it has been assigned a 'moderate' condition.

<u>Other Features</u>

4.1.6 Other habitats described in the 2019 survey, including species-rich neutral grassland, a hedgerow (identified as a Priority Habitat) and plantation woodland are all outside the Application Site boundary.

Value of Habitats in Wider Area

4.1.7 Lockington Marsh SSSI can be considered an important ecological feature on a **national** scale of importance.

4.1.8 Forbes Hole LNR, and the Local Wildlife Sites set out in Table 6.1.3 can be regarded as important ecological features on a **County-level** scale of importance.

4.2 Protected and Priority Species

4.2.1 This assessment has not identified a significant risk of occurrence of protected species on the Site. This is consistent with the findings of the 2019 survey.

4.2.2 Habitats identified in the 2019 survey as potentially supporting foraging bat habitat and nesting birds are all located outside of the currently Proposed Development footprint.

4.3 Valuation of Site using Biodiversity Metric 2.0

4.3.1 The following table sets out the Site Habitat Baseline values inputted to the Biodiversity Metric 2.0 spreadsheet.

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Table 4.2: Site Habitat Baseline values

Habitat type	Area (ha)	Condition	Connectivity	Score
Urban – Amenity grassland	0.05	Moderate	Low	0.20
Sparsely vegetated land- Ruderal / Ephemeral	0.16	Moderate	Low	0.64
Urban – Developed land; sealed surface	2.37	n/a	Low	0.00
Urban – Artificial unvegetated, unsealed surface	1.39	n/a	Low	0.00
			TOTAL	**0.84**

4.3.2 Assuming these habitats all fall within the development footprint, the target for restoration would be a site value equal or in excess of **0.93 Biodiversity Units** in order to achieve 10 % Net Gain.

4.3.3 Appendix 6-4 provides the Biodiversity Metric spreadsheet which illustrates that, with the implementation of the illustrative landscape design, habitat units would be 1.28 (a 0.44 increase) with a further 1.19 hedgerow units. This results in a total net percentage change in habitat units of 52.46 %. This accords with the requirements of the National Planning Policy Framework and significantly exceeds the anticipated future requirements under the Environmental Bil (i.e. of a 10 % net biodiversity gain).

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5 Conclusions and Recommendations

5.1 Conclusions

5.1.1 The report has not identified any important ecological features within the Site. Its wider surroundings include a statutory designated site, and a number of non-statutory designated sites within 2 km of the Site boundary. Potential and predicted impacts on these are considered further in the ES, including human disturbance, noise and air quality effects.

5.1.2 No protected species have been identified as occupying the Site or with a risk of occurrence thereon, and it would not be necessary to obtain a European protected species disturbance licence in order to implement the Proposed Development.

5.2 Recommendations

5.2.1 No additional survey works are recommended as a consequence of the data search and PEA. The June 2019 survey recommended bat surveys should be undertaken if a bund supporting woodland, scrub and grassland habitats was affected by the Proposed Development; however, as this is located over 400 m away from the nearest Site boundary, further survey works are not necessary. Checks on nesting birds were also recommended if this feature, and the hedgerow which extends west from outside the Site boundary, were affected. Again, as these features lie outside the development footprint, no further survey works are necessary to inform the Environmental Impact Assessment of the Proposed Development.

5.2.2 This report has established that habitat creation or enhancement works, either within or outside the Site, will be required to achieve in excess of 0.93 Biodiversity Units, in order to achieve over 10 % Net Gain.

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Figure 2.1: Data Search – the area of which encompasses a 2 km buffer

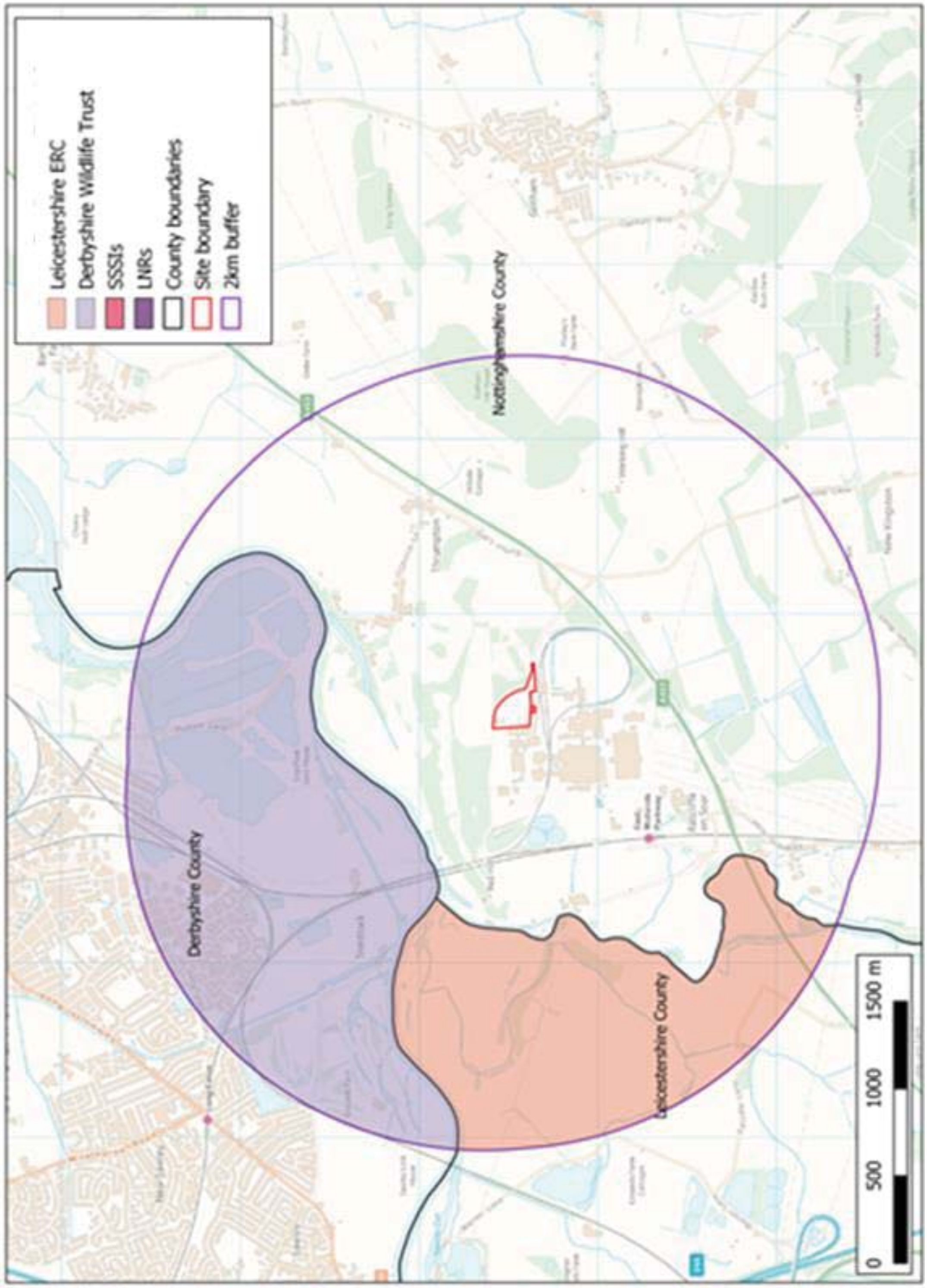

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Figure 3.1: Statutory Designated Sites – the area of which encompasses a 2 km buffer

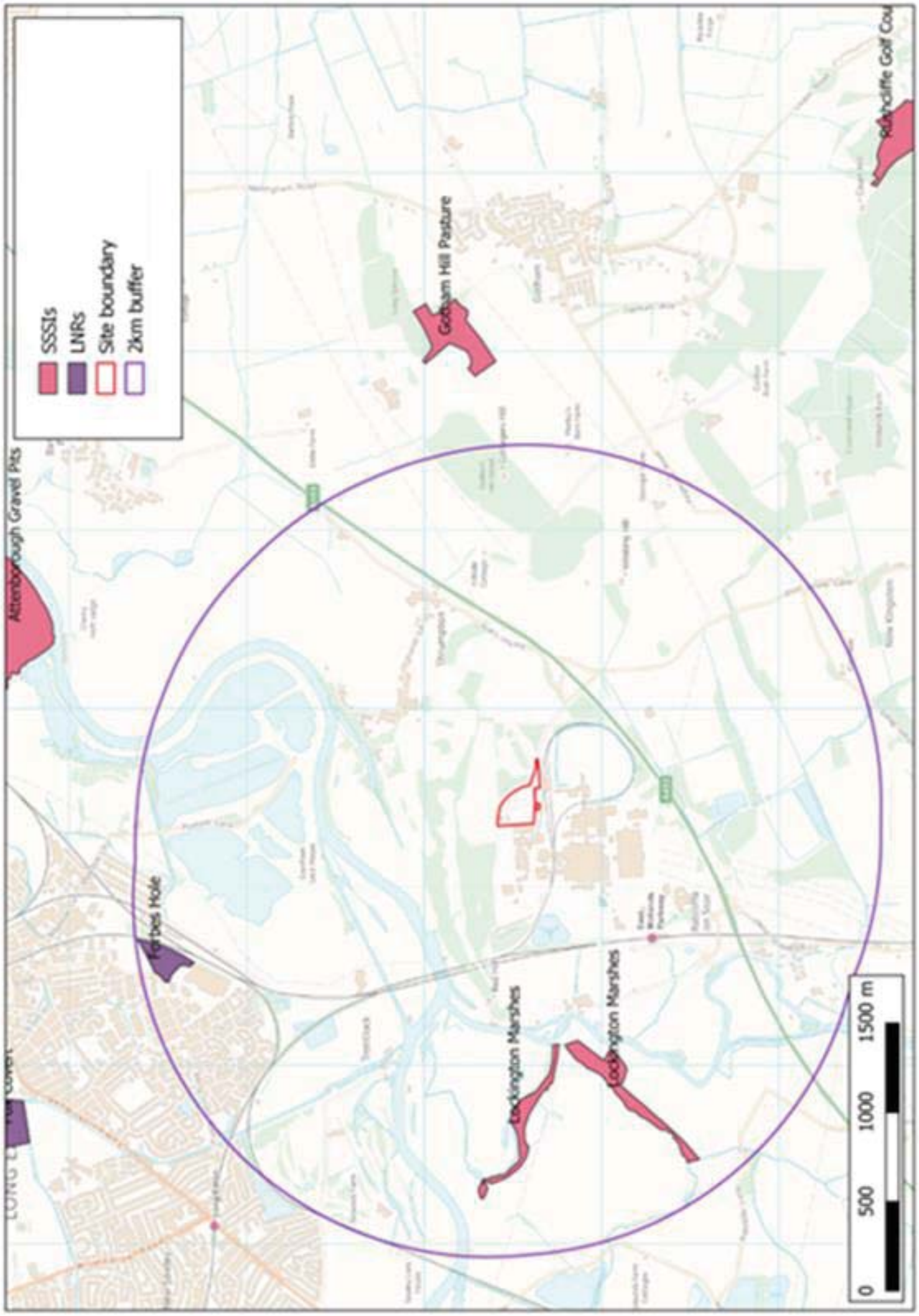

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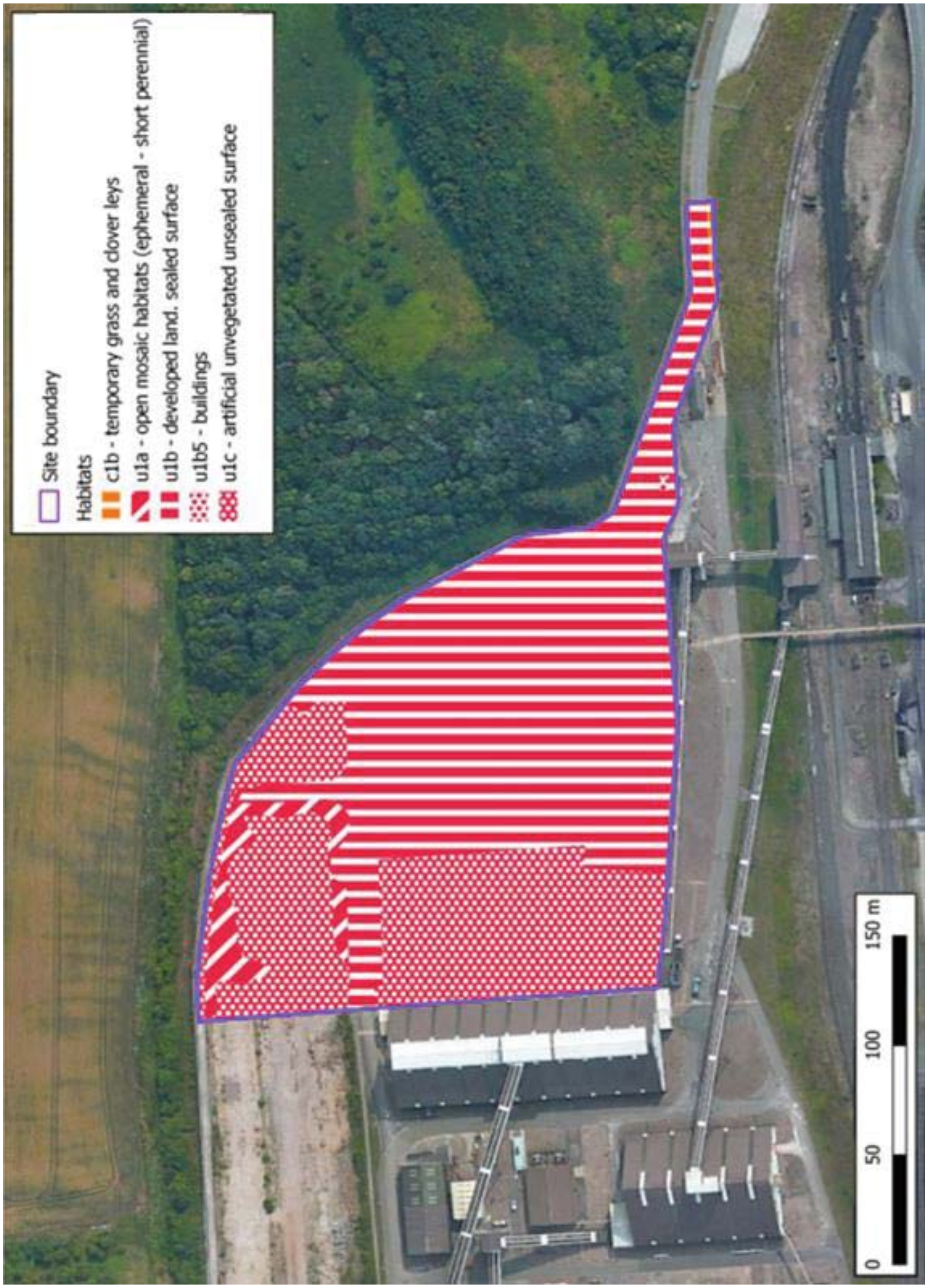
Figure 3.2: UKHC Habitats



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APPENDIX 6-2: PRELIMINARY ECOLOGICAL APPRAISAL – 2019

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Potential Energy Project at Ratcliffe Power Station
Ratcliffe on Soar, Nottinghamshire

Preliminary Ecological Appraisal (PEA)

A report to:

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Technology Centre
Ratcliffe-on-Soar
Nottingham
NG11 0EE

By:

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July 2019

Redacted Version

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NON-TECHNICAL SUMMARY

Introduction
This report provides the details of an ecological walk-over survey of two areas of land at Ratcliffe Power Station.

Method of Study
EMEC Ecology's brief was to identify potential ecological issues associated with any future works and make recommendations for general mitigation, compensation, enhancements and further surveys, as appropriate. To meet the requirements of the brief, an ecological walk-over survey was carried out.

Results
The habitats within the two survey areas range from low ('Sub-parish') to moderate ('Parish') value. The most notable habitats were the species-rich grassland on the bund and the plantation woodland in Survey Area 2.

No evidence of protected or notable species were found within the surveys areas, [redacted] The woodland within the survey area was considered to provide potential for birds and bats.

Conclusions
It is considered unlikely that any terrestrial fauna, including [redacted] small species such as reptiles, would be able to breach the electric security fence and the absence of any signs of common species, such as rabbit, further indicates that smaller fauna cannot access the site.

The main potential impacts of the proposed works in absence of mitigation, are considered to be possible disturbance to roosting and foraging bats, if the plantation woodland requires removal, and disturbance to nesting birds during removal of trees and scrub (including the hedgerow and the woodland). There will also be loss of species-rich neutral grassland if the bund requires removal. The remainder of the site, comprising primarily of ephemeral / short perennial vegetation which is beginning to colonise the hardstanding, is currently of little value to any protected or notable fauna. If it is permitted to continue to develop however, it may become more valuable, particularly to invertebrates.

Recommendations
- Please refer to Sections 6.1, 6.2 and 6.3 of the report for more detailed recommendations.

Mitigation Recommendations
- If possible, it is recommended that the bund supporting species-rich neutral grassland and the plantation woodland are retained.
- Ideally, the hedgerow should also be retained.
- Any temporary storage of plant or machinery should be on hardstanding to avoid unnecessary disturbance to semi-natural habitats. Although considered unlikely due to the electric security fence, if any common amphibians are found during works, they should be removed carefully by hand to areas of semi-natural habitat such as scrub or grassland which will not to be impacted.
- Lighting, if required as part of any development, should be 'bat friendly' and lamps should be positioned so that they are facing away from semi-natural habitats The lighting scheme

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should utilise either low or high pressure sodium lamps and minimise light scatter using light spill accessories (Bat Conservation Trust 2018).

- Any vegetation clearance including tree, shrub or hedgerow removal, should be timed to avoid the bird breeding season, which runs from March to September (inclusive). This is to avoid adverse impacts to any nests present. If it is necessary to carry out the vegetation clearance works during the breeding season, then a survey must be carried out by a qualified ecologist prior to works going ahead to ensure that no active nests will be affected. If active nests were found then the vegetation clearance works would have to be delayed until all chicks had fledged.

Compensation & Enhancement Recommendations

- As the details of the possible development are not yet known, it is not possible to provide recommendations for compensation and enhancement measures. These can be provided at a later date, when details of the proposals become available and when any necessary further surveys have been completed. Recommendations are likely to include enhancements to the existing hedgerow, appropriate management of the grassland and woodland (if they are to be retained) in order to maximise their value. The installation of bird and bat boxes are also likely to be recommended.

Further Survey Recommendations

[redacted]

- *Bats*
  If it becomes necessary to remove any of the plantation woodland, further surveys will be required in order to determine the presence / absence of roosting bats. This is likely to comprise a daytime inspection and bat activity surveys. It is likely that any bat surveys will need to be completed before a planning application can be submitted (if the woodland is likely to be impacted).

- *Desk Study*
  A desk study would involve consultation with various ecological records centres and any other relevant holders of biological information. This will provide existing information on i) any non-statutory designated nature conservation sites in the vicinity and ii) any existing records of protected/notable species from the site and vicinity.

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1. Introduction

1.1 Site Location and Background Information

This report has been prepared by EMEC Ecology for Uniper Technologies Limited. It provides the details of an ecological walk-over survey of two areas of land at Ratcliffe Power Station.

Survey Areas 1 and 2 are centred on grid references SK 503 301 and SK 501 305, respectively. Survey Area 1 lies in the centre of the site and Survey Area 2 occurs along the northern boundary. Both are shown on Figure 1 in Appendix 1.

1.2 Proposed Works

The proposed works involve a potential energy project. At this stage the project has not yet been confirmed and hence no plans are currently available.

1.3 Survey Brief and Approach

EMEC Ecology's brief was to identify potential ecological issues associated with the works and make recommendations for general mitigation, compensation and further surveys, as appropriate. To meet the requirements of the brief, an ecological walk-over survey was carried out by a suitably qualified ecologist.

2. Description of Survey Areas and Surroundings

2.1 Survey Area Descriptions

Both survey areas lie within the Ratcliffe Power Station site. Survey Area 1 occurs in the centre of the site and comprises of hardstanding with various structures and buildings. Survey Area 2 lies at the northern boundary of the site and comprises of hardstanding and bare ground (which is starting to become colonised by annual and ruderal vegetation) along with a large bund in the western end which has been seeded with a wildflower seed mix. An area of plantation woodland also occurs in this western end.

2.2 Surrounding Habitats

The Power Station is situated in a rural environment near the small village of Ratcliffe on Soar, between the towns of Kegworth, to the south and Long Eaton, to the north. The River Soar lies approximately 370m to the west of the Power Station site and the River Trent, approximately 250m to the north. Beyond the River Trent, various old gravel pit lagoons occur, including Attenborough Nature Reserve which occurs around 2.5km to the north-east.

Various major roads occur in close proximity to the site (including the A453, which runs along the southern boundary of the site and the M1 which lies approximately 2.5km to the west), as well as busy rail lines.

Habitats surrounding the Power Station include Thrumpton Park, adjacent to the northern boundary which comprises parkland, woodland and large lakes, and farmland, primarily arable, to the south and east.

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3. METHODOLOGY

3.1 Ecological Survey

3.1.1 Survey Area

The areas surveyed are shown on Figures 2a and 2b in Appendix 1.

3.1.2 Ecological Walk-over Survey

An ecological walk-over survey of the two areas was conducted and notes were made on the Phase-1 habitat types present (JNCC 2010) and their suitability for protected species. Target notes were used to record any habitats or features of particular interest and any sightings, signs or evidence of protected or notable faunal species or any potential habitat for such species, as detailed below:

[redacted]

- Buildings and trees with features suitable for roosting bats were noted, such as holes, cracks and crevices.

- The suitability of habitats was assessed for amphibians (including great crested newt, *Triturus cristatus*) and reptiles.

- The suitability of habitats was assessed for nesting birds.

Surveying in late June is ideal as it is at the height of the plant growing season (i.e. April to September) when many plant species are flowering and are easily identifiable and faunal species are active.

3.1.3 Survey Details

EMEC Ecology carried out the above surveys on 25th June 2019. The survey was carried out by Zoe Jackson MSc ACIEEM.

3.1.4 Survey Limitations

Only a brief assessment of the survey areas was made and no systematic surveys to establish the presence / absence of protected species were undertaken. As such, a lack of evidence of a protected species does not necessarily indicate an absence of the species. It should be noted that a single visit at any time of year is likely to miss a proportion of the plant species present.

At the request of the client, no desk study was undertaken; therefore, the evaluation and recommendations are provisional. These recommendations could change if records of protected species or non-statutory sites are found to occur in close vicinity.

3.2 Ecological Evaluation Criteria

Ecological evaluation was undertaken using a combination of evaluation criteria for both habitats and species although the general framework follows that provided by the Chartered Institute of Ecology and Environmental Management (CIEEM 2016). Key categories are as follows:

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- International value (internationally designated sites or sites supporting populations of internationally important species);
- National value (nationally designated sites such as Sites of Special Scientific Interest, or sites supporting viable populations of nationally important species);
- Regional value (sites exceeding county-level designations but not meeting SSSI criteria or supporting viable populations of species on the regional Biodiversity Action Plan, BAP);
- County value (county sites (e.g. Local Wildlife Site) and other sites which meet the published ecological selection criteria for county designation, a viable area of habitat identified on the county BAP);
- District value (sites/features that are scarce within the District and appreciably enrich the District's habitat resource);
- Parish value (areas of habitat considered to appreciably enrich the habitat resource within the context of a parish or neighbourhood);
- Sub-parish value (common, low grade habitats).

Additional criteria employed were from the following:

- Schedules and Annexes of UK and European wildlife legislation, e.g. Wildlife and Countryside Act (1981) (as amended) and The Conservation of Habitats and Species Regulations 2017;
- International conventions on wildlife (e.g. Bern Convention, Bonn convention);
- Habitats and Species of Principal Biological Importance listed on Section 41 of the Natural Environment and Rural Communities Act (2006);
- UK Post-2010 Biodiversity Framework (JNCC and Defra 2012);
- County Biodiversity Action Plan (Nottinghamshire BAG 1998);
- Taxa-specific conservation lists (e.g. Bird Species of Conservation Concern, Eaton *et al*. 2015).

3.3 Mitigation Measures

Wherever possible, mitigation measures have been proposed for adverse ecological effects.

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4. RESULTS

4.1 Ecological Walk-over Survey

4.1.1 Survey Area 1 - *Habitat Types*

The following Phase-1 habitat types were recorded (on and immediately adjacent to the site):

- Building
- Hardstanding

4.1.2 Habitat Descriptions

a) *Buildings*

The survey area comprised only of hardstanding with various buildings and structures, as described below. The majority of the buildings had flat or slightly pitched roofs with no internal loft spaces. None of the buildings were entered, except B10. The locations of the buildings are shown on Figure 2a in Appendix 1.

B1: three-storey modular buildings or portacabins containing the Engineering Offices.

B2: Brick building with a flat roof. Glass and steel panelling at the front of the building.

B3: Several modular / container-type structures, two-storeys high.

B4 & B5: Modular steel panelled buildings with slightly pitched steel panelled roofs.

B6: Small (2.5 x 2m) brick building with flat, corrugated plastic roof and timber bargeboard (flush to wall).

B7, B8 & B9: Three small brick buildings (one two storeys high) containing offices, with flat roofs. Timber barge boards present but all flush to wall.

B10: A modular steel panelled building with pitched steel panelled roof. Breeze block interior walls present; no loft space.

B11: Brick building with a flat roof containing the Oil Store. Overlapping lip around roof edge flush to wall.

B12: Brick building with steel panelled roof used for storage.

B13: Modular steel panelled building with pitched steel panelled roof containing workshops.

B14: Brick building with steel panelled section around upper portion of building.

All other structures were either container-type or machinery. The northern section of this survey area was used as a scaffold storage area.

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B1


B2


B3


B4


B5


B6


B7


B8

B9


B10


B11


B12


B13


B14

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4.2.1 Survey Area 2 - *Habitat Types*

The following Phase-1 habitat types were recorded (on and immediately adjacent to the site):

- Building
- Dense scrub
- Ephemeral / short perennial
- Hardstanding
- Semi-improved neutral grassland
- Species-poor hedgerow
- Plantation broadleaved woodland
- Scattered scrub

Habitat descriptions are provided below. Nomenclature follows that of Stace (1997). In the text species are referred to using their English names, Appendix 3 provides a list of species including their scientific names.

4.2.2 *Habitat Descriptions*

a) *Building*

One large steel panelled building occurred within Survey Area 1 with a multi-pitched steel panelled roof.

One small brick building also occurred on site with a very slightly pitched, bitumastic felt covered roof. A barge board was present around wall top which sat flush to the wall.

All other buildings on site were portacabins or container type structures, containing staff welfare facilities.

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b) *Hardstanding, Bare Ground & Ephemeral / Short Perennial Vegetation*

The majority of Survey Area 2 comprised of various substrates, including tarmac and gravel and was used for storage. The area was previously in use as a construction compound. Much of the bare ground was becoming colonised by ephemeral / short perennial vegetation, including rosebay willowherb, Canadian fleabane, great willowherb, yellow-wort, common centaury, prickly lettuce, bristly ox-tongue and black medick with occasional common knapweed, ox-eye daisy and salad burnet. Occasional scattered buddleia and dog-rose also occurred throughout this area.


The electric perimeter fence ran along the northern boundary of this area which encircled the whole of the Power Station site.


c) *Bund & Plantation Woodland*

To the west of Survey Area 2, a large bund occurred comprising of the top soil which had been scraped from the rest of the area. This had been seeded and currently supported a dense, species-rich sward of semi-improved neutral grassland. Species recorded included ox-eye daisy, common knapweed, hairy tare, cowslip, common bird's-foot trefoil, salad burnet, musk mallow, ribwort plantain, yarrow, kidney vetch, meadow buttercup, creeping cinquefoil, wild carrot, lady's-bedstraw, yellow rattle, perforate St-John's-wort, white clover and sainfoin. Grasses included red fescue, false oat-grass and Yorkshire-fog.

Another small strip of semi-improved neutral grassland occurred along the northern boundary of the survey area. This was a remnant from before the topsoil was stripped and comprised very similar species to those described above.

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The western bank of the bund had become colonised by scrub species, primarily dog-rose, bramble and young sycamore saplings.

To the south of the bund, and partially within the survey area, immature to semi-mature plantation woodland was present. Tree species within the plantation included common lime, wild cherry, aspen, silver birch, sycamore and whitebeam.




d) *Species-rich Hedgerow*

A hedgerow, in total, approximately 320m long, occurred along the southern boundary fence of Survey Area 2. This comprised of hazel, dog-rose, hawthorn, wild privet, goat willow, field maple and occasional blackthorn. It had a poor structure and lacked any characteristic ground flora and it was also isolated within the site, lacking connectivity with other semi-natural habitats.

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4.1.3 Target Notes

The locations of target notes are shown on Figure 2b in Appendix 1.

1) Bund supporting species-rich neutral grassland.
[redacted]

4.1.4 Faunal Species

a) Amphibians

There was no potential breeding habitat (i.e. standing open water) within the survey area or in the close vicinity. The grassland within Survey Area 2 provided potential foraging opportunities and the scrub, hedgerows and woodland edges provides potential shelter.

[redacted]

b) Bats

None of the buildings in either of the survey areas were considered suitable for supporting a bat roost. None comprised a loft space and all had either pitched steel panelled roofs or flat roofs with corrugated plastic sheeting or bitumastic felt. Some had barge boards but these were found to sit flush to the wall tops. No sheltered crevices were found which were considered to provide potential for roosting bats.

The majority of the trees in the plantation woodland were immature to semi-mature and whilst it is possible that immature trees can provide roost potential, in such a dense stand of woodland it is considered unlikely. It is possible however, that trees within the woodland edge could offer features with roost opportunities.

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The plantation woodland did provide good potential foraging habitat and the hedgerow and woodland edges offered potential flightlines for bats.

c) *Nesting Birds*
The woodland, scrub and hedgerows in Survey Area 2 provided potential for nesting birds and the berry-producing species within the scrub habitats and the hedgerow provided a potential foraging resource for over-wintering bird species.

d) *Reptiles*
The large bund supporting a tall sward of neutral grassland with scattered scrub offered some potential habitat for grass snake (*Natrix natrix*) and possibly slow worm (*Anguis fragilis*). However, the electrified security fence (narrow mesh and concreted into the ground) surrounding the boundaries would prevent movement of reptiles in and out of the site.

e) *Other Species*
No sign of any other species, such as rabbit (*Oryctolagus cuniculus*) or fox (*Vulpes vulpes*) were found within the survey area.

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5. EVALUATION

5.1 Designated Nature Conservation Sites

The closest statutory designated site to the survey area is Lockington Marshes SSSI, which lies in the floodplains of the Rivers Soar and Trent, approximately 730m to the west. As this site is extremely unlikely to be directly or indirectly impacted by any potential development within the survey area, no further specific survey with regards to designated sites is considered necessary.

There was no desk study undertaken therefore we cannot comment on the presence of non-statutory sites such as Local Wildlife Sites. Should future works be proposed, a desk study would need to be carried out.

5.2 Habitats

The evaluation of the habitats within the survey areas is based on the guidelines from CIEEM (CIEEM 2016) and is summarised in Table 5.1 and 5.2 below. As indicated the survey areas comprise of habitats ranging from low ('Sub-parish') to moderate ('Parish') value (CIEEM 2016).

No rare or particularly notable habitats are present within the survey areas, although 'hedgerows' are considered to be Habitats of Principal Biological Importance on Section 41 of the NERC Act 2006 or UK BAP Priority Habitats (UK BAP 2007). The UK BAP defines a hedgerow as 'any boundary line of trees or shrubs over 20m long and less than 5m wide, and where any gaps between the trees or shrub species are less than 20m wide'. Nevertheless, as the hedgerow on site lacks any connectivity to other semi-natural habitat and is isolated within an area of bare ground and hardstanding, it is not considered to be a Priority Habitat.

Table 5.1: Summary of Ecological Evaluation of the Habitats on Survey Area 1

Habitat	Reason for Valuation
Sub-Parish Value	
Building	Various structures, many of which are modular prefabricated buildings or steel-panelled structures, which offer extremely limited potential for protected/notable species including roosting bats and nesting birds. All of the buildings, including the brick-built structures, lacked any loft spaces or sheltered crevices.
Hardstanding	Man-made habitat, devoid of any vegetation, that is considered to provide very limited opportunities for protected/notable faunal species.

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Table 5.2: Summary of Ecological Evaluation of the Habitats on Survey Area 2

Habitat	Reason for Valuation
Parish Value	
Semi-improved neutral grassland	The seeded sward situated on the bund supports a high number of floral species which provides good habitat for invertebrates, including pollinators.
Species-rich hedgerow	Contains a good mix of woody species but lacks good structure and characteristic ground flora, as well having no connection to other semi-natural habitats. It would not qualify as 'important' (using ecological criteria) under the Hedgerow Regulations (1997). It does however provide potential bird nesting and foraging habitat as well as a potential bat foraging route.
Plantation broadleaved woodland	The woodland itself is young and limited in extent but does provide an extension to the more established woodlands which are present in the close vicinity. It provides good potential for nesting birds and foraging (and possibly roosting) bats.
Sub-Parish Value	
Bare ground	Primarily comprising of Type-1 gravel which, although starting to become colonised by vegetation, currently offers little potential for protected or notable species. If the habitat is permitted to develop it will provide good habitat for invertebrates.
Building	One large steel-panelled structure as well as small prefabs and container-type buildings which are considered to offer extremely limited potential for protected/notable species including roosting bats and nesting birds.
Dense scrub & scattered scrub	Relatively limited in extent but does provide good potential bird nesting and foraging habitat.
Ephemeral / short perennial	Currently rather sparse within the gravel areas and offers little potential for protected or notable fauna.
Hardstanding	Man-made habitat that is considered to provide very limited opportunities for protected/notable faunal species.

5.3 Protected/notable Species[1]

5.3.1 Floral Species

None of the species recorded during the survey are specifically protected by the Wildlife and Countryside Act (WCA) 1981 (as amended) or considered rare nationally or locally (e.g. Preston *et al.* 2002). Also, none are listed as UK BAP Priority Species (UK BAP 2007) or County BAP (Nottinghamshire BAG 1998).

No non-native invasive species, such as Japanese knotweed (*Fallopia japonica*) or Himalayan balsam (*Impatiens glandulifera*), were recorded during the survey.

5.3.2 Faunal Species

a) Amphibians

The habitats present within the survey area and in the vicinity suggest that the area of works is unlikely to be of local importance for amphibians, including great crested newt. In addition, it is considered likely that the electrified security fence surrounding the

[1] Protected species legislation is provided in Appendix 2.

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perimeter of the site would impede easy access to the survey area. Therefore, no further survey work is considered necessary.

[redacted]

b) *Bats*

None of the buildings within either of the survey areas were considered to provide opportunities for roosting bats. However, it is possible that some of the trees within the woodland edge, could provide features which offer roosting potential. In addition, the woodland edges are likely to offer foraging habitat for bats. Therefore, if the plantation woodland in Survey Area 2 is likely to require removal (either full or partial) then it is recommended that further survey for bats is undertaken prior to works commencing (see Section 6.3).

All bat species are afforded full protection under UK and European legislation, including the WCA 1981 (as amended), the CRoW Act 2000 and The Conservation of Habitats and Species Regulations 2017. Together, this legislation makes it illegal to intentionally or deliberately take, kill or injure a bat; damage, destroy or obstruct access to bat roosts; and deliberately disturb bats. A bat roost is defined in the legislation as "*any structure or place which a bat uses for shelter or protection*". Roosts are protected whether or not bats are present at the time.

c) *Nesting Birds*

A variety of bird species are likely to breed within the woodland and scrub in Survey Area 2. Therefore, although no further specific survey for breeding birds is considered necessary, any tree or shrub removal required would be constrained by the bird breeding season, which runs from March to September inclusive (see Section 6.1.2).

All wild birds are protected under the WCA 1981 (as amended) and the CRoW Act 2000. This legislation makes it illegal to intentionally kill, injure or take any wild bird; take, damage or destroy the nest of any wild bird while it is being built or in use; take or destroy the eggs of any wild bird; and possess or control any wild bird or egg unless obtained legally.

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d) *Reptiles*

Although some of the habitats in the western end of Survey Area 2 were considered to offer some potential for reptiles, it is considered unlikely that they would be able to traverse the electric security fence around the site boundaries. Therefore, as their presence within the potential area of works is considered unlikely, no further survey work or mitigation is recommended.

5.4 Summary of Main Potential Ecological Issues

The main potential impacts of the proposed works in the absence of mitigation are considered to be possible disturbance to roosting and foraging bats if the plantation woodland requires removal and disturbance to nesting birds during removal of trees and scrub (including the hedgerow and the woodland).

There will also be loss of species-rich neutral grassland if the bund requires removal. The remainder of the site, comprising primarily of ephemeral / short perennial vegetation which is beginning to colonise the hardstanding, is currently of little value to any protected or notable fauna. If it is permitted to continue to develop however, it may become more valuable, particularly to invertebrates.

It is considered unlikely that any terrestrial fauna, including [redacted] small species such as reptiles, would be able to breach the electric security fence and the absence of any signs of common species, such as rabbit, further indicates that smaller fauna cannot access the site.

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6. MITIGATION, COMPENSATION, ENHANCEMENT & FURTHER SURVEY RECOMMENDATIONS

6.1 Mitigation Recommendations

6.1.1 Habitats

- If possible, it is recommended that the bund supporting species-rich neutral grassland and the plantation woodland are retained.

- Ideally, the hedgerow should also be retained.

- Any temporary storage of plant or machinery should be on hardstanding to avoid unnecessary disturbance to semi-natural habitats.

6.1.2 Faunal Species

a) Common Amphibians

Although considered unlikely due to the electric security fence, if any common amphibians are found during works, they should be removed carefully by hand to areas of semi-natural habitat such as scrub or grassland which will not to be impacted.

b) Bats

Specific mitigation for bats may be recommended following the results of the recommended bat surveys (see Section 6.3).

Lighting, if required as part of any development, should be 'bat friendly' and lamps should be positioned so that they are facing away from semi-natural habitats The lighting scheme should utilise either low or high pressure sodium lamps and minimise light scatter using light spill accessories (Bat Conservation Trust 2018).

c) Nesting Birds

Any vegetation clearance including tree, shrub or hedgerow removal, should be timed to avoid the bird breeding season, which runs from March to September (inclusive). This is to avoid adverse impacts to any nests present. If it is necessary to carry out the vegetation clearance works during the breeding season, then a survey must be carried out by a qualified ecologist prior to works going ahead to ensure that no active nests will be affected. If active nests were found then the vegetation clearance works would have to be delayed until all chicks had fledged.

6.2 Compensation and Enhancement Recommendations

6.2.1 Habitats & Faunal Species

As the details of the possible development are not yet known, it is not possible to provide recommendations for compensation and enhancement measures. These can be provided at a later date, when details of the proposals become available and when any necessary further surveys have been completed.

Recommendations are likely to include enhancements to the existing hedgerow, appropriate management of the grassland and woodland (if they are to be retained) in order to maximise their value. The installation of bird and bat boxes are also likely to be recommended.

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6.3 Further Survey Recommendations

6.3.1 Faunal Species

[redacted]

a) Bats

If it becomes necessary to remove any of the plantation woodland, further surveys will be required in order to determine the presence / absence of roosting bats. This is likely to comprise a daytime inspection and bat activity surveys.

It is likely that any bat surveys will need to be completed before a planning application can be submitted (if the woodland is likely to be impacted).

b) Desk Study

A desk study would involve consultation with various ecological records centres and any other relevant holders of biological information. This will provide existing information on i) any non-statutory designated nature conservation sites in the vicinity and ii) any existing records of protected/notable species from the site and vicinity.

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APPENDIX 1: FIGURES

Figure 1: Site Location Plan

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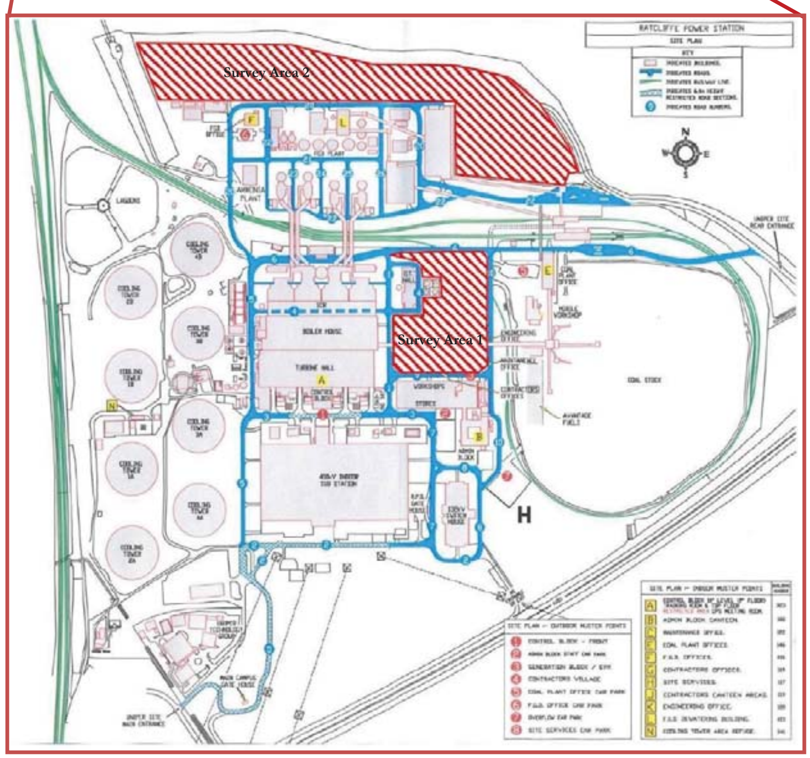

Prepared by EMEC Ecology
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Figure 2a: Survey Area 1

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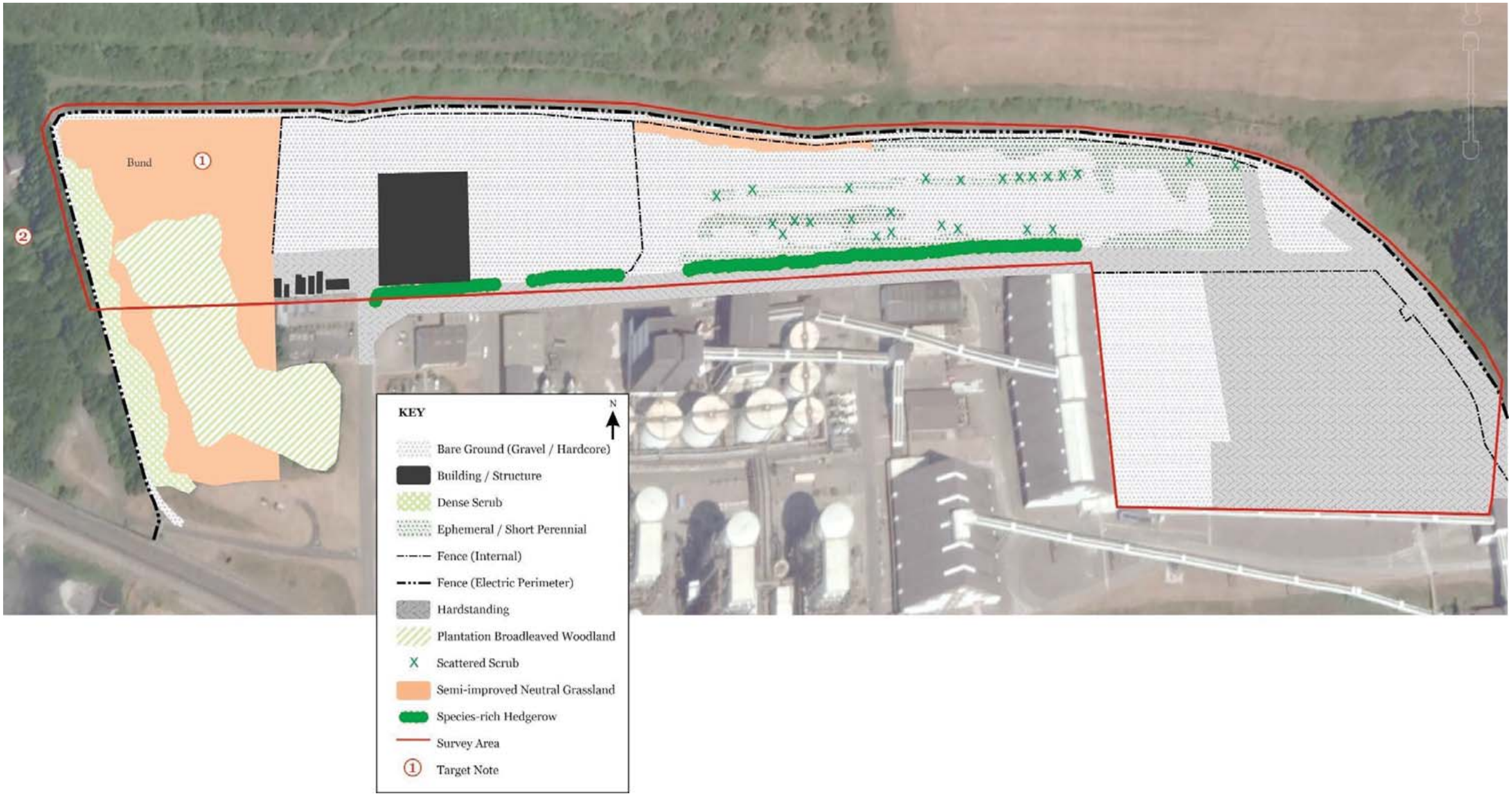
Figure 2b: Survey Area 2, Survey Features and Target Notes



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APPENDIX 2: PROTECTED SPECIES LEGISLATION / CONSERVATION STATUS

Plants
All wild plants are protected against unauthorised removal or uprooting under Section 13 of the Wildlife and Countryside Act (WCA) 1981 (as amended). Plants listed on Schedule 8 of the Act (e.g. triangular club rush and Deptford Pink) are afforded additional protection against picking, uprooting, destruction and sale.

Amphibians (Common Species)
Common amphibian species (i.e. common frog, common toad, smooth newt and palmate newt) are afforded partial legal protection under UK legislation, i.e. Schedule 5, Section 9 (5) of the WCA 1981 (as amended) and the Countryside and Rights of Way (CRoW) Act 2000. This legislation prohibits:

- Sale;
- Transportation; and
- Advertising for sale.

[redacted]

Bats
All bat species are afforded full protection under UK and European legislation, including the WCA 1981 (as amended), the CRoW Act 2000 and The Conservation of Habitats and Species Regulations 2017. Together, this legislation makes it illegal to:

- Intentionally or deliberately take, kill or injure a bat;
- Damage, destroy or obstruct access to bat roosts; and
- Deliberately disturb bats.

A bat roost is defined in the legislation as *"any structure or place which a bat uses for shelter or protection". Roosts are protected whether or not bats are present at the time.* If a development activity is likely to result in disturbance or killing of a bat, damage to its habitat or any of the other activities listed above, then a licence will usually be required from Natural England.

Birds
The bird breeding season generally lasts from early March to September for most species. All wild birds are protected under the WCA 1981 (as amended) and the CRoW Act 2000. This legislation makes it illegal to intentionally:

- Kill, injure or take any wild bird;
- Take, damage or destroy the nest of any wild bird while it is being built or in use;

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- Take or destroy the eggs of any wild bird; and
- Possess or control any wild bird or egg unless obtained legally.

Birds listed under Schedule 1 of the WCA 1981 (as amended) are afforded additional protection, which makes it an offence to disturb a bird while it is nest building, or at a nest containing eggs or young, or disturb the dependent young of such a bird.

The UK's birds can be split in to three categories of conservation importance - red, amber and green (Eaton *et al.* 2014).

Red is the highest conservation priority, with species needing urgent action. Amber is the next most critical group, followed by green.

Red list criteria

- Globally threatened
- Historical population decline in UK during 1800–1995
- Severe (at least 50%) decline in UK breeding population over last 25 years, or longer-term period (the entire period used for assessments since the first BoCC review, starting in 1969).
- Severe (at least 50%) contraction of UK breeding range over last 25 years, or the longer-term period

Amber list criteria

- Species with unfavourable conservation status in Europe (SPEC = Species of European Conservation Concern)
- Historical population decline during 1800–1995, but recovering; population size has more than doubled over last 25 years
- Moderate (25-49%) decline in UK breeding population over last 25 years, or the longer-term period
- Moderate (25-49%) contraction of UK breeding range over last 25 years, or the longer-term period
- Moderate (25-49%) decline in UK non-breeding population over last 25 years, or the longer-term period
- Rare breeder; 1–300 breeding pairs in UK
- Rare non-breeders; less than 900 individuals
- Localised; at least 50% of UK breeding or non-breeding population in 10 or fewer sites, but not applied to rare breeders or non-breeders
- Internationally important; at least 20% of European breeding or non-breeding population in UK (NW European and East Atlantic Flyway populations used for non-breeding wildfowl and waders respectively)

Green list

- Species that occur regularly in the UK but do not qualify under any or the above criteria.

Great Crested Newt

Great crested newts and their habitat are afforded full protection under UK and European legislation, including the WCA 1981 (as amended), the CRoW Act 2000 and The Conservation of Habitats and Species Regulations 2017. This makes it is an offence to kill, injure or disturb great crested newts and to destroy any place used for rest or shelter by a newt. The great crested newt is also listed on Annexes II and IV of the EC Habitats Directive and Appendix II of the Bern Convention. If a development activity is likely to result in disturbance or killing of a great

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crested newt, damage to its habitat etc, then a licence will usually be required from Natural England.

Reptiles

There are six native species of reptiles in the UK, including slow-worm, common lizard, grass snake and adder, smooth snake and sand lizard, which are afforded varying degrees of protection under UK and European legislation.

Slow-worm, viviparous/common lizard, adder and grass snake are protected under Schedule 5, Section 9 (1 and 5) of the WCA 1981 (as amended) and the CRoW Act 2000 against deliberate killing and injuring and sale.

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Appendix 3: Botanical Species List

English Name	*Scientific Name*
Ash	*Fraxinus excelsior*
Aspen	*Populus tremuloides*
Black medick	*Medicago lupulina*
Blackthorn	*Prunus spinosa*
Bramble	*Rubus fruticosus* agg.
Bristly ox-tongue	*Picris echioides*
Broadleaved willowherb	*Epilobium montanum*
Buddleia	*Buddleja davidii*
Bush vetch	*Vicia sepium*
Canadian fleabane	*Conyza canadensis*
Cherry species	*Prunus spp.*
Cleavers	*Galium aparine*
Cock's-foot	*Dactylis glomerata*
Common bird's-foot trefoil	*Lotus corniculatus*
Common cat's ear	*Hypochaeris radicata*
Common centaury	*Centaurium erythraea*
Common knapweed	*Centaurea nigra*
Common lime	*Tilia × europaea*
Common mouse-ear	*Cerastium fontanum*
Common nettle	*Urtica diotica*
Common poppy	*Papaver rhoeas*
Common ragwort	*Senecio jacobaea*
Cowslip	*Primula veris*
Creeping cinquefoil	*Potentilla reptans*
Creeping thistle	*Cirsium arvense*
Curled dock	*Rumex crispus*
Cut-leaved crane's-bill	*Geranium dissectum*
Dandelion	*Taraxcum officinale* agg.
Dog-rose	*Rosa canina*
False oat-grass	*Arrhenatherum elatius*
Field forget-me-not	*Myosotis arvensis*
Field maple	*Acer campestre*
Goat willow	*Salix caprea*
Hairy tare	*Vicia hirsuta*
Hawthorn	*Crataegus monogyna*
Hazel	*Corylus avellana*
Hedge bedstraw	*Galium mollugo*
Kidney vetch	*Anthyllis vulneraria*
Lady's bedstraw	*Galium verum*
Meadow buttercup	*Ranunculus acris*
Musk mallow	*Malva moschata*
Oxeye daisy	*Leucanthemum vulgare*
Oxford ragwort	*Senecio squalidus*
Perforate St. John's-wort	*Hypericum perforatum*
Prickly lettuce	*Lactuca serriola*
Ragged robin	*Lychnis flos-cucli*
Red clover	*Trifolium pratense*
Red fescue	*Festuca rubra*
Ribwort plantain	*Plantago lanceolata*
Rosebay willowherb	*Chamerion angustifolium*

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Rough hawkbit	*Leontodon hispidus*
Salad burnet	*Sanguisorba minor*
Sanfoin	*Onobrychis viciifolia*
Selfheal	*Prunella vulgaris*
Silver birch	*Betula pendula*
Smooth sow-thistle	*Sonchus oleraceus*
Spear thistle	*Cirsium vulgare*
Traveller's joy	*Clematis vitalba*
Weld	*Reseda luteola*
White beam	*Sorbus aria*
White clover	*Trifolium repens*
Wild carrot	*Daucus carota*
Wild cherry	*Prunus avium*
Wild privet	*Ligustrum vulgare*
Wild teasel	*Dipsacus fullonum*
Wood avens	*Geum urbanum*
Yarrow	*Achillea millefolium*
Yellow rattle	*Rhinanthus minor*
Yellow-wort	*Blackstonia perfoliata*
Yorkshire-fog	*Holcus lanatus*

NCC received 16.07.2020

QUALITY ASSURANCE:

TITLE: Ratcliffe Power Station, Ratcliffe on Soar, Nottinghamshire: Preliminary Ecological Appraisal

SUBMITTED TO: Uniper Technologies Limited

ISSUE AND REVISION RECORD:

Contract Number: ZJ/19/10604/01

Revision Number: 1

Description: Final Report

Date: 8th July 2019

Disclosure: the information, data, evidence, advice and opinions which have been prepared and provided are true, and have been prepared and provided in accordance with the Chartered Institute of Ecology and Environmental Management's Code of Professional Conduct. I confirm that the opinions expressed are my true and professional bona fide opinions.

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APPENDIX 6-3: ECOLOGICAL INTERPRETATION OF AIR QUALITY ASSESSMENT

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East Midlands Energy Re-Generation (EMERGE) Centre

Ecological interpretation of AQA

Technical Appendix 6-3

Prepared for Axis PED on behalf of Uniper UK Limited

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Version 1.0 / Ref. 20-002
16/06/2020

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Ecological interpretation of AQA

Report Reference	Ref. 20-002
Date	16/06/2020
Date of survey/s	n/a

Issue	**Prepared by**	**Checked by**	**Approved by**	**Status**	**Date**
FINAL	Kevin Barry Honour MSc MCIEEM	Claire Gilchrist MSc	Paul Lupton MSc	FINAL	16/06/2020
	[redacted]				

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Contents

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1 Introduction

1.1 This document provides an assessment of the likely effects of changes in air quality at sensitive ecological receptors, as a consequence of the operation of the proposed EMERGE Centre, (the 'Proposed Development'), to be located to the north of Ratcliffe-on-Soar Power Station, Nottinghamshire.

1.2 The assessment is designed both to provide an ecological interpretation of the Air Quality chapter (8.0) in the Environmental Statement (ES), and to inform the ecological impact assessment set out in the Ecology and Nature Conservation chapter (6.0) of the ES. Although primarily written within the context of guidance for the assessment of planning applications, it is also designed to inform an Environmental Permit application for the Proposed Development.

1.3 This analysis is based on dispersion and deposition modelling undertaken by Uniper, and reported in the Air Quality Assessment (AQA) (Appendix 8-1 to the ES). It focusses on potential ecological effects at sensitive receptors where exceedances of the identified screening thresholds are predicted. Further ecological assessment has been undertaken to:

- Confirm sensitivity of qualifying and notified features;
- Assess potential effects by comparing dispersion and deposition model plots with the spatial distribution of sensitive habitats; and
- Provide an informed ecological opinion on the likelihood of significant effects or significant harm.

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2 Scope and Methodology

2.1 Scope of Assessment

Geographic Scope of Assessment

2.1.1 In accordance with Environment Agency guidance[1] for combustion processes, the effects on sensitive ecological receptors were considered within the following radii from the proposed emission source:

- 10 km for Ramsar Sites and European designated conservation sites, comprising existing and proposed Special Areas of Conservation (SACs) and Special Protection Areas (SPAs);
- 2 km for nationally designated Sites of Special Scientific Interest (SSSIs); and
- 2 km for ancient woodlands, Local Nature Reserves (LNR), and Local Wildlife Sites (LWS) and other locally designated sites ('local nature sites').

Screening Thresholds

2.1.2 Screening thresholds in this guidance are set out in the AQA, and can be summarised as follows:

- For Ramsar, Natura 2000 sites and SSSIs, predicted process contributions (PCs) below 1 % of the relevant long-term (annual) Critical Level and Critical Load or 10 % of the relevant short-term (24-hour) Critical Level are screened out;
- For Ramsar, European sites and SSSIs, PCs above 1 %, where the predicted environmental concentration (PEC; PC plus background) is <70 % of the Critical Level and Critical Load are screened out; and
- For local nature sites, PCs below 100 % of the relevant Critical Level and Critical Load are screened out.

2.1.3 For Natura 2000 sites the 1 % PC has been regarded as a *de minimis* threshold, below which effects can be considered inconsequential. The English and Welsh agencies which make up the Air Quality Technical Advisory Group (AQTAG) clarified that projects below the 1 % PC do not have to be considered in an in-combination

[1] Gov.uk: *Air emissions risk assessment for your environmental permit*. 2 August 2016. https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit#screening-for-protected-conservation-areas (accessed 29/05/20)

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assessment[2], although this has been subject to further revision (particularly with respect to cumulative vehicle emissions) through UK and European case law.

2.1.4 The Institute of Air Quality Management (IAQM) published guidance on the assessment of air quality impacts on designated sites in June 2019[3]. This confirmed the use of the 1 % long-term / 10 % short-term thresholds for industrial point source emissions, with some important clarifications:

- '*The 1 % screening criterion is not a threshold of harm and exceeding this threshold does not, of itself, imply damage to a habitat*' (IAQM 2019, para. 5.5.1.8);
- The 70 % PEC threshold '*was intended to be a trigger for detailed dispersion modelling. It is not intended to be a damage threshold*.' (5.5.3.2); and
- The 100 % threshold for locally designated sites and ancient woodlands used in permit applications purposes may be inappropriate in a planning context, failing to provide adequate protection (5.5.2.2).

2.1.5 IAQM guidance suggests that for planning purposes the 1 % screening threshold is used for locally designated sites, but results should be interpreted in the context of the lower level of policy protection afforded to local sites: '*it is …normal practice to treat such sites in the same manner as SSSIs and European sites, although the determination of the significance of the effect may be different*.' (5.5.2.2).

Pollutants Considered in Assessment

2.1.6 The AQA models a range of pollutants with respect to their impact on sensitive ecological receptors. These include predictions of ambient levels of ammonia (NH_3), short and long-term oxides of nitrogen (NO_x), daily and weekly hydrogen fluoride (HF), and sulphur dioxide (SO_2) levels, together with nitrogen and acid deposition rates.

2.1.7 In terms of the ecological assessment, HF and SO_2 can be safely excluded from consideration as the predicted environmental concentration (PEC) always remains well below the relevant Critical Level.

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[2] *Environment Agency (2015). AQTAG position. In-combination guidance and assessment. Response to PINS, March 2015.*

[3] *Holman et al (2019). A guide to the assessment of air quality impacts on designated nature conservation sites – version 1.0, Institute of Air Quality Management, London. www.iaqm.co.uk/text/guidance/airquality-impacts-on-nature-sites-2019.pdf*

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2.1.8 Short-term (24 hour mean) oxides of nitrogen levels are considered less accurate predictors of ecological effect than long-term (annual mean) levels. Although short-term levels can have measurable physiological effects at the level of individual plants (e.g. stimulation of leaf nitrate reductase activity), there is little evidence of any phytotoxic effects in the absence of elevated SO_2 or ozone levels. Annual mean levels are a better predictor of the potential for effects to occur at the plant community level, for example by changes in competitive advantage in species due to differential response to elevated nitrogen levels. In turn, nitrogen deposition rates provide better prediction of ecological effect, as they incorporate longer range wet and occult deposition of nitrogen compounds in rain and cloud water.

2.2 Methodology

Data Search

2.2.1 The assessment was informed by a desktop study including:

- a web-based data search for statutory designated sites and ancient woodlands within a 2 km radius of the Proposed Development, using the Multi-agency Geographic Information for the Countryside (MAGIC) database, together with collation of information on notified features of SSSIs;
- a web-based data search for European (Natura 2000) and internationally designated sites within 10 km of the Proposed Development, together with collation of information on qualifying features and Conservation Objectives;
- data requests from local biological records centres, comprising Nottinghamshire Biological and Geological Records Centre (NBGRC), Derbyshire Wildlife Trust (DWT) and Leicestershire Environmental Records Network (LERN) for Local Wildlife Site information within an area encompassing a 2 km buffer around the Proposed Development boundary (see Appendix 6-1).

Identification of Appropriate Habitats and Environmental Quality Standards

2.2.2 The Air Pollution Information System (APIS) website's Site Relevant Critical Loads function was used to provide an initial assessment of the sensitivity of statutory designated sites to pollutant impacts. This provides habitat-specific critical loads for nitrogen and acid deposition, as well as setting out recommended Critical Levels for long-term (annual mean) ammonia (NH_3) and sulphur dioxide (SO_2), which vary according to whether bryophytes and lichens are an important component of the ecosystem.[4]

2.2.3 With respect to locally designated sites, it is necessary to determine the appropriate EQS from habitat information supplied by the biological records centres. The appropriate EUNIS[5] habitat was identified, and cross-referenced with the corresponding Critical Loads for nitrogen deposition on APIS. For acid deposition, the appropriate Broad Habitat is selected for the relevant 1 km grid square of the site, using the 'Search by Location' tool.[6]

Assessment of Effect Magnitude and Significance

2.2.4 There are no currently accepted thresholds for assessing the magnitude of air quality effects on ecological receptors. At the time of preparation of this report, draft CIEEM / IAQM guidance has been published, but has not yet been finalised and cannot yet be referred to; neither this draft document or the IAQM (2019) guidance provides any guidance on effect magnitude or ecological significance thresholds. In the absence of current guidance for ecological receptors, Environmental Protection UK (EPUK, 2010)[7] advice can be applied with caution; although this was primarily developed for assessment of nitrogen dioxide and particulate emissions on human health in a development control context, it provides a useful descriptor to express impact magnitude as a percentage of the relevant assessment level (see Table 2.1 below). This has now been superseded by revised advice, which is now explicitly reserved for application in a human health assessment context.

Table 2.1: EPUK (2010) Guidance on Impact Magnitude

Magnitude of change	Annual mean value increase / decrease (as percentage of assessment level)
Large	>10 %
Medium	5–10 %
Small	1–5 %
Imperceptible	<1 %

[4] http://www.apis.ac.uk/srcl
[5] *Strachan, I.M. (2015). Manual of terrestrial EUNIS habitats in Scotland. Scottish Natural Heritage Commissioned Report No. 766*
[6] http://www.apis.ac.uk/search-location
[7] *Environmental Protection UK (2010) Development Control: Planning for Air Quality (2010 Update) EPUK, April 2010.*

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2.2.5 With respect to assessing **significance** of ecological effects, it is important to note that the 1 % screening threshold is not an effect threshold. The magnitude of impact which might result in a significant ecological effect is likely to depend on baseline conditions and sensitivity of the receiving environment.

2.2.6 CIEEM (2016[8]) define a significant ecological effect as: *"an impact on the integrity of a defined site or ecosystem and/or the conservation status of habitats or species within a given geographical area."* The guidelines do not favour a matrix approach to the assessment of significance, because these can downplay impacts on features of local importance, and the ecological meaning of the resulting terms is often poorly defined. Instead, significance is defined at the geographic scale at which it occurs.

2.2.7 With respect to assessing whether it is possible to conclude no adverse effect on site integrity (European site) and to conclude no damage (SSSIs) in a permitting context in England and Wales, Environment Agency (EA) guidance[9] distinguished between circumstances when:

- the background concentration is less than the appropriate environmental criterion but a small process contribution leads to an exceedance; or
- the background concentration is currently exceeding the appropriate environmental criterion and the new process contribution will cause an additional **small** increase; and
- the background concentration is less than the appropriate environmental criterion, but the process contribution is significant (*i.e. of higher magnitude*) and leads to an exceedance; or
- the background concentration is more than the appropriate environmental criterion, and the process contribution is **large.**

2.2.8 In the first two circumstances, the EA recommends that a decision is based on local circumstances, based on factors set out in guidance (such as spatial disposition of sensitive habitats relative to predicted effects); in the latter two circumstances, the EA state that it is not possible to conclude no adverse effect. The EA goes on distinguishing between the varying level of legal and policy protection applied to European sites relative to SSSIs. For European sites (SACs, SPAs and Ramsar sites) the

[8] *CIEEM (2016). Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal, 2nd edition. Chartered Institute of Ecology and Environmental Management, Winchester*

[9] *Environment Agency (2012). Detailed assessment of the impact of aerial emissions from new or expanding IPPC regulated industry for impacts on nature conservation. Operational Instruction 67_12, Issued 08/05/12*

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key policy test is ‘no likely significant effect’, which is best understood as ‘no possible significant effect according to best available scientific knowledge’. For SSSIs, the EA refers to ‘operations likely to damage’ a SSSI.

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3 Sensitivity of Ecological Receptors

3.1 Introduction

3.1.1 This section describes sensitive ecological receptors surrounding the Application Site. When reading this section reference should be made to Figure 3.1 as it provides the location of the receptors.

3.2 Statutory Designated Sites

European (Natura 2000) Sites

3.2.1 There are no European conservation sites (existing or SAC or SPA) within the 10 km screening radius of the emission source.

UK Statutory Designated Sites

3.2.2 There is one SSSI and one LNR within the 2 km screening radius. Table 3.1 summarises their ecological interest features, and sensitivity to ammonia levels, nitrogen and acid deposition.

Table 3.1: Sensitivity of Statutory Designated Sites

Site	Habitat (EUNIS code)	CL NH_3 ($\mu g/m^3$)	CL N dep. (kg N/ha/yr)	CL acid dep. (CLmaxN) (keq H^+/ha/yr)
Lockington Marshes SSSI	S5 *Glyceria maxima* swamp (C3.2)	3	Not sensitive	Not sensitive
Lockington Marshes SSSI	S7 - *Carex acutiformis* swamp (C3.2)	3	Not sensitive	Not sensitive
Lockington Marshes SSSI	W6 - *Alnus glutinosa - Urtica dioica* woodland (G1.21)	3	Not sensitive	Not sensitive
Lockington Marshes SSSI	Invertebrate assemblage (n/a)	n/a	n/a	No critical load assigned
Forbes Hole LNR	Rich fens (D4.1)	3	15–30	Not sensitive
Forbes Hole LNR	Broadleaved woodland (G1)	3	10–20	1.762

3.2.3 APIS Site Relevant Critical Loads for Lockington Marshes SSSI[10] sets the critical load for nitrogen deposition at 10–20 kg N/ha/yr for W6 woodland, based on the 'broadleaved deciduous woodland' Broad Habitat critical load class. However, there is an anomaly in the interpretation of plant communities by APIS, which results in a different Critical Load for W6 alder woodland depending on whether it is a notified

[10] http://www.apis.ac.uk/srcl/select-a-feature?site=1000882&SiteType=SSSI&submit=Next

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feature of a SSSI or a qualifying feature of a SAC. The relevant European Annex I habitat applied which includes the W6 community is '*Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae) (H91E0)*'. APIS advise that this community is not sensitive to nitrogen deposition; this is partly because it occupies naturally nutrient-rich habitats, but also because alder trees support nitrogen-fixing bacteria, resulting in high levels of nitrogen in the soil. This community is similarly not regarded as sensitive to acid deposition.

3.2.4 The Site Relevant Critical Load advice with respect to the two notified swamp communities is that they are not sensitive to either nitrogen or acid deposition. They are both plant communities associated with eutrophic wetlands, with nutrient inputs likely to be predominantly derived from fluvial and / or groundwater inputs.

3.2.5 With respect to ammonia levels, APIS state that 'site specific advice' should be sought with respect to sensitivity. The site citation does not identify bryophytes and lichens as being important elements of the plant community, and there is no indication that species of high sensitivity will be present. The 3 $\mu g/m^3$ Critical Level for ammonia is therefore appropriate for this site, as well as the broadly similar habitats present at Forbes Hole LNR.

3.3 Non-statutory Sites

Ancient Woodlands

3.3.1 There are no ancient woodlands within a 2 km radius of the emission source, based on shapefile data from Ancient Woodlands Inventory v.3.7.

Local Wildlife Sites

3.3.2 Those relevant LWSs within 2 km of the Site boundary are set out in Table 3.2, with relevant habitats and sensitivities. Note that Leicestershire designates a number of individual trees and hedgerows as LWSs; this approach is not followed in Derbyshire or Nottinghamshire. It is not appropriate to apply Critical Levels or Critical Loads at the level of individual trees; they have been derived from ecosystem or habitat-level studies, and do not denote concentrations or deposition rates at which directly toxic effects would occur at the level of individual plants. These features have therefore been excluded from further analysis and are not included in the table.

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Table 3.2: Sensitivity of Locally Designated Sites

LWS Site	Habitat (EUNIS code)	CL NH_3 ($\mu g/m^3$)	CL N dep. (kg N/ha/yr)	CL acid dep. (CLmaxN) (keq H^+/ha/yr)
Attenborough West Gravel Pits	Rich fens (D4.1)	3	15–30	Not sensitive
Erewash Canal	Surface standing waters	n/a	Depends on N or P limitation	Not sensitive
Gotham Hill Wood	Meso and eutrophic Quercus woodland (G1.A)	3	15–20	10.976
Lockington Confluence Backwater	Seasonally wet and wet grasslands (E3.5)	3	15–25	4.928
Lockington Fen	Rich fens (D4.1)	3	15–30	Not sensitive
Lockington, swamp by SSSI	Water-fringing reedbeds (C3.2)	3	Not sensitive	Not sensitive
Meadow Lane Carr	Rich fens (D4.1)	3	15–30	Not sensitive
Meadow Lane Carr	Broadleaved woodland (G1)	3	10–20	1.762
Narrow Bridge Fish Pond	Rich fens (D4.1)	3	15–30	Not sensitive
Poplars Fish Pond	Rich fens (D4.1)	3	15–30	Not sensitive
Rare Plant Register Mousetail Pasture	Arable land (with rare plant) (I1.5)	3	Not sensitive	Not sensitive
Ratcliffe Lane Pasture and Stream	Low and medium altitude hay meadows (E2.2)	3	20–30	4.856
Red Hill, Ratcliffe on Soar	Sub-Atlantic semi-dry calcareous grassland (E1.26)	3	15–25	4.928
Redhill Marina Backwater	Rich fens (D4.1)	3	15–30	Not sensitive
River Soar West Bank south of A453	Surface running waters (C2)	3	Depends on N or P limitation	Not sensitive
River Soar, Loughborough Meadows to Trent	Surface running waters (C2)	3	Depends on N or P limitation	Not sensitive
River Soar, Loughborough Meadows to Trent	Rich fens (D4.1)	3	15–30	Not sensitive
River Trent North Bank	Low and medium altitude hay meadows (E2.2)	3	20–30	4.856
Sheetstores Junction Pond	Rich fens (D4.1)	3	15–30	Not sensitive
Soar Meadow near Ratcliffe Lock	Low and medium altitude hay meadows (E2.2)	3	20–30	5.071

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LWS Site	Habitat (EUNIS code)	CL NH_3 ($\mu g/m^3$)	CL N dep. (kg N/ha/yr)	CL acid dep. (CLmaxN) (keq H^+/ha/yr)
South Junction Pond	Water-fringing reedbeds (C3.2)	3	Not sensitive	Not sensitive
Thrumpton Park	Low and medium altitude hay meadows (E2.2)	3	20–30	4.928
Thrumpton Park	Meso and eutrophic Quercus woodland (G1.A)	3	15–20	10.977
Trent Floodplain Wetland – Lock m07	Surface standing waters (C1)	3	Depends on N or P limitation	Not sensitive
Trent Lock Marsh	Water-fringing reedbeds (C3.2)	3	Not sensitive	Not sensitive
Trent Lock Marsh	Broadleaved woodland (G1)	3	10–20	1.763

3.3.3 There are no habitats present which would justify application of the lower critical level for ammonia; this is supported by site descriptions in citations received by the respective biological records centres. Lowland broadleaved woodlands will contain bryophytes and lichens, as will rich fen communities, but given the relatively urban and industrial setting of the search area are unlikely to be important elements of the plant community. Their lower plant flora is likely to reflect both the elevated ammonia levels of recent decades, and the legacy effects of past acidifying pollutants. This can be contrasted, for example, with sites in rural Nottinghamshire supporting habitats where bryophytes and lichens do form important parts of the plant community; one example would be Birklands and Bilhaugh SAC, which is an old acidophilous oak woodland – a community where bryophytes and particularly epiphytic lichens can be important elements of the overall biodiversity interest of the Site.

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3.4 Background Levels

Statutory Designated Sites

3.4.1 The following background annual average pollutant levels and deposition rates are given for Lockington Marshes SSSI, based on the Site Relevant Critical Loads in APIS. For Forbes Hole LNR, rates are taken from the Query by Location function on APIS.

Background levels in bold exceed the relevant Critical Level or Critical Load.

Table 3.3: Background levels at statutory designated sites[11]

Site	Deposition velocity	NH_3 (µg/m³)	NOx (µg/m³)	SO_2 (µg/m³)	N dep. (kg N/ha/yr)	Acid dep. (keq N+S/ha/yr)
Lockington Marshes SSSI	Grassland	2.13	23.43	1.46	19.4	1.6
Lockington Marshes SSSI	Woodland	2.13	23.43	1.46	33.4	2.6
Forbes Hole LNR	Grassland	2.09	28.97	1.87	**19.18**	1.26
Forbes Hole LNR	Woodland	2.09	28.97	1.87	**32.76**	**2.11**

Locally Designated Sites

3.4.2 Values given in Table 3.4 are all taken from the APIS Query by Location function. Background levels in bold exceed the relevant Critical Level or Critical Load for the most sensitive habitat(s) found on the site, as set out in Table 3.3 above.

Table 3.4: Background levels at locally designated sites[11]

Site	Deposition velocity	NH_3 (µg/m³)	NOx (µg/m³)	SO_2 (µg/m³)	N dep. (kg N/ha/yr)	Acid dep. (keq N+S/ha/yr)
Attenborough West Gravel Pits	Grassland	2.21	23.66	1.56	**19.32**	1.27
Erewash Canal	Surface waters	2.09	26.74	1.87	19.18	1.26
Gotham Hill Wood	Woodland	2.21	21.74	1.56	**33.46**	2.15
Lockington Confluence Backwater	Grassland	2.09	23.92	1.87	**19.18**	1.96
Lockington Fen	Grassland	2.18	23.41	1.56	**19.74**	1.30

[11] It should be noted that the concentration and deposition values in Table 3.3 and Table 3.4 may differ slightly from those stated in the AQA for the Lockington Marshes SSSI as the AQA used concentration and deposition values extracted from the APIS using the Query by Location function at the location of the maximum impact from the Proposed Development.

Site	Deposition velocity	NH_3 (µg/m³)	NOx (µg/m³)	SO_2 (µg/m³)	N dep. (kg N/ha/yr)	Acid dep. (keq N+S/ha/yr)
Lockington Shooting Ground Marsh, Grassland	Grassland	2.09	23.92	1.87	**19.18**	1.26
Lockington, swamp by SSSI	Grassland	2.09	22.95	1.87	19.18	1.26
Meadow Lane Carr	Grassland	2.09	28.97	1.87	**19.18**	1.26
Meadow Lane Carr	Woodland	2.09	28.97	1.87	**32.76**	**2.11**
Narrow Bridge Fish Pond	Grassland	2.09	26.74	1.87	**19.18**	1.26
Poplars Fish Pond	Grassland	2.09	26.74	1.87	**19.18**	1.26
Rare Plant Register Mousetail Pasture	Grassland	2.09	23.92	1.87	19.18	1.26
Ratcliffe Lane Pasture and Stream	Grassland	2.09	26.74	1.87	**19.18**	1.26
Red Hill, Ratcliffe on Soar	Grassland	2.09	23.92	1.87	**19.18**	1.26
Redhill Marina Backwater	Grassland	2.09	23.92	1.87	**19.18**	1.26
River Soar West Bank south of A453	Surface waters	2.18	24.14	1.56	19.74	1.30
River Soar, Loughborough Meadows to Trent	Grassland	2.09	23.92	1.87	**19.18**	1.26
River Trent North Bank	Grassland	2.21	23.12	1.56	19.32	1.27
Sheetstores Junction Pond	Grassland	2.09	26.74	1.87	**19.18**	1.26
Soar Meadow near Ratcliffe Lock	Grassland	2.18	25.37	1.56	19.74	1.30
South Junction Pond	Grassland	2.09	26.74	1.87	19.18	1.26
Thrumpton Park	Grassland	2.21	21.21	1.56	19.32	1.27
Thrumpton Park	Woodland	2.21	21.21	1.56	**33.46**	2.15

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Site	Deposition velocity	NH_3 (µg/m^3)	NOx (µg/m^3)	SO_2 (µg/m^3)	N dep. (kg N/ha/yr)	Acid dep. (keq N+S/ha/yr)
Trent Floodplain Wetland – Lock m07	Surface waters	2.09	26.74	1.87	19.18	1.26
Trent Lock Marsh	Grassland	2.09	23.66	1.87	19.18	1.26
Trent Lock Marsh	Woodland	2.09	23.66	1.87	**32.76**	**2.11**

3.4.3 Note that APIS do not give deposition velocities to surface waters, and grassland values substituted accordingly; these are lower than grassland velocities, so their use is therefore precautionary.

3.4.4 Table 3.4 illustrates that background nitrogen deposition rates are above the lower Critical Load for most sensitive habitats, including rich fens and calcareous grassland (15 kg N/ha/yr) and close to the Critical Load for neutral grassland (low and medium altitude hay meadows: 20 kg N/ha/yr). Due to the higher deposition velocity to woodland habitats, background nitrogen deposition rates significantly exceed both lower and upper Critical Loads. This is typical of the situation in most lowland woodlands in England.

4 Predicted ecological effects

4.1 Current and Future Baseline

Current Baseline

4.1.1 The AQA has undertaken dispersion modelling using the four different scenarios:

- Scenario A: The Proposed Development operating continuously including only the buildings associated with the energy recovery facility;
- Scenario B: The Proposed Development and the open-cycle gas turbine generating facility (OCGTs) operating continuously including only the buildings associated with the energy recovery facility;
- Scenario C: The Proposed Development and the OCGTs operating continuously including the Proposed Development buildings and buildings on the Ratcliffe site above 30 m in height (above 1/3 of the lowest stack height); and
- Scenario D: The Proposed Development, the OCGTs and the coal-fired Power Station all operating continuously including the Proposed Development buildings and buildings on the Ratcliffe site above 30 m in height (above 1/3 of the lowest stack height).

4.1.2 For the purposes of ecological impact assessment, modelling results for Scenario A provide the process contribution of the Proposed Development, subject to variations in dispersion caused by proximal buildings which are addressed in the other scenarios. This is because the contributions of the OCGT and the Power Station are already taken account of in the modelling of background pollutant levels. The CBED (Concentration Based Estimated Deposition) model used by APIS estimates total nitrogen and sulphur deposition at a 5 km grid-square scale of resolution. This is derived from national scale monitoring of each component pollutant[12], modified by information from the emissions inventory to improve the spatial pattern of the deposition maps. As established emission sources, the contribution of the Power Station and OCGTs will be reflected in monitoring data, which have recently been updated to 2016–2018 average values. With respect to source attribution, the Power Station is identified as a major contributor to deposition at statutory designated sites (e.g. 12 % contribution to sulphur deposition (as keq H^+/ha/yr) at Lockington Marshes SSSI). Source attribution is based on 2012 emission rates, using the FRAME model;

[12] The UK Eutrophying and Acidifying Pollutants (UKEAP) network: see http://www.apis.ac.uk/cbed-concentration-based-estimated-deposition

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however, it should be noted that in recent years the annual load factor associated with the Power Station has been well below the 2012 level and the source attribution data cannot be regarded as representative of recent operation.

Future Baseline

4.1.3 The key change in the future baseline is the anticipated closure of the Power Station. This will result in a reduction in local point-source emissions, which as a 'best-case' scenario could in simple terms be regarded as being broadly equivalent to Scenario D minus Scenario C. However, as Scenario D is modelled on a full loading capacity of the Power Station, whereas average annual load averaged only 17 % over the past five years, the actual reduction in pollutant concentrations at sensitive receptors is likely to be substantially lower. Nevertheless, when considering the effects of the Proposed Development, the future baseline will provide some headroom, with the prospect of a net reduction in annual average concentrations and deposition rates.

4.2 Predicted Effects at Lockington Marshes SSSI

Predicted Impacts of Proposed Development

4.2.1 As discussed in Section 3.1, alder woodland and swamp habitats at Lockington Marshes SSSI are not considered sensitive to nitrogen or acid deposition.

4.2.2 The PCs to annual mean oxides of nitrogen, sulphur dioxide and ammonia levels are set out in Tables 24, 26 & 28 of the AQA. They are summarised in Table 4.1, with percentage contributions to Critical Level and PECs.

Table 4.1: Predicted Impacts at Lockington Marsh SSSI

Pollutant	Critical Level (µg/m^3)	Background (µg/m^3)	PC (µg/m^3)	% of CL	PEC (µg/m^3)	% of CL
Ammonia	3.0	2.13	0.014	0.47	2.14	71.47
Oxides of nitrogen	30	23.43	0.164	0.55	23.59	78.65
Sulphur dioxide	20	1.46	0.04	0.20	1.5	7.5

Effect Magnitude and Significance

4.2.3 In all cases the PC is below 1 % and can be regarded as *de minimis* in ecological assessment terms, and does not require more detailed ecological interpretation. In addition, the PEC remains below the relevant environmental quality standard for all parameters.

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4.3 Predicted effects at Locally Designated Sites

Environmental Permitting Considerations

4.3.1 The AQA does not predict any effects in excess of the 100 % Environment Agency screening threshold for locally designated sites (LNRs and LWSs), and there is therefore no requirement for further ecological interpretation for permitting purposes.

Effects above IAQM Screening Thresholds

Nitrogen Deposition Rates

4.3.2 The following modelled impacts are above the 1 % screening threshold, in a situation where either background levels or the PEC are close to or exceed the Critical Load. Values in Table 4.2 are taken from Table 35 of the AQA.

Table 4.2: Nitrogen Deposition Rates above Screening Thresholds (values all kg N/ha/yr)

Site	Habitat	CL	Back-ground (% of CL)	PC (% of CL)	PEC	% of CL
Gotham Hill Wood	Broadleaved woodland (G1)	10	**33.46** (334.6 %)	0.299 (**3.0 %**)	**33.76**	**337.6**
Thrumpton Park	Meso and eutrophic Quercus woodland (G1.A)	15	**33.46** (223.1 %)	0.296 (**1.97 %**)	**33.76**	**225.0**
Thrumpton Park	Low and medium altitude hay meadows (E2.2)	20	19.32 *	0.182 (0.9 %)	19.50	97.51

* % of CL is not available

4.3.3 Nitrogen deposition rates in grassland habitats at Thrumpton Park LWS have been included in Table 4.2, as the PEC is close to the lower Critical Load, and the PC is close to the 1 % screening threshold.

Acid Deposition Rates

4.3.4 In Table 4.3, the modelled impacts are above the 1 % screening threshold, when background levels or the PEC are close to or exceed the relevant Critical Load.

4.3.5 As explained in the AQA, the method for calculating the PC to acid deposition can be simplified as:

*PC as % of CL function = ((PC of S+N deposition / CLmaxN) *100)*

4.3.6 Both are woodland sites where background deposition rates already exceed the relevant Critical Load.

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Table 4.3: Acid Deposition Rates above Screening Thresholds (values in keq H^+/ha/yr)

Site	**Habitat**	**CLmaxN**	**Back-ground (% of CL)**	**PC (% of CL)**	**PEC**	**% of CL**
Forbes Hole LNR	Broadleaved woodland (G1)	1.762	**2.11 (119.75%)**	0.017 **(0.96%)**	**2.13**	**120.71**
Meadow Lane Carr LWS	Broadleaved woodland (G1)	1.762	**2.11 (119.75%)**	0.018 **(1.02%)**	**2.13**	**120.77**

Ammonia Levels

4.3.7 The maximum modelled PC to ammonia levels is 0.027 µg/m^3, which is just below the 1 % threshold for the 3 µg/m^3 Critical Level. These values are predicted at Gotham Hill Woods LNR, River Trent North Bank LNR, and Thrumpton Park LNR. None of the PECs approach the 3 µg/m^3 Critical Level.

Oxides of Nitrogen levels

4.3.8 In Table 4.4, the modelled impacts are above the 1 % screening threshold of 0.3 µg/m^3 annual mean.

Table 4.4: Oxides of Nitrogen Levels above Screening Thresholds

Site	**CL**	**Back-ground µg/m^3 (% of CL)**	**PC (µg/m^3) (% of CL)**	**PEC (µg/m^3)**	**% of CL**
Gotham Hill Woods LWS	30	21.74 (72.47%)	0.319 (**1.06%**)	22.06	73.53
River Trent North Bank LWS	30	23.12 (77.06%)	0.329 (**1.10%**)	23.45	78.16
Thrumpton Park LWS	30	21.21 (70.07%	0.308 (**1.03**%)	21.52	71.73

4.3.9 The PC in all these cases only just exceeds the 1 % screening threshold, and can be considered a small magnitude effect.

4.4 Magnitude and Ecological Significance of Predicted Effects

Lockington Marshes SSSI

4.4.1 The magnitude of impacts at Lockington Marshes SSSI is negligible, and there is no risk of any ecological effects as a consequence of the Proposed Development.

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Local Nature Reserves

4.4.2 Current baseline levels of nitrogen and acid deposition at Forbes Hole LNR are above the relevant Critical Loads. There will be a negligible (<1 %) increase in nitrogen deposition as a consequence of the Proposed Development, with a negligible to minor magnitude increase (just below 1 %) increase in acid deposition.

4.4.3 There is no risk that such low magnitude impacts would have any ecological effect on woodland habitats within the LNR. No other air quality parameters approach screening thresholds at the LNR.

Local Wildlife Sites

<u>Nitrogen Deposition Rates</u>

4.4.4 There are two small magnitude (2–3 %) exceedances of nitrogen deposition rates at woodland LWSs: Thrumpton Park and Gotham Hill Woods. Deposition rates are similar at both sites at just under 0.3 kg N/ha/yr; however, Thrumpton Park LWS can be regarded as an example of the less sensitive G1.A meso- and eutrophic *Quercus* woodland category, with a 15 kg N/ha/yr lower Critical Load. This is justified in the Site Description supplied by Nottinghamshire biological records centre, which states:

4.4.5 '*Wooded areas have a canopy containing Beech* Fagus sylvatica *and Ash* Fraxinus excelsior *with Hawthorn* Crataegus monogyna *dominating scrubby areas. Plants found in the ground flora include Wood Sedge* Carex sylvatica*, Ramsons* Allium ursinum *and Bluebell* Hyacinthoides non-scripta*.'*

4.4.6 This is clearly a description of the National Vegetation Classification W8 community, which translates to the EUNIS G1.A habitat.

4.4.7 Gotham Hill Woods was not identified as a LWS in the written information supplied by the records centre, although it is within the 2 km radius and was identified as a sensitive receptor in the AQA. Published descriptions suggest this is an elm woodland community, although without further information on ground flora it is more precautionary to default to the broadleaved woodland broad habitat (EUNIS level 2 community G1) with a lower critical load of 10 kg N/ha/yr.

4.4.8 With regard to significance of effect, these both fall into the situation defined by the EA where '*the background concentration is currently exceeding the appropriate environmental criterion and the new process contribution will cause an additional **small** increase'* (see subsection 2.2 above). In common with most lowland woodlands, there may have been long-term changes in plant community structure or other

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parameters (e.g. litter decomposition rates; mycorrhizal communities) which are harder to detect. However, the very small magnitude increase in impact is very unlikely to have a further measurable effect on the woodland community.

4.4.9 In addition, the predicted increase in local deposition rates will be short-term in nature, and subject to a net reduction following the projected closure of the coal-fired Power Station in line with UK Government policy. This is not dependent on the reduction of other emission sources, such as reductions in agricultural emissions or reductions following changes in vehicle emission factors.

Acid Deposition Rates

4.4.10 Acid deposition rates at Meadow Lane Carr LWS just exceed the 1 % screening threshold using the APIS Query by Location function for broadleaved woodland broad habitat (see Table 4.3).

4.4.11 The data search from Derbyshire Wildlife Trust described this site as a ‘secondary broad-leaved wet woodland’, without specifying the species composition. Some wet woodland communities, notably alder woodlands, are not regarded as sensitive to acid deposition; lowland wetland communities are generally well-buffered with respect to base cations, so it is possible that the values in the APIS Query by Location function are over-precautionary for this site.

4.4.12 A process contribution of this small magnitude is extremely unlikely to have a measurable ecological effect. In addition, future baseline deposition rates will show a net reduction relative to current and past values following closure of the coal-fired Power Station.

Ammonia Levels

4.4.13 No effects are predicted above screening thresholds, and in no cases does the PEC exceed the 3 $\mu g/m^3$ Critical Level.

Oxides of Nitrogen Levels

4.4.14 The PEC shown in Table 4.4 in all cases exceeds the 70 % Environment Agency screening threshold, but remains safely below the Critical Level for the protection of ecosystems. There is therefore no risk that the Proposed Development would have any ecological effect on these sites as a consequence of increased long-term oxides of nitrogen levels.

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5 Conclusions

5.1 Conclusions

Current Baseline

5.1.1 Following consideration of the results of the dispersion and deposition modelling, with regard to the sensitivity of ecological receptors, it can be safely concluded that there will be no ecologically significant effects as a consequence of emissions to air from the Proposed Development.

5.1.2 No impacts in excess of screening thresholds are predicted at Lockington Marshes SSSI, the only nationally important statutory designated site in a 2 km radius of the Proposed Development.

5.1.3 Two woodland LWSs are predicted to experience small magnitude exceedances of screening thresholds for nitrogen deposition. Forbes Hole LNR, and one LWS, is predicted to have a small magnitude process contribution to acid deposition, around or just above the 1 % screening threshold. These impacts are not likely to have a measurable ecological effect, and cannot be regarded as significant in EIA terms, or significant in terms of the policy protection accorded to locally designated sites in the NPPF.

Future Baseline

5.1.4 The closure of the coal-fired Power Station is likely to result in a net reduction in nitrogen and acid deposition rates at nature conservation sites in the vicinity of the Proposed Development. This provides further certainty that there would be no adverse ecological effects as a consequence of emissions from the Proposed Development.

5.2 Recommendations

5.2.1 This assessment has not identified a requirement for further ecological mitigation measures to be applied, either at emission source or receptor, in addition to those already incorporated in the design of the Proposed Development and taken account of in the dispersion and deposition modelling set out in the AQA.

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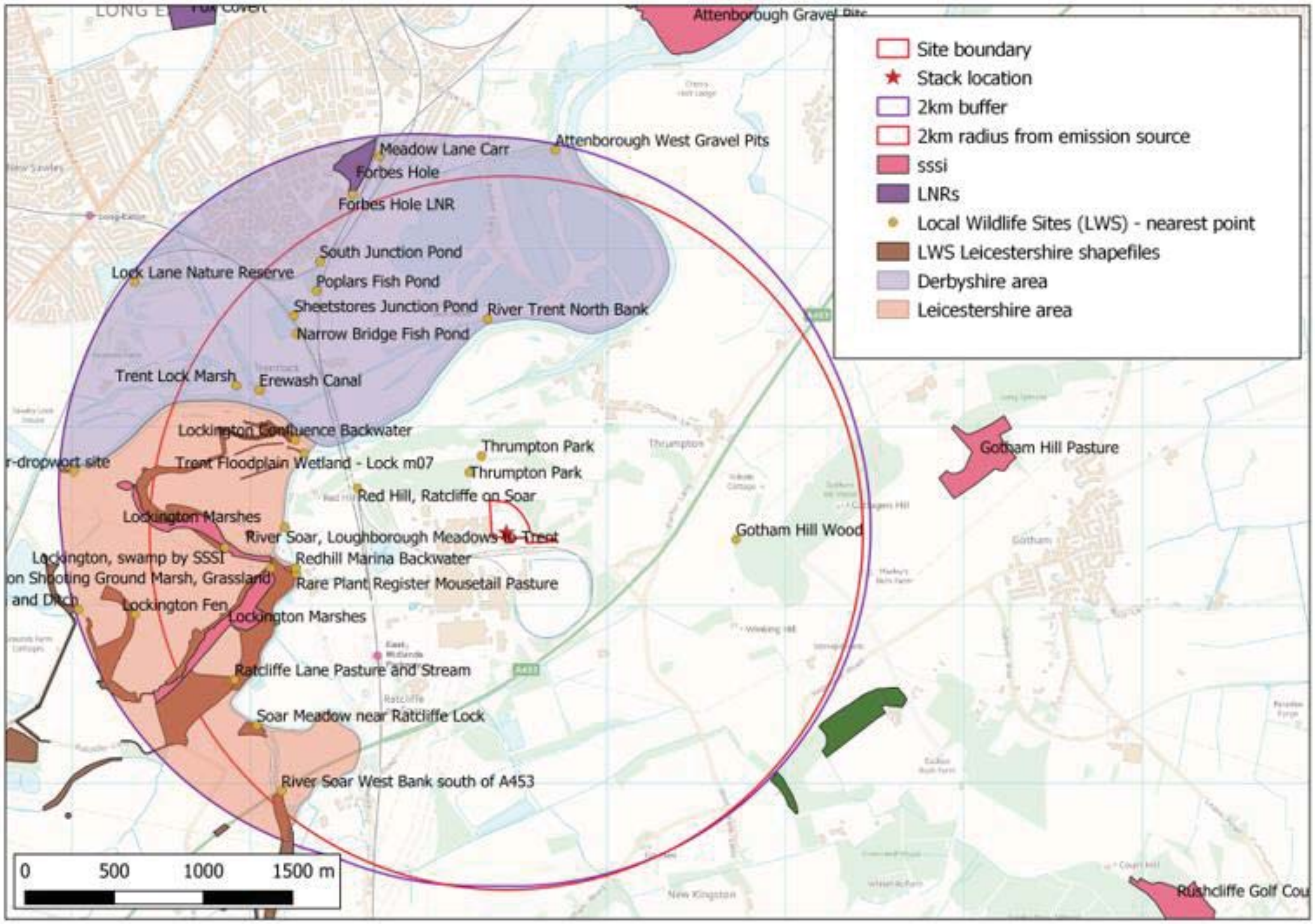
Figure 3.1: Location of Sensitive Ecological Receptors



Note: The purple 2 km buffer is based upon a historic Application Site boundary, with the search area derived using a buffer smoothed to 100 points on its circumference. The red 2 km buffer is based upon the stack grid coordinates.

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APPENDIX 7-1: BASIC ACOUSTIC TERMINOLOGY

APPENDIX 7-2: SOUND SURVEY DETAILS

APPENDIX 7-3: BACKGROUND SOUND SURVEY RESULTS

APPENDIX 7-4: RATCLIFFE-ON-SOAR POWER STATION CONTRIBUTION AND FUTURE BASELINE

APPENDIX 7-5: CONSTRUCTION PLANT INVENTORY

APPENDIX 7-6: ASSUMED PLANT NOISE LEVELS AND CLADDING PERFORMANCE

APPENDIX 7-7: NOISE MAPPING RESULTS

APPENDIX 7-8: ECOLOGICAL/LOCAL WILDLIFE SITE MONITORING

APPENDIX 7-9: ROAD TRAFFIC NOISE SENSITIVITY

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EAST MIDLANDS ENERGY RE-GENERATION (EMERGE) CENTRE

Environmental Statement

Appendix 7 – Noise

May 2020

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Registered number 02902387

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CONTENTS

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APPENDIX 7-1: BASIC ACOUSTIC TERMINOLOGY

Noise

Sound is produced by mechanical vibration of a surface, which sets up rapid pressure fluctuations in the surrounding air.

Between the quietest audible sound and the loudest tolerable sound there is a million to one ratio in sound pressure level. It is because of this wide range that a noise level scale based on logarithms is used in noise measurement. This is the decibel or dB scale.

Audibility of sound covers a range of about 0 to 140 decibels (dB) corresponding to the intensity of the sound pressure level. The ability to recognise a particular sound is dependent on the pitch or frequencies present in the source. Sound pressure measurements taken with a microphone cannot differentiate in the same way as the ear; consequently, a correction is applied by the noise measuring instrument in order to correspond more closely to the frequency response of the ear which responds to sounds from 20 Hz to 20000 Hz. This is known as 'A weighting' and written as dB(A).The use of this unit is internationally accepted and correlates well with subjective annoyance to noise.

Table 1 gives typical noise levels in terms of dB(A) for common situations.

Table 1: Examples of Typical Noise Levels

Source/Activity	Indicative noise level [dB(A)]
Threshold of hearing	0
Rural night-time background	20–40
Quiet bedroom	35
Wind farm at 350 m	35–45
Busy road at 5 km	35–45
Car at 65 km/h at 100 m	55
Busy general office	60
Conversation	60
Truck at 50 km/h at 100 m	65
City traffic at 5 m	75–85
Pneumatic drill at 7 m	95
Jet aircraft at 250 m	105
Threshold of pain	140

The logarithmic basis of noise measurements means that, when considering more than one noise source, their addition must be undertaken in terms of logarithmic arithmetic. Thus, two noise sources each of 40 dB(A) acting together would not give rise to 40 + 40 = 80 dB(A) but rather 40 + 40 = 43 dB(A). This 3 dB(A) increase represents a doubling in sound energy but would be only just perceptible to a human ear.

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Noise levels can vary with time according to source activity and indices have been developed in order to be able to assign a value to represent a period of noise level variations and to correspond with subjective response.

The definition in layman's terms is given below for terminology used in the measurement and results obtained during the survey work.

A-weighting: Normal hearing covers the frequency (pitch) range from about 20 Hz to 20,000 Hz but sensitivity of the ear is greatest between about 500 Hz and 5000 Hz. The 'A-weighting' is an electrical circuit built into noise meters to mimic this characteristic of the human ear.

Ambient noise: The totally encompassing sound in a given situation at a given time usually composed of sound from many sources near and far.

Attenuation: Noise reduction.

Background noise: The general quiet periods of ambient noise when the noise source under investigation is not there.

Decibel (dB): The unit of measurement for sound based on a logarithmic scale. 0 dB is the threshold of normal hearing; 140 dB is the threshold of pain. A change of 1 dB is only detectable under controlled laboratory conditions.

dB(A) [decibel A weighted]: Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) serves to distinguish sounds of different frequency (or pitch) in a similar way to how the human ear responds. Measurements in dB(A) broadly agrees with an individual's assessment of loudness. A change of 3 dB(A) is the minimum perceptible under normal everyday conditions, and a change of 10 dB(A) corresponds roughly to doubling or halving the loudness of sound.

dB(C) [decibel C weighted]: Frequency weighting which does not alter low frequency octave band levels by very much compared to A weighting. Similar to linear reading (i.e. linear does not alter frequency spectra at all).

Frequency (Hz): The number of sound waves to pass a point in one second.

L_{Aeq}: This is a noise index used to describe the 'average' level of a noise that varies with time (T). It allows for the different sensitivities of the human ear to different frequencies (pitch), and averages fluctuating noise levels in a manner which correlates well with human perceptions of loudness.

$L_{A10,T}$: This noise index gives an indication of the upper limit or peak levels of the fluctuating noise. It is the A weighted noise level exceeded for 10 per cent of the specified measurement period (T). For example, if the measurement period was over 10 hours and the L_{A10} reading was 60 dB, then this means that for 1 hour out of 10 the level went above 60 dB.

$L_{A90,T}$: This noise index gives an indication of the lower limit or levels of the fluctuating noise. It is the A weighted noise level exceeded for 90 per cent of the specified measurement period (T). For example, if the measurement period was over 10 hours and the L_{A90} reading was 50 dB, then this means that for 9 hours out of 10 the level went above 50 dB.

L_{Amax}: This is the highest A weighted noise level recorded during a noise measurement period.

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$L_{night,outside}$: This is the A weighted long-term average sound level measured outside as defined in ISO 1996-2: 1987, determined over all the night periods of a year.

Residual noise: The ambient noise remaining at a given position in a given situation when the noise source under investigation is not there.

Specific noise: The noise source under investigation for assessing the likelihood of complaints.

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APPENDIX 7-2: NOISE SURVEY DETAILS

Important Survey Context

The baseline surveys were completed between 3 and 25 March 2020, with some monitoring at the Local Wildlife Site extending to 1 April 2020. During this time the UK Government was progressively implementing movement restrictions on the public to limit the spread of coronavirus. The timeline of key events was:

- Monday 16 March – UK Prime Minister urges everybody into work from home where possible and avoid pubs and restaurants;
- Friday 20 March – UK Prime Minister orders all pubs, restaurants, gyms and other social venues across the country to close for the foreseeable future; and
- Monday 23 March – UK Schools largely closed, except for children of key workers.

Subjectively, the background / residual noise from human activity in the vicinity of the Proposed Development declined considerably during this period, mainly due to lower vehicle movements. At the time of writing, the decrease in traffic flows due to restrictions were not available to directly compare to normal flows.

On 24 March 2020, the Institute of Acoustics (IOA) and Association of Noise Consultants (ANC) [1] provided joint guidance on assessment approaches to take into account the special circumstances. In the absence of representative measurement data the guidance suggests that, by agreement with the appropriate authorities, it would be appropriate to estimate background noise levels from historic measurements or modelling.

Since some of the monitoring for this project commenced prior to the significant decreases in activity, it is considered that the measurement dataset is sufficient to form the basis of an assessment. However, it should be noted that, had the baseline surveys taken place under normal circumstances, it is anticipated that higher residual L_{Aeq} and background L_{A90} levels would have been measured. It is likely that an assessment based on more typical traffic and activity conditions would have resulted in a lower impact and effect than derived here.

Instrumentation

The noise meters used during the survey were precision grade Type 1 meters to IEC 651 or IEC 61672-1 standard and accuracy; the acoustic calibrator conforms to Class 1 Standard of IEC 60942 (Table 2). The settings were:

- Calibration Setting: 94 dB; and
- Meter Setting: A-weighting and fast response. Consecutive logging of 5-minute duration L_{Aeq}, L_{A10}, L_{A50}, L_{A90} and L_{Amax}.

[1] 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, Association of Noise Consultants [ANC] and the Institute of Acoustics [IOA], Version 2, 24 March 2020.

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Table 2: Instrumentation

Instrumentation	Model	Serial Number	Calibration Date	Certificate Number	Usage
Sound Level Meter	RION NL32	451267	23/07/2019	TCRT19/1595	[A] Redhill Marina/Farm Area, [D] Winking Hill Farm & Thrumpton LWS
Sound Level Meter	RION NL52	120529	01/04/2019	TCRT19/1233	Attended Noise Surveys [A,B,C,D and E]
Sound Level Meter	RION NL52	620864	29/01/2020	UCRT20/1128	[B] Middle Gate Cottage
Sound Level Meter	RION NL52	510143	28/01/2020	UCRT20/1127	[C] Thrumpton
Acoustic Calibrator	B&K 4231	1762168	01/04/2019	TRCT19/1226	All pre- and post-measurement checks

For the continuous monitoring survey, the noise meters were located within a weatherproof box with extension lead to microphone mounted on a tripod fixed to a height of approximately 1.5 m above ground level and fitted with a wind shield.

All instruments were calibrated before and after monitoring to a calibration level of 94 dB. No significant drift in calibration response was detected.

General weather conditions were noted during the attended baseline survey and continuous data from a nearby meteorological observation station at East Midlands Airport has been used to characterise the weather during the continuous monitoring.[2]

Continuous Noise Monitoring – Positions and Duration of Tests

[A] Redhill Marina/Farm — 3–16 March 2020
[B] Middle Gate Cottage — 5–25 March 2020
[C] Thrumpton — 5–25 March 2020
[D] Winking Hill Farm — 16–20 March 2020
[E] Ratcliffe-on-Soar Village — None, attended survey only

Monitoring comprised consecutive 5-minute duration L_{Aeq}, L_{A10}, L_{A50}, L_{A90} and L_{Amax} at positions.

Attended Noise Survey – Locations and Measurement Dates

Survey #1: Various Locations — 3 March 2020 4 p.m. to 4 March 2020 2 p.m.
Survey #2: Various Locations — 15 March 2020 8 p.m. to 16 March 2020 2 a.m. and 4 p.m.

L_{Aeq}, L_{A10}, L_{A50}, L_{A90} and L_{Amax} levels were monitored at Positions [A] to [E] in combination with subjective observations of sound climate and source dominance. Typically, the sample periods were 15-minute during the daytime and 5-minute during the night time to allow measurements/observations across

[2] http://skylinkweather.com/metar/metar-show-data.php?stationid=EGNX

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multiple positions throughout period. These periods are shorter than the BS4142 reference assessment periods of 1-hour during the daytime and 15-minute during the night time Taken in conjunction with the medium-term continuous monitoring at nearby positions, it is considered that the baseline noise climate has been robustly quantified.

Meteorological Conditions

Figure 1 and Figure 2 show the wind speed and wind direction, respectively, for the weather from East Midlands airport during noise monitoring. The blue periods are those for which data was excluded due to rainy, windy or sub-zero temperature conditions.

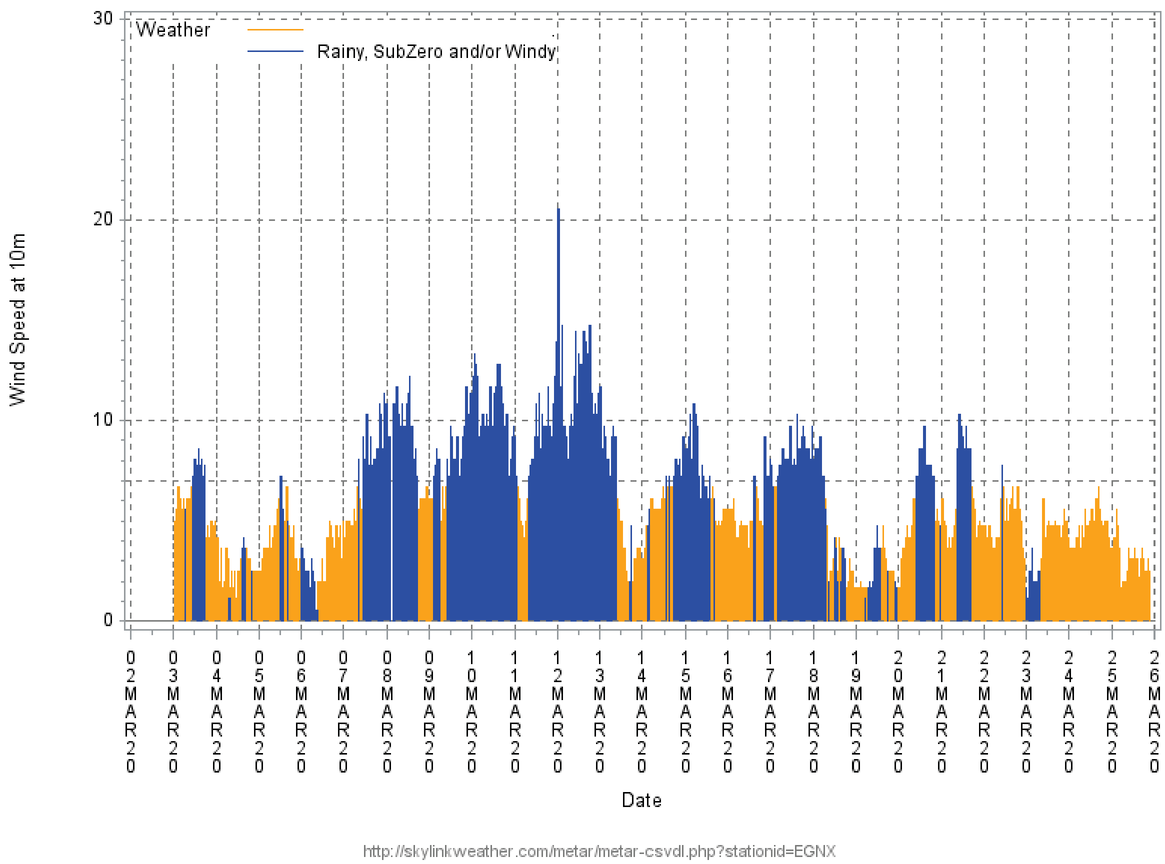

Figure 1: Wind Speed during Noise Monitoring

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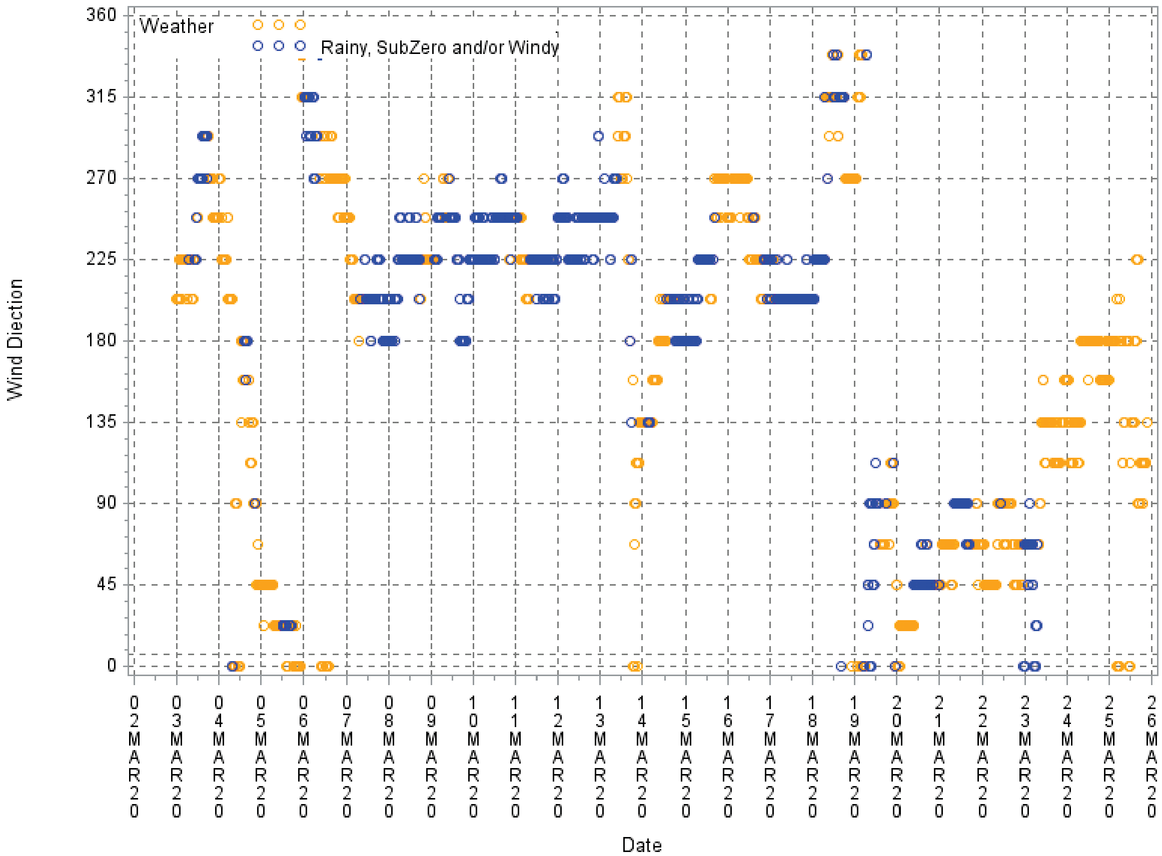

http://skylinkweather.com/metar/metar-csvdl.php?stationid=EGNX

Figure 2: Wind Direction during Noise Monitoring

Photographs of Monitoring Positions

Photograph 1: Redhill Marina/Farm Area (Position A)

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Photograph 2: Middle Gate Cottage – Rear Garden (Position B, Continuous Monitoring Position)

Photograph 3: Middle Gate Cottage (Position B Attended Monitoring Position)

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Photograph 4: Thrumpton – Cricket Ground (Position C Continuous Monitoring Position)

Photograph 5: Thrumpton – Cricket Ground (Position C Attended Monitoring Position)

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Photograph 6: Winking Hill Farm (Position D Continuous Monitoring Position)

Photograph 7: Winking Hill Farm (Position D Attended Monitoring Position)

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Photograph 8: Ratcliffe-on-Soar Village (Position E Attended Monitoring Position)

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APPENDIX 7-3: BACKGROUND SOUND SURVEY RESULTS

Table 3: Attended Noise Survey 03/03/2020 4 p.m. to 04/03/2020 2 p.m.

Position	Date	Start Time	Duration	Sound Pressure Level - dB					
				L_{Aeq}	L_{A01}	L_{A10}	L_{A50}	L_{A90}	L_{A99}
[B] Middle Gate Cottage	03/03/2020	18:05	00:14:58	57.4	68.3	54.7	50.0	48.9	48.3
	03/03/2020	20:05	00:08:58	51.6	57.8	49.3	47.9	46.9	46.2
	04/03/2020	00:45	00:05:02	46.2	49.0	47.5	46.0	44.9	44.2
	04/03/2020	01:40	00:06:43	47.7	53.9	49.7	46.7	45.5	44.8
[C] Thrumpton	03/03/2020	16:47	00:15:00	43.8	49.7	45.9	42.9	41.5	40.6
	03/03/2020	19:08	00:14:58	44.1	51.7	46.4	42.3	41.3	40.8
	04/03/2020	00:06	00:07:40	42.4	46.2	43.2	42.1	41.2	40.5
	04/03/2020	01:12	00:06:07	41.8	44.2	43.3	41.4	40.3	39.6
[D] Winking Hill Farm	03/03/2020	17:23	00:12:43	58.3	61.9	60.1	58.0	55.6	54.3
	03/03/2020	19:32	00:15:00	54.1	58.2	56.1	53.6	51.4	49.2
	03/03/2020	19:47	00:04:28	52.6	56.4	54.7	52.2	50.0	49.2
	04/03/2020	00:22	00:05:08	47.6	52.7	50.1	46.7	44.5	43.6
	04/03/2020	01:26	00:05:09	47.1	53.9	49.6	45.6	43.5	42.3
[E] Ratcliffe-on-Soar Village	03/03/2020	17:43	00:15:00	60.5	64.8	62.4	60.1	58.0	55.8
	03/03/2020	20:22	00:14:57	54.4	58.6	56.3	54.0	51.6	49.9
	04/03/2020	00:55	00:06:49	51.3	62.4	52.4	48.2	45.7	44.7
	04/03/2020	01:54	00:05:43	49.0	54.9	51.7	48.1	44.9	44.0
Plant Operational State	Power Station Unit 1 on-load (500 MW_e approx.) during day and early evening period, off-load at 03/03/2020 20:15. Afterwards only a single cooling water pump running through towers.								
Meteorological State	Dry, cool and light breeze (locally 2–3 m/s) from westerly direction (observations from East Midlands Airport (10 m mast) nearby show 5 m/s west, 7 °C/ 75 % RH initially and 3 m/s south-west,2 °C / 85 % RH overnight).								
Survey Details	Duration typically 15-min during day/evening. Reducing to 5-min at night – to facilitate more measurements and observations across all positions.								

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Table 4: Attended Noise Survey 3–4 March 2020 – Subjective Observations

Position	Day 07:00-19:00	Evening 19:00-23:00	Night 23:00-24:00 & 00:00-07:00
[B] Middle Gate Cottage	**Mainly traffic noise from A453 and M1,** intermittent contributions from Aircraft/Trains and Local vehicles, broadband high frequency noise from nearby cooling towers (minor).	**Mainly traffic noise from A453 and M1,** cooling tower noise indiscernible.	**Distant traffic noise,** minor broadband contribution from nearby cooling towers (Power Station noise otherwise indiscernible).
[C] Thrumpton	**Mainly traffic noise from A453 and M1,** general broadband noise perceptible from Power Station site direction (minor), aircraft/trains (minor), wildlife and distant agricultural noises.	**Mainly traffic noise from M1,** general broadband noise perceptible from Power Station site direction (minor), A453 and other distant urban roads (minor).	**Mainly distant traffic noise,** general noise from direction of Power Station site (minor).
[D] Winking Hill Farm	**Mainly traffic noise from A453 (constant)** and West Leake Lane (intermittent/minor), Power Station site noise indiscernible due to traffic. Minor contribution from nearby premises.	**Mainly traffic noise from A453 (constant)** and West Leake Lane (Intermittent/Minor), Power Station site noise just discernible as a general industrial noise during occasional lulls in traffic.	**Predominantly traffic noise from A453,** Power Station site noise discernible as a general broadband industrial noise. Aircraft at EMA, distant train.
[E] Ratcliffe-on-Soar Village	**Mainly traffic noise from nearby A453,** intermittent contributions from air/rail and Kegworth Road traffic, Power Station site noise indiscernible.	**Mainly traffic noise from nearby A453,** intermittent contributions from Kegworth road traffic (minor). Power Station site noise indiscernible.	**Mainly traffic noise from nearby A453** and distant roads, single contribution from car on Kegworth Road (minor). Trains and aircraft movements (minor). Power Station site noise indiscernible.
Note: Bold denotes the ambient noise source that is subjectively considered to be the main contributor to the steady L_{A90} level			

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Table 5: Attended Noise Survey 15/03/2020 8 p.m. to 16/03/2020 2 a.m. and 4 p.m.

Position	Date	Start Time	Duration	Sound Pressure Level - dB					
				L_{Aeq}	L_{A01}	L_{A10}	L_{A50}	L_{A90}	L_{A99}
[A] Redhill Marina	15/03/2020	21:54	00:05:15	48.7	54.1	49.5	48.4	47.2	46.7
	15/03/2020	22:04	00:10:49	48.3	50.3	49.1	48.1	47.5	46.9
	16/03/2020	00:17	00:05:01	41.2	43.5	42.3	41.0	40.0	39.0
[B] Middle Gate Cottage	15/03/2020	22:20	00:05:42	45.5	48.3	46.4	45.4	44.4	43.8
	15/03/2020	22:26	00:09:59	48.9	55.8	47.0	45.2	43.3	42.3
	16/03/2020	00:07	00:05:42	43.2	47.7	45.1	42.6	41.2	40.1
	16/03/2020	01:08	00:05:01	42.5	45.5	44.2	42.2	40.7	39.6
[C] Thrumpton	15/03/2020	21:27	00:14:59	41.8	45.5	43.2	41.5	40.2	39.4
	15/03/2020	23:31	00:05:02	40.7	42.7	41.6	40.5	39.7	38.9
	16/03/2020	00:51	00:05:45	40.6	43.3	41.8	40.3	39.1	38.3
[D] Winking Hill Farm	15/03/2020	20:39	00:15:00	53.0	57.6	55.3	52.4	49.8	47.1
	15/03/2020	23:12	00:05:30	48.9	53.8	51.4	48.3	45.2	42.7
	15/03/2020	23:42	00:05:18	48.5	54.1	51.1	47.7	44.2	42.7
	16/03/2020	00:35	00:05:02	47.8	53.7	50.9	46.2	43.2	41.8
	16/03/2020	01:31	00:05:01	46.9	54.6	49.7	45.2	41.4	39.8
	16/03/2020	16:05	00:14:58	56.5	63.9	57.0	54.7	52.7	50.8
[E] Ratcliffe-on-Soar Village	15/03/2020	21:03	00:14:58	53.9	58.9	56.2	53.2	50.3	47.3
	15/03/2020	22:44	00:14:57	50.2	56.1	53.1	49.0	45.3	43.2
	15/03/2020	23:54	00:07:39	49.2	55.4	52.2	47.9	43.7	42.7
	16/03/2020	01:19	00:05:01	50.4	57.3	53.6	48.7	43.0	41.2
	16/03/2020	16:26	00:15:00	57.0	62.9	58.9	56.3	54.4	53.2
Plant Operational State	Power Station off-load. Single cooling water pump running through towers.								
Meteorological State	Evening/night period: Cool, clear/partially cloudy skies and low winds. Locally 1–2 m/s from west. (Observations from East Midlands Airport (10 m mast) nearby show 5 m/s west, 4 °C/85 %RH). Daytime period: bright and sunny, locally 2–4 m/s from south-west direction. (Observations from East Midlands Airport (10 m mast) nearby show 6 m/s south-west, 11 °C/50 %RH).								
Survey Details	Typically 15-min during day/evening. Reducing to 5-min at night – to facilitate more measurements and observations across all locations.								

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Table 6: Attended Noise Survey 15–16 March 2020 – Subjective Observations

Position	Day 07:00-19:00	Evening 19:00-23:00	Night 23:00-24:00 & 00:00-07:00
[A] Redhill Marina/Farm		**Mainly distant traffic noise from M1 and A453**, wildlife noise (minor), Power Station site noise indiscernible.	**Mainly distant traffic noise from M1 and A453**. Wildlife noise (minor). Power Station site noise indiscernible.
[B] Middle Gate Cottage		**Mainly traffic noise from A453 and M1.** Cooling tower broadband waterfall noise only just discernible.	**Distant traffic noise,** very minor broadband contribution from nearby cooling towers (Power Station site noise otherwise indiscernible).
[C] Thrumpton		**Mainly traffic noise from M1 and A453**. General broadband noise perceptible from Power Station site direction (minor), wildlife and other transport noises (minor).	Distant traffic noise, and **general industrial noise from direction of Power Station site.**
[D] Winking Hill Farm	**Traffic noise from A453 (constant),** local cars on access road and West Leake Lane intermittent), Power Station site noise indiscernible.	**Traffic noise from A453 (constant)** and West Leake Lane (intermittent/minor), Power Station site noise discernible as a general industrial done during occasional lulls in traffic.	Predominantly traffic noise from A453 but progressively reducing throughout period. **Power Station site general noise** discernible throughout (typically main steady ambient noise). Infrequent traffic on West Leake Lane (minor).
[E] Ratcliffe-on-Soar Village	**Mainly traffic noise from nearby A453,** intermittent contributions from local cars, air/rail and Kegworth Road traffic, domestic activities, Power Station site noise indiscernible.	**Mainly traffic noise from nearby A453,** intermittent contributions from Kegworth Road traffic (minor). Power Station site noise indiscernible. Single local car movement and other transport noise (train/aircraft)(minor).	**Mainly traffic noise from nearby A453 and distant roads**, trains and aircraft movements (minor). Power Station site noise indiscernible.
Note: Bold denotes the ambient noise source that is subjectively considered to be the main contributor to the steady L_{A90} level.			

NCC received 16.07.2020

Continuous Monitoring Results

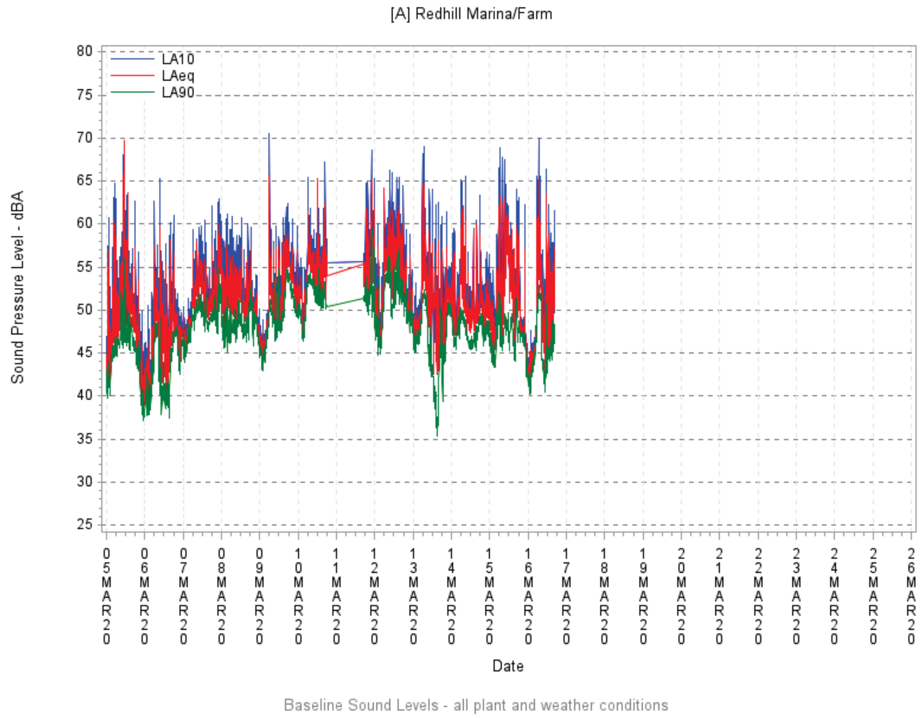

Figure 3: Time Series of all 5-minute L_{A10}, L_{Aeq} and L_{A90} Levels at Position [A]

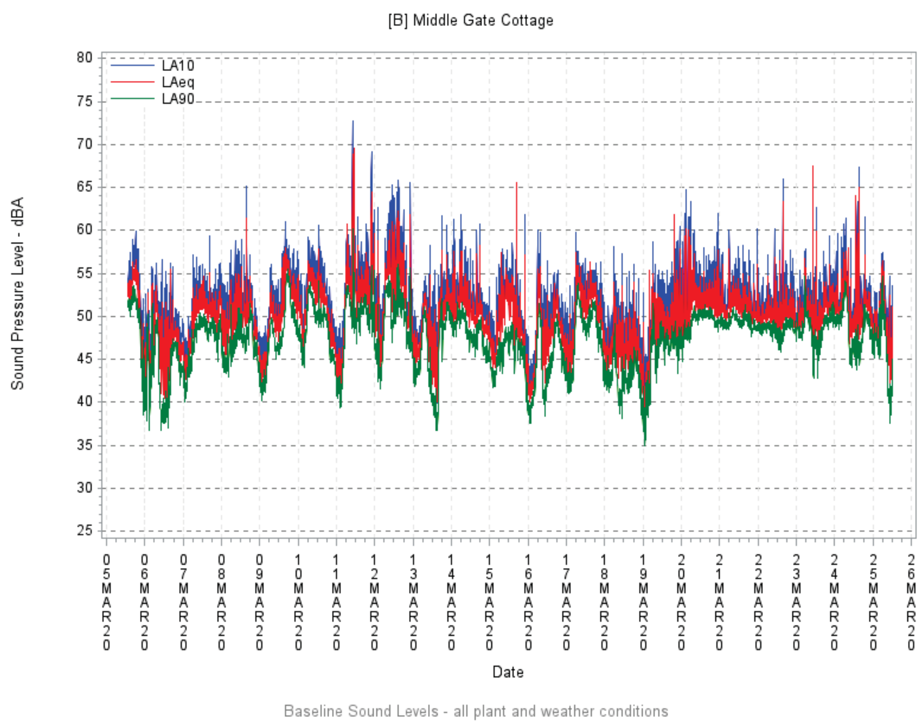

Figure 4: Time Series of all 5-minute L_{A10}, L_{Aeq} and L_{A90} Levels at Position [B]

NCC received 16.07.2020

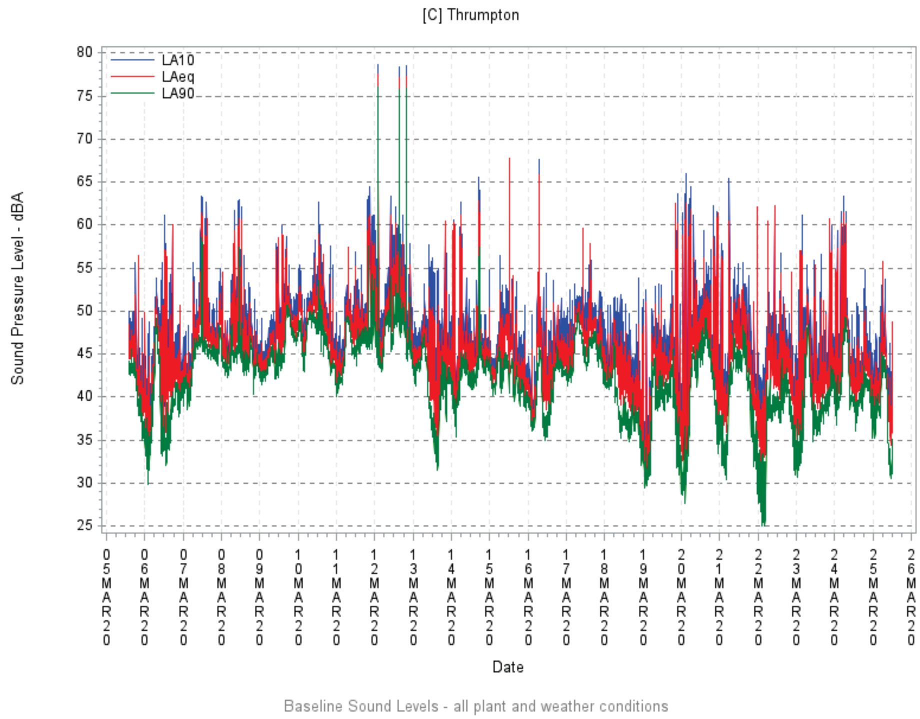

Figure 5: Time Series of all 5-minute L_{A10}, L_{Aeq} and L_{A90} Levels at Position [C]

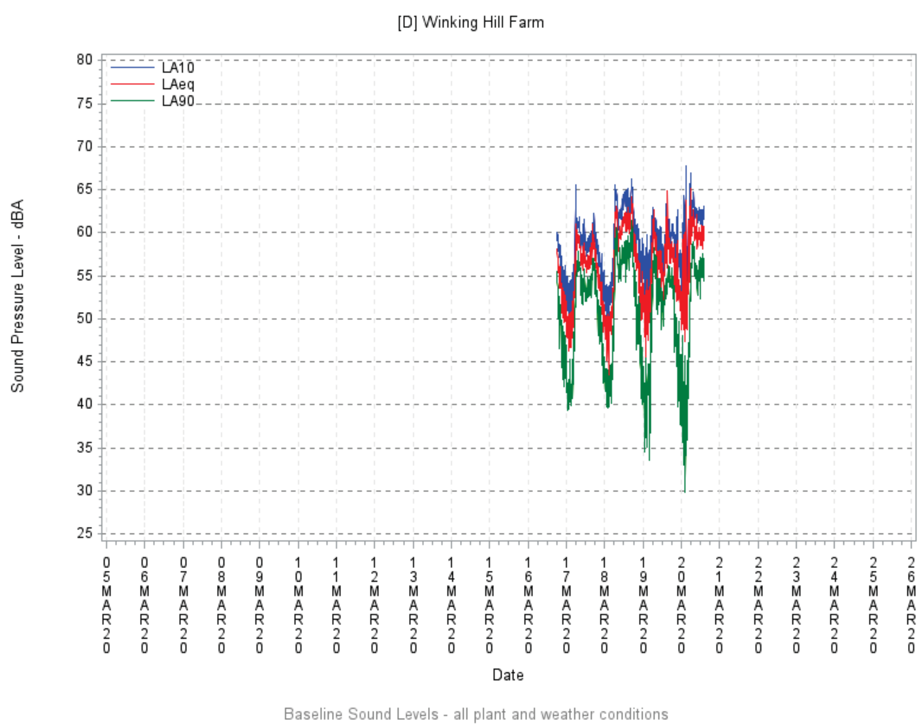

Figure 6: Time Series of all 5-minute L_{A10}, L_{Aeq} and L_{A90} Levels at Position [D]

NCC received 16.07.2020

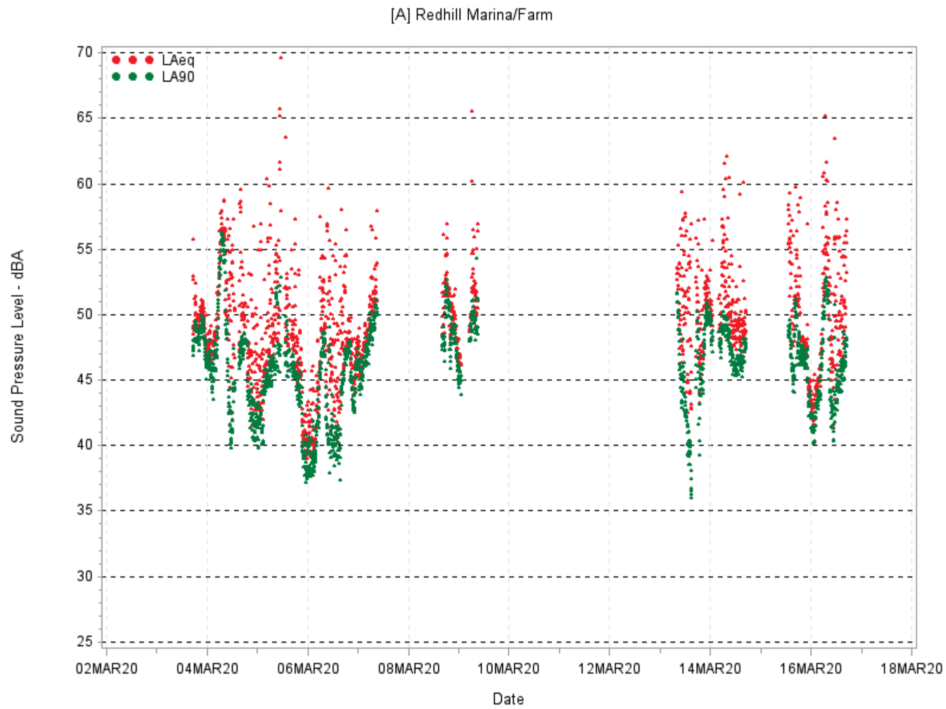

Figure 7: Time Series of L_{Aeq} and L_{A90} at Position [A]
(Excluding periods of high winds, rain and sub-zero temperatures)

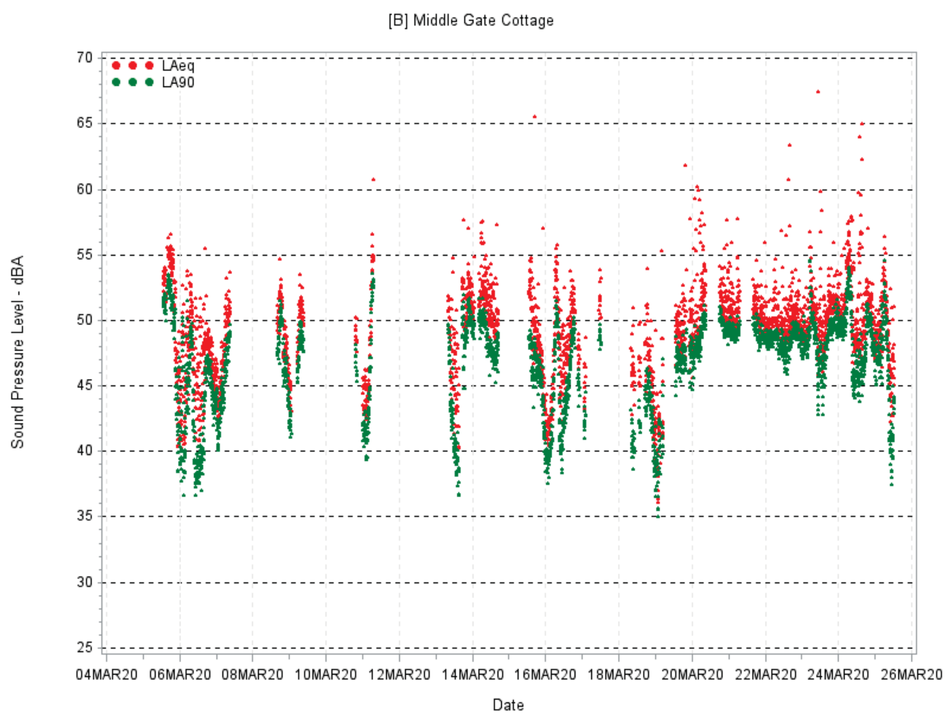

Figure 8: Time Series of L_{Aeq} and L_{A90} at Position [B]
(Excluding periods of high winds, rain and sub-zero temperatures)

NCC received 16.07.2020

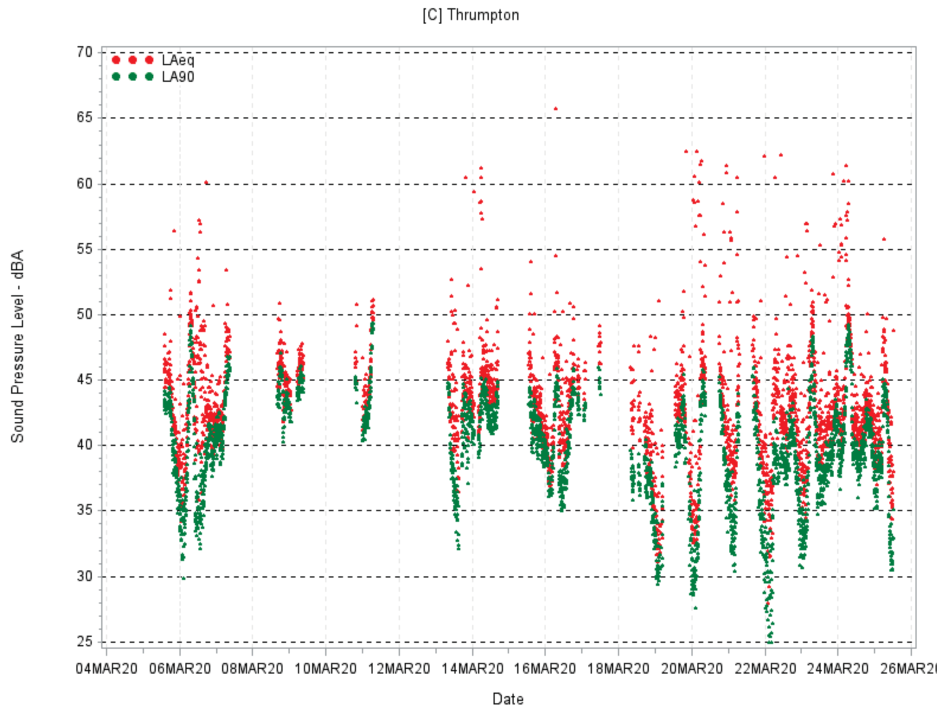

Figure 9: Time Series of L_{Aeq} and L_{A90} at Position [C]
(Excluding periods of high winds, rain and sub-zero temperatures)

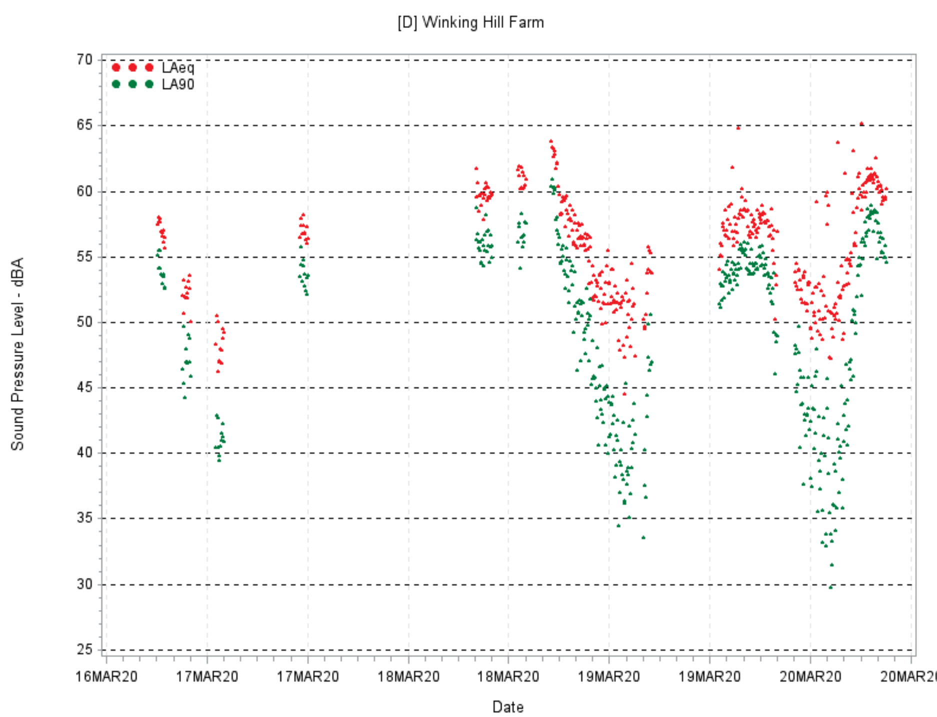

Figure 10: Time Series of L_{Aeq} and L_{A90} at Position [D]
(Excluding periods of high winds, rain and sub-zero temperatures)

NCC received 16.07.2020

[A] Redhill Marina/Farm

L_{A90} dB	Day (07:00-19:00)	Evening (19:00-23:00)	Night (23:00-07:00)
36	0.3	0.0	0.0
37	0.3	0.0	0.0
38	0.5	0.0	2.3
39	2.5	0.0	2.7
40	4.8	0.5	4.4
41	4.5	4.5	3.9
42	4.1	3.0	8.2
43	4.5	4.0	5.0
44	5.1	4.0	6.6
45	6.6	3.5	12.1
46	15.6	11.1	15.3
47	12.9	18.6	10.8
48	11.9	14.1	9.6
49	9.5	19.6	8.5
50	6.9	13.1	6.6
51	5.6	4.0	2.0
52	3.6	0.0	1.1
53	0.6	0.0	0.9
54	0.2	0.0	0.2

Note: Highlighted figures are the most commonly occurring L_{A90} levels

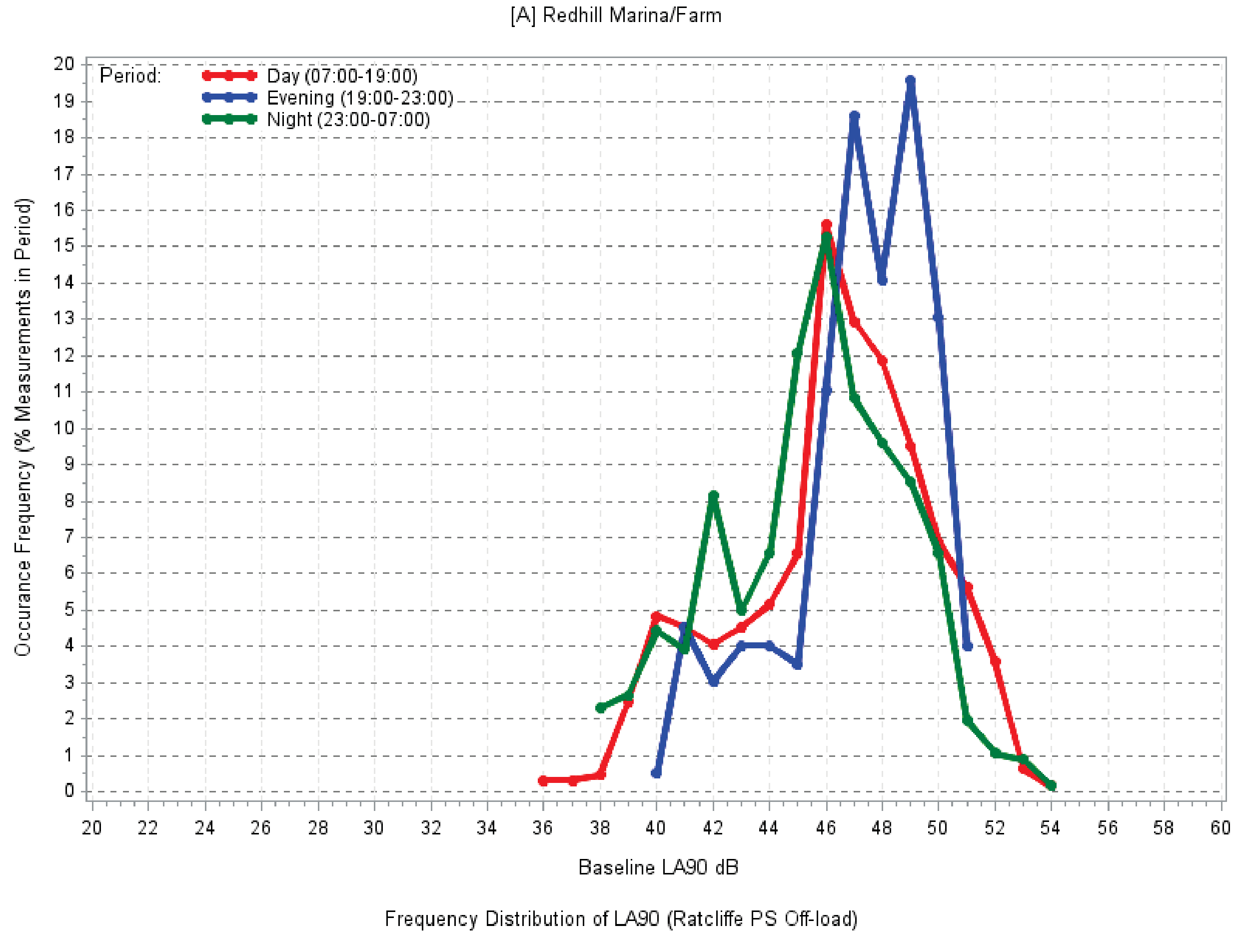

Figure 11: L_{A90} Occurrence Frequency at Position [A]
(Low wind speeds, no precipitation and Power Station off-load)

[B] Middle Gate Cottage

L_{A90} dB	Day (07:00-19:00)	Evening (19:00-23:00)	Night (23:00-07:00)
35	0.0	0.0	0.2
36	0.0	0.0	0.2
37	0.4	0.0	0.7
38	2.2	0.0	1.2
39	3.4	0.4	3.5
40	4.3	0.6	4.7
41	3.1	0.9	4.5
42	3.1	2.3	5.7
43	3.7	3.0	4.1
44	4.4	5.8	3.4
45	4.4	6.8	3.9
46	8.8	10.0	3.9
47	12.9	5.3	6.8
48	17.1	7.9	13.4
49	16.7	30.1	21.7
50	11.2	21.5	12.9
51	3.1	4.9	4.1
52	0.8	0.4	2.5
53	0.3	0.0	1.7
54	0.2	0.0	0.7
55	0.0	0.0	0.3

Note: Highlighted figures are the most commonly occurring L_{A90} levels

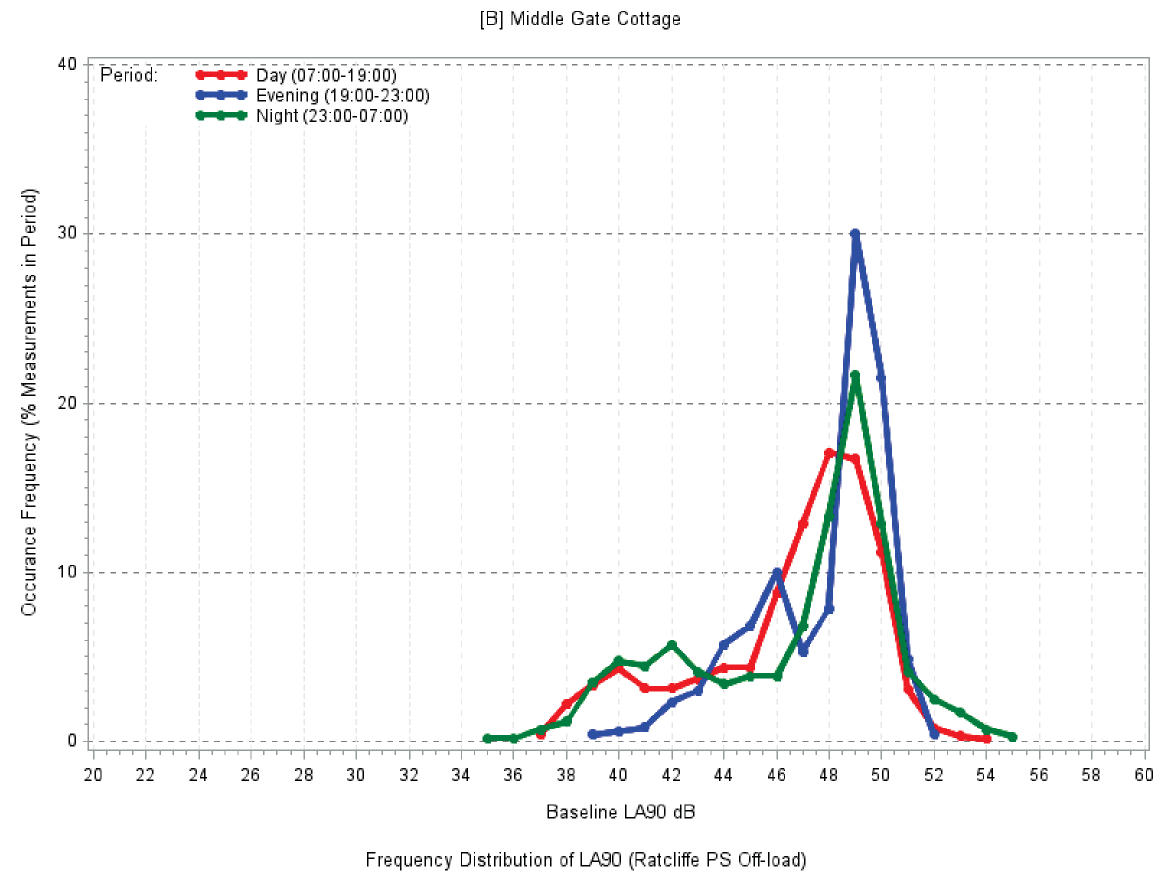

Figure 12: L_{A90} Occurrence Frequency at Position [B]
(Low wind speeds, no precipitation and Power Station off-load)

NCC received 16.07.2020

[C] Thrumpton

L_{A90} dB	Day (07:00-19:00)	Evening (19:00-23:00)	Night (23:00-07:00)
28	0.0	0.0	0.7
29	0.0	0.0	1.4
30	0.0	0.0	3.1
31	0.8	0.4	3.6
32	0.9	1.5	4.8
33	1.3	1.7	5.2
34	1.6	3.2	5.0
35	2.7	4.1	4.4
36	4.3	4.5	3.4
37	6.7	8.5	5.4
38	10.0	8.3	5.2
39	11.7	10.0	7.7
40	10.3	11.3	8.1
41	8.5	12.6	7.3
42	9.5	14.1	10.1
43	8.2	10.4	7.8
44	9.1	5.8	6.3
45	7.4	3.2	3.6
46	3.7	0.4	1.1
47	1.5	0.0	0.9
48	1.5	0.0	1.4
49	0.4	0.0	1.6

Note: Highlighted figures are the most commonly occurring L_{A90} levels

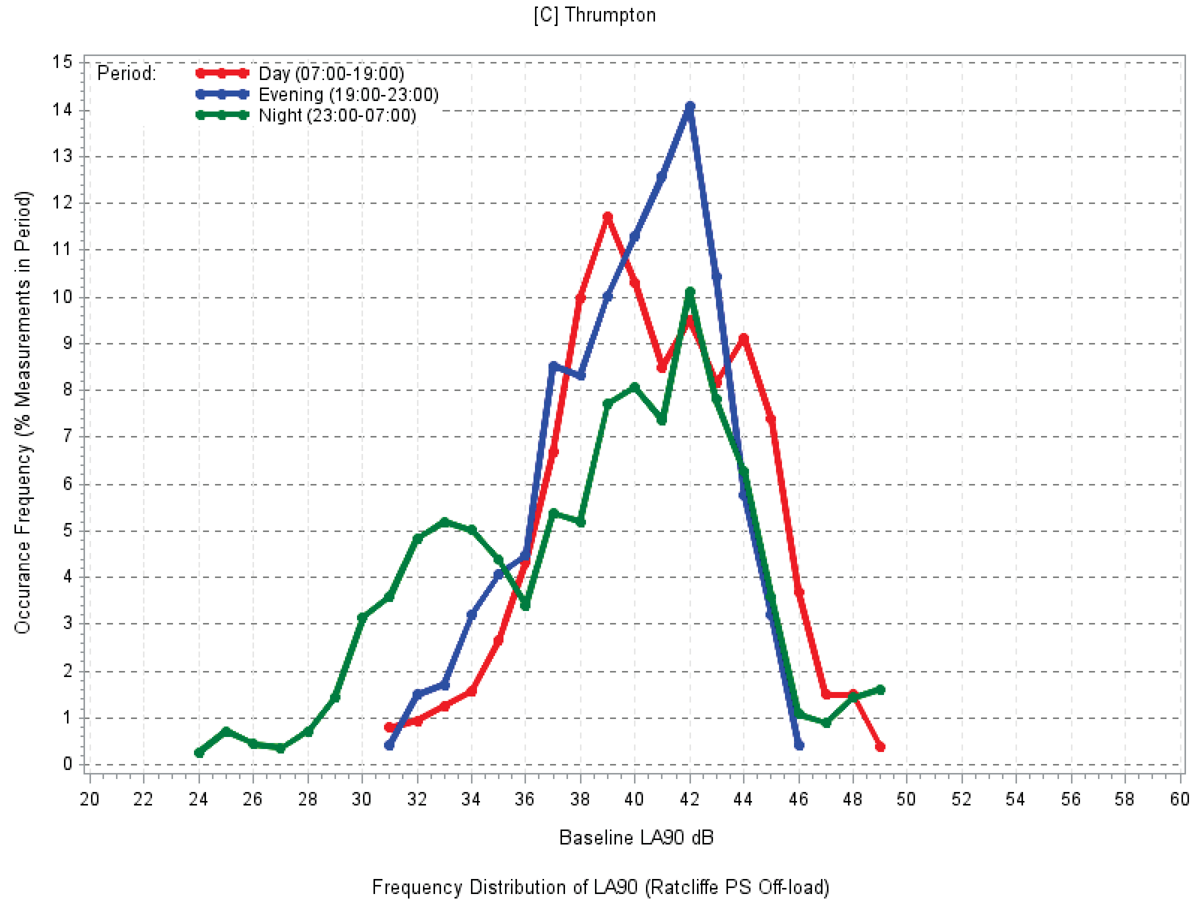

Figure 13: L_{A90} Occurrence Frequency at Position [C]
(Low wind speeds, no precipitation and Power Station off-load)

NCC received 16.07.2020

[D] Winking Hill Farm

LA90 dB	Day (07:00-19:00)	Evening (19:00-23:00)	Night (23:00-07:00)
30	0.0	0.0	0.6
32	0.0	0.0	0.6
33	0.0	0.0	1.8
34	0.0	0.0	2.4
35	0.0	0.0	1.2
36	0.0	0.0	5.4
37	0.0	0.0	3.0
38	0.0	0.0	6.0
39	0.0	0.0	6.0
40	0.0	0.0	7.7
41	0.0	2.8	10.7
42	0.0	0.0	7.7
43	0.0	2.8	9.5
44	0.0	6.9	7.1
45	0.0	8.3	4.2
46	0.0	11.1	0.0
47	0.0	11.1	0.0
48	0.0	9.7	0.0
49	0.0	9.7	0.0
50	0.0	8.3	0.0
51	1.4	9.7	0.0
52	3.6	9.7	0.0
53	12.3	2.8	0.0
54	19.6	4.2	0.0
55	15.9	2.8	0.0
56	18.1	0.0	0.0
57	11.6	0.0	0.0

Note: Highlighted figures are the most commonly occurring L_{A90} levels

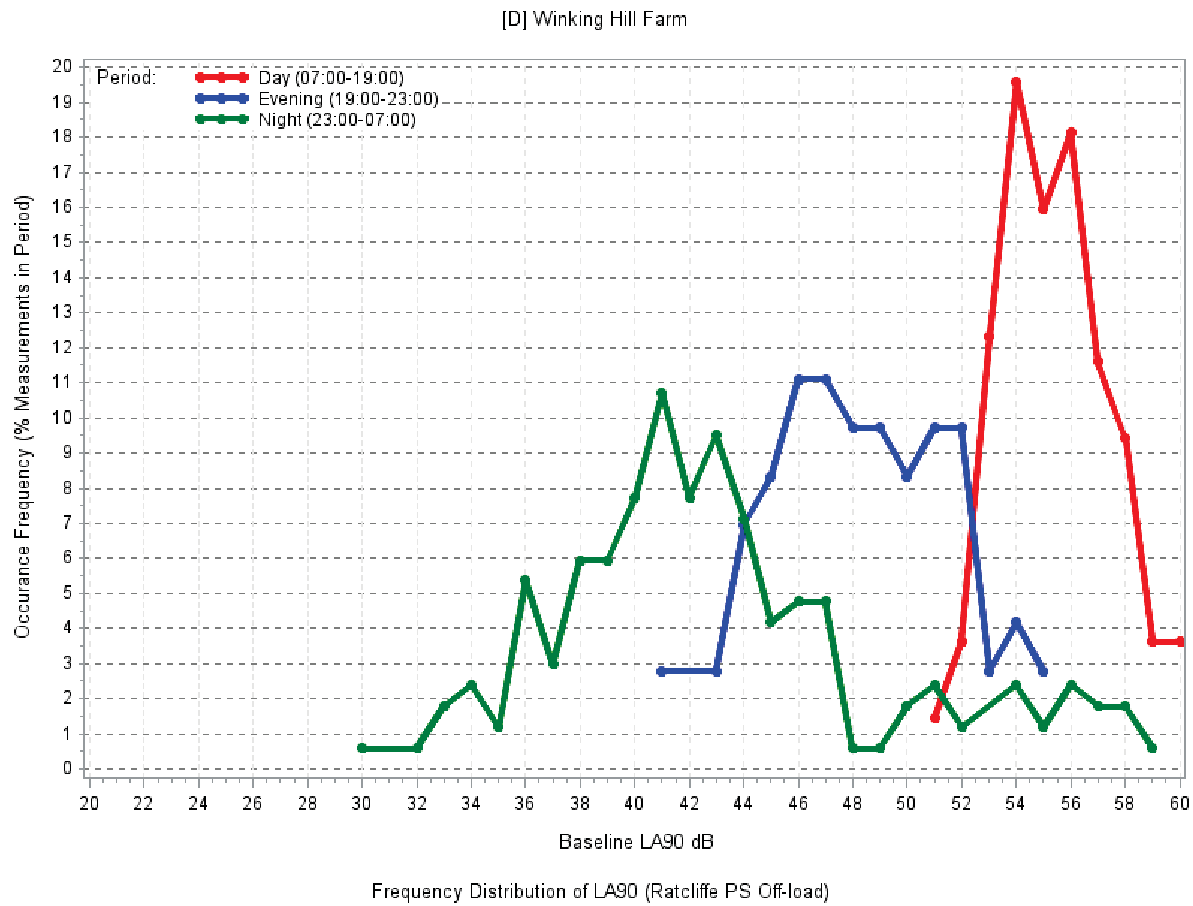

Figure 14: L_{A90} Occurrence Frequency at Position [D]
(Low wind speeds, no precipitation and Power Station off-load)

NCC received 16.07.2020

Table 7: Summary of Daily L_{Aeq}, L_{A10} and L_{A90} Statistics for Continuous Monitoring at Positions [A] to [D]

		[A] Redhill Marina /Farm			[B] Middle Gate Cottage			[C] Thrumpton			[D] Winking Hill Farm		
Date	Period	L_{A10} dB	L_{Aeq} dB	L_{A90} dB	L_{A10} dB	L_{Aeq} dB	L_{A90} dB	L_{A10} dB	L_{Aeq} dB	L_{A90} dB	L_{A10} dB	L_{Aeq} dB	L_{A90} dB
03/03/2020	Day (07:00-19:00)	51.5	50.3	**48.4**	.	.	.	.	.	.	.	.	.
	Evening (19:00-23:00)	50.7	49.7	**48.6**	.	.	.	.	.	.	.	.	.
	Night (23:00-07:00)	49.0	47.8	**46.5**	.	.	.	.	.	.	.	.	.
04/03/2020	Day (07:00-19:00)	54.4	52.2	**47.2**	.	.	.	.	.	.	.	.	.
	Evening (19:00-23:00)	48.7	46.6	**42.9**	.	.	.	.	.	.	.	.	.
	Night (23:00-07:00)	50.5	49.3	**47.7**	.	.	.	.	.	.	.	.	.
05/03/2020	Day (07:00-19:00)	52.5	50.9	**47.0**	56.0	54.2	**51.9**	47.0	45.6	**43.0**	.	.	.
	Evening (19:00-23:00)	46.0	44.2	**41.9**	51.2	49.5	**47.2**	42.9	41.1	**38.4**	.	.	.
	Night (23:00-07:00)	49.0	46.9	**43.1**	46.5	45.1	**43.3**	41.2	39.2	**36.4**	.	.	.
06/03/2020	Day (07:00-19:00)	50.5	48.5	**43.1**	49.4	47.0	**42.4**	47.3	45.4	**38.7**	.	.	.
	Evening (19:00-23:00)	48.1	46.8	**45.3**	48.4	46.9	**44.9**	43.7	42.2	**40.0**	.	.	.
	Night (23:00-07:00)	45.9	44.3	**42.0**	48.3	46.4	**43.7**	42.7	40.8	**37.5**	.	.	.
07/03/2020	Day (07:00-19:00)	53.0	52.1	**49.9**	52.2	50.6	**48.5**	48.9	47.5	**45.8**	.	.	.
	Night (23:00-07:00)	49.5	48.5	**47.0**	48.0	46.3	**44.1**	44.7	43.3	**41.6**	.	.	.
08/03/2020	Day (07:00-19:00)	53.3	51.8	**49.7**	52.7	51.2	**49.2**	48.3	46.7	**44.7**	.	.	.
	Evening (19:00-23:00)	50.9	49.8	**48.6**	49.7	48.3	**46.5**	46.2	44.8	**43.3**	.	.	.
	Night (23:00-07:00)	48.1	47.1	**45.9**	47.2	45.5	**43.5**	45.2	44.1	**42.8**	.	.	.
09/03/2020	Day (07:00-19:00)	53.2	52.1	**49.7**	52.4	50.9	**48.8**	47.7	46.5	**45.0**	.	.	.
	Night (23:00-07:00)	51.8	50.3	**47.9**	49.3	47.7	**45.7**	46.1	44.9	**43.6**	.	.	.
10/03/2020	Evening (19:00-23:00)	.	.	.	50.8	49.0	**46.8**	48.7	46.9	**44.7**	.	.	.
11/03/2020	Night (23:00-07:00)	.	.	.	49.1	47.3	**44.9**	46.4	45.1	**43.7**	.	.	.
13/03/2020	Day (07:00-19:00)	52.4	50.7	**44.2**	49.9	47.8	**43.6**	45.8	43.6	**38.8**	.	.	.
	Evening (19:00-23:00)	51.4	49.9	**47.6**	53.1	51.7	**49.9**	46.4	44.7	**41.8**	.	.	.
	Night (23:00-07:00)	52.5	51.3	**49.9**	53.0	51.6	**49.9**	46.0	44.2	**41.7**	.	.	.
14/03/2020	Day (07:00-19:00)	51.5	50.3	**47.0**	53.1	51.2	**48.2**	46.8	45.2	**42.8**	.	.	.
	Night (23:00-07:00)	54.2	52.2	**48.7**	54.1	52.4	**50.0**	47.8	46.3	**41.9**	.	.	.
15/03/2020	Day (07:00-19:00)	53.4	52.4	**47.7**	52.3	50.5	**47.0**	45.9	44.5	**41.8**	.	.	.
	Evening (19:00-23:00)	48.2	47.3	**46.3**	48.6	47.0	**44.9**	43.6	42.0	**40.3**	.	.	.
	Night (23:00-07:00)	45.2	44.2	**43.2**	45.3	43.2	**40.7**	42.7	41.4	**40.0**	.	.	.
16/03/2020	Day (07:00-19:00)	52.6	50.9	**45.7**	50.7	48.9	**45.2**	45.6	43.7	**40.2**	59.2	57.1	**54.0**

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		[A] Redhill Marina /Farm			[B] Middle Gate Cottage			[C] Thrumpton			[D] Winking Hill Farm		
Date	Period	L_{A10} dB	L_{Aeq} dB	L_{A90} dB	L_{A10} dB	L_{Aeq} dB	L_{A90} dB	L_{A10} dB	L_{Aeq} dB	L_{A90} dB	L_{A10} dB	L_{Aeq} dB	L_{A90} dB
	Evening (19:00-23:00)	.	.	.	49.6	47.6	**45.2**	46.7	45.0	**43.1**	55.0	52.2	**47.1**
	Night (23:00-07:00)	48.3	47.0	**45.0**	46.8	45.0	**42.6**	42.4	41.2	**39.2**	.	.	.
17/03/2020	Day (07:00-19:00)	.	.	.	53.2	51.5	**48.8**	49.4	47.6	**44.9**	59.2	57.0	**53.7**
	Night (23:00-07:00)	.	.	.	47.2	45.3	**42.5**	45.6	44.1	**42.5**	52.3	48.3	**41.1**
18/03/2020	Day (07:00-19:00)	.	.	.	48.9	47.1	**42.4**	45.0	42.2	**37.8**	62.6	60.3	**56.4**
	Evening (19:00-23:00)	.	.	.	47.5	45.6	**43.1**	41.7	39.5	**36.5**	58.7	55.4	**49.1**
	Night (23:00-07:00)	.	.	.	44.3	42.1	**38.9**	39.0	36.9	**33.3**	56.3	52.4	**43.7**
19/03/2020	Day (07:00-19:00)	.	.	.	50.9	49.2	**46.9**	46.1	44.3	**41.3**	59.7	57.7	**54.1**
	Evening (19:00-23:00)	.	.	.	51.6	50.3	**47.2**	43.4	41.5	**37.6**	57.3	54.4	**48.4**
	Night (23:00-07:00)	.	.	.	44.8	43.4	**41.1**	37.2	35.3	**32.0**	55.6	51.6	**41.2**
20/03/2020	Day (07:00-19:00)	.	.	.	54.5	52.7	**50.2**	49.2	47.3	**44.1**	62.8	60.5	**56.9**
	Evening (19:00-23:00)	.	.	.	53.2	51.6	**49.5**	46.3	44.6	**39.7**	.	.	.
	Night (23:00-07:00)	.	.	.	52.6	51.1	**48.2**	43.2	40.9	**34.9**	58.3	54.7	**44.4**
21/03/2020	Day (07:00-19:00)	.	.	.	52.7	51.4	**49.5**	47.3	45.5	**42.7**	.	.	.
	Evening (19:00-23:00)	.	.	.	51.6	50.5	**48.8**	43.3	40.8	**35.9**	.	.	.
	Night (23:00-07:00)	.	.	.	52.6	51.1	**49.1**	44.5	41.9	**35.7**	.	.	.
22/03/2020	Day (07:00-19:00)	.	.	.	51.8	50.4	**48.1**	45.9	43.9	**39.7**	.	.	.
	Evening (19:00-23:00)	.	.	.	51.9	50.5	**48.9**	43.9	41.5	**37.3**	.	.	.
	Night (23:00-07:00)	.	.	.	51.1	50.1	**48.7**	41.7	38.7	**32.0**	.	.	.
23/03/2020	Day (07:00-19:00)	.	.	.	51.7	50.3	**47.7**	44.6	42.8	**39.2**	.	.	.
	Evening (19:00-23:00)	.	.	.	52.6	51.3	**49.7**	45.0	43.7	**40.7**	.	.	.
	Night (23:00-07:00)	.	.	.	51.6	50.5	**49.3**	44.8	42.6	**38.0**	.	.	.
24/03/2020	Day (07:00-19:00)	.	.	.	52.6	51.2	**47.4**	44.7	43.2	**40.9**	.	.	.
	Evening (19:00-23:00)	.	.	.	52.7	51.2	**49.4**	45.1	43.3	**41.0**	.	.	.
	Night (23:00-07:00)	.	.	.	53.5	51.9	**50.1**	47.7	46.1	**41.9**	.	.	.
25/03/2020	Day (07:00-19:00)	.	.	.	48.9	47.4	**43.5**	42.6	40.8	**36.7**	.	.	.
	Night (23:00-07:00)	.	.	.	51.4	50.2	**48.5**	44.2	42.3	**39.8**	.	.	.

NCC received 16.07.2020

Table 8: Detailed Day Period L_{A90} Statistics for Positions [A] to [E]
(for Day (07:00-19:00), Evening (19:00-23:00) and Night (23:00-07:00)

Position[1]	Period	No.	Max	75%ile	Median	25%ile	Min	Mean	Std Dev.	Mode/Most Common
[A] Redhill Marina/ Farm	Day (07:00-19:00)	641	54.3	48.5	46.5	44.2	36.0	46.2	3.4	46
	Evening (19:00-23:00)	199	51.0	49.1	47.5	46.0	40.4	47.1	2.6	48
	Night (23:00-07:00)	563	53.7	47.8	45.9	43.2	37.7	45.5	3.3	46
[B] Middle Gate Cottage	Day (07:00-19:00)	1275	53.5	48.8	47.4	44.5	36.7	46.4	3.4	48
	Evening (19:00-23:00)	469	51.7	49.5	48.7	45.9	38.5	47.7	2.5	49
	Night (23:00-07:00)	1116	54.6	49.3	48.0	43.5	35.0	46.6	3.9	49
[C] Thrumpton	Day (07:00-19:00)	1272	49.2	43.2	40.4	38.2	30.5	40.5	3.5	39
	Evening (19:00-23:00)	469	45.7	42.0	40.0	37.6	30.9	39.7	3.1	42
	Night (23:00-07:00)	1116	49.4	42.2	39.2	34.3	24.0	38.4	5.1	42
[D] Winking Hill Farm	Day (07:00-19:00)	138	61.0	56.7	55.3	53.7	51.2	55.4	2.1	54
	Evening (19:00-23:00)	72	54.7	50.7	48.1	45.8	40.5	48.2	3.3	46
	Night (23:00-07:00)	168	58.7	45.8	42.2	39.1	29.8	43.0	6.1	41
[E] Ratcliffe-on-Soar Village	Day (07:00-19:00)	2	58				54.4	56.2		
	Evening (19:00-23:00)	3	51.6				45.3	49.1		
	Night (23:00-07:00)	4	45.7				43	44.3		

Notes:
(i) Results for [A]–[D] positions are based on periods continuous monitoring from 3–25 March 2020 and exclude those periods when Power Station was on-load.
(ii) Results for Ratcliffe-on-Soar village [E] are based on all attended monitoring surveys, more details in Appendix 7-3.
(iii) Measurements made during on-load operation has been included since subjectively the noise from Power Station was not discernible.

NCC received 16.07.2020

Table 9: Detailed Day Period Baseline L_{A90} Statistics for Positions [A] to [E] (for Day (06:00-18:00), Evening (18:00-23:00) and Night (23:00-06:00)

Position	Period	No.	Max	75%ile	Median	25%ile	Min	Mean	Std Dev.	Mode/Most Common
[A] Redhill Marina/ Farm	Day (06:00-18:00)	677	54.3	48.8	46.6	44.5	36.0	46.4	3.4	46
	Evening (18:00-23:00)	235	52.7	49.2	47.5	46.0	39.3	47.2	2.7	49
	Night (23:00-06:00)	491	53.7	47.2	45.4	42.6	37.7	45.0	3.2	46
[B] Middle Gate Cottage	Day (06:00-18:00)	1299	54.1	48.9	47.5	44.9	36.7	46.5	3.5	49
	Evening (18:00-23:00)	589	51.7	49.6	48.8	46.2	38.5	47.9	2.4	49
	Night (23:00-06:00)	972	54.6	49.0	47.7	42.8	35.0	46.1	3.9	49
[C] Thrumpton	Day (06:00-18:00)	1297	49.4	43.7	40.8	38.3	30.5	40.9	3.7	39
	Evening (18:00-23:00)	588	47.1	42.4	40.6	38.1	30.9	40.1	3.1	42
	Night (23:00-06:00)	972	48.6	41.4	38.3	33.7	24.0	37.5	4.7	42
[D] Winking Hill Farm	Day (06:00-18:00)	126	61.0	57.1	55.9	54.1	51.2	55.7	2.1	56
	Evening (18:00-23:00)	96	55.9	53.5	49.8	46.6	40.5	49.8	3.9	54
	Night (23:00-06:00)	156	55.0	44.5	41.6	38.8	29.8	41.9	4.9	41
[E] Ratcliffe-on-Soar Village	Day (06:00-18:00)	2	58				54.4	56.2		
	Evening (18:00-23:00)	3	51.6				45.3	49.1		
	Night (23:00-06:00)	4	45.7				43	44.3		

Notes:
(i) Results for [A]–[D] positions are based on periods continuous monitoring from 3–25 March 2020 and exclude those periods when Power Station was on-load.

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APPENDIX 7-4: POWER STATION ON-LOAD CONTRIBUTION

The Power Station comprises four independent generating units, whose operation is dictated by the electricity market and demand. Technically, it is possible for all four units to be on-load at the same time; whilst this has not been a regular occurrence for some time, it nevertheless remains a possibility in the future. The situation of all four units being on-load simultaneously is the current baseline assumption for other environmental assessment Chapters in this ES. However, as this has not occurred for some time, and monitoring of environmental noise levels has not routinely occurred, there are no recent measurements in the community that can be used to characterise this baseline. As it is not viable to operate all four units specifically to quantify the noise impact from that possible operational scenario, the current level of noise that would arise in the community during on-load operation of all four units remains unquantified.

An alternative basis for the assessment is adopted for the current baseline scenario. Recently, the four units are most commonly all off-load, but there is still auxiliary activity across the site associated with maintaining the integrity, availability and readiness of the plant. It is under these circumstances that the majority of recent measurements have been collected and therefore this shutdown state represents an appropriate current baseline as an alternative to the four unit on-load scenario.

Whilst this provides a common baseline against which to assess the noise from the Proposed Development, it needs to be recognised that the additional plant processes associated with electricity generation on 1, 2, 3 or all 4 units would give rise to an increase in noise emission from the Power Station site.

A broad indication of the magnitude of this increase is shown in some historic continuous noise monitoring on the north-east perimeter of the Power Station site that was undertaken to support the plant's Pollution Prevention and Control (PPC) Permit application. Figure 15 shows the mean diurnal values of L_{Aeq} and L_{A90} levels for the plant being on-load (typically multiple units) or off-load.

Compared to when no units were on-load, the average perimeter noise L_{Aeq} and L_{A90} levels are around 4 dB higher overnight when one or more units were on-load. This suggests that, in the event of future on-load operation of multiple units at the Power Station, their specific noise level contribution in the community to the north of the site is also likely to increase by 4 dB compared to the no-load operation scenario for the Baseline 1 (Current). This corresponding increase in the baseline noise level in the community has the effect of reducing the apparent impact of any concurrent operational noise from the Proposed Development.

Note that as the historic monitoring took place at a position on the north-east perimeter of the site, any change in level only applies to properties in that direction (i.e. Thrumpton). On-load operation of multiple units generates additional noise; however, the magnitude of any increase in specific levels at other locations cannot be inferred.

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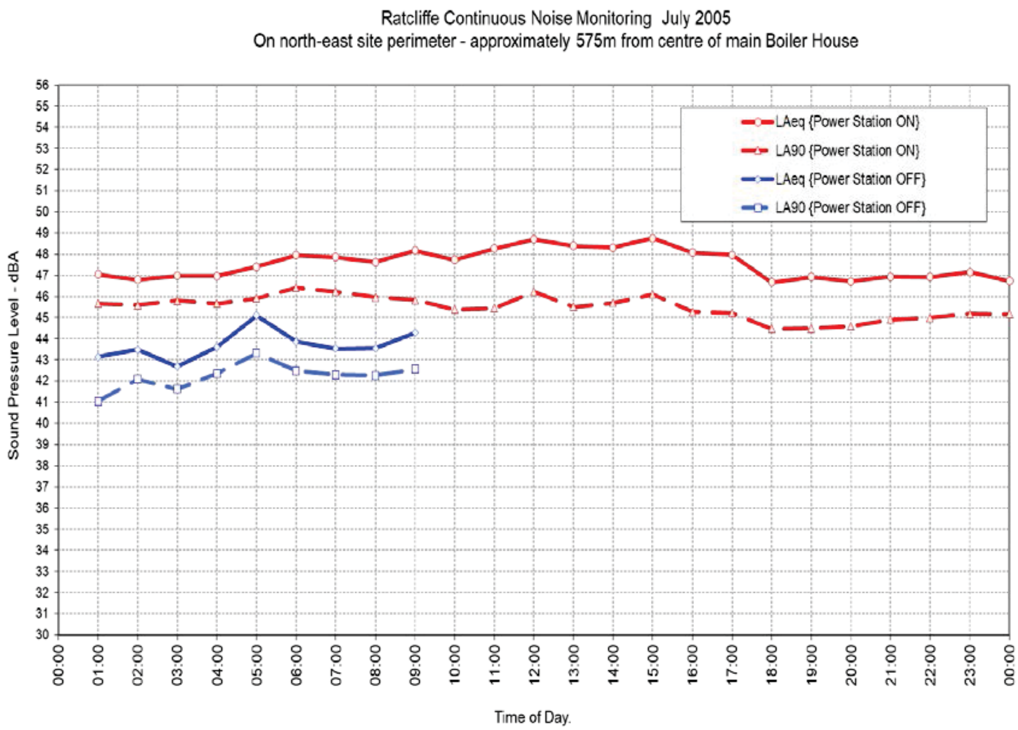

Figure 15: Historic Continuous Noise Monitoring on the North-East Perimeter of the Power Station

Current Recent Baseline Levels

Unit 1 of the Power Station was on-load for a limited number of occasions during some of the recent continuous noise monitoring surveys. This occurred during day and evening periods when traffic noise was prominent, so the data should be interpreted in that context.

Date and approximate times when Unit 1 was on-load were:

- 3 March 2020 from 7 a.m. to 8 p.m.
- 4 March 2020 from 6 a.m. to 9 p.m.
- 5 March 2020 from 4 p.m. to 10 p.m.
- 6 March 2020 from 4 p.m. to 9 p.m.
- 19 March 2020 from 4 p.m. to 9 p.m.

The continuous monitoring data for Positions [A] to [D] has been analysed based on whether the Power Station was on-load or off-load during the measurement and grouped by day, evening and night periods (Table 10).

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Table 10: Day Period Statistics of L_{Aeq} and L_{A90} at Receptor Positions [A] to [D] (Power Station off-load and on-load)

		[A] Redhill Marina/Farm		[B] Middle Gate Cottage		[C] Thrumpton		[D] Winking Hill Farm	
		Off-load	On-load	Off-load	On-load	Off-load	On-load	Off-load	On-load
Day (07:00-19:00)	L_{Aeq}	50.8	50.4	49.7	50.6	44.1	44.6	59.1	57.9
	L_{A90}	46.2	45.8	46.4	48	40.5	41.1	55.4	54.6
	N	641	181	1275	119	1272	119	138	42
Day (07:00-23:00)	L_{Aeq}	50.4	48.9	49.7	50	43.8	43.6	57.5	57.4
	L_{A90}	46.4	45.3	46.7	47.5	40.3	40.4	52.9	53.8
	N	840	303	1744	211	1741	211	210	54
Day (06:00-18:00)	L_{Aeq}	51	50.7	49.9	50.5	44.5	44.7	59.5	57.9
	L_{A90}	46.4	45.5	46.5	47.8	40.8	40.9	55.7	54.8
	N	677	145	1299	83	1297	83	126	30
Evening (19:00-23:00)	L_{Aeq}	48.8	46.6	49.7	49.2	42.8	42.2	54.5	55.6
	L_{A90}	47.1	44.5	47.7	46.8	39.7	39.6	48.2	50.9
	N	199	122	469	92	469	92	72	12
Evening (18:00-23:00)	L_{Aeq}	49.2	47.2	50	49.7	43.2	42.9	55.4	56.8
	L_{A90}	47.2	45.1	47.9	47.3	40.1	40.2	49.7	52.6
	N	235	158	589	128	588	128	96	24
Night (23:00-07:00)	L_{Aeq}	47.8	.	48.7	.	42.1	.	53	.
	L_{A90}	45.5	.	46.6	.	38.4	.	43	.
	N	563	.	1116	.	1116	.	168	.
Night (23:00-06:00)	L_{Aeq}	47	.	48.2	.	41.3	.	52.4	.
	L_{A90}	45	.	46.1	.	37.5	.	41.9	.
	N	491	.	972	.	972	.	156	.

Notes:
[1] N.– Number of 5-min period values used in the analysis.
[2] On-load – relates to those periods when Unit 1 of the Power Station was generating electricity.
[3] Off-load – relates to those periods when no electricity was being generated on the Power Station site. There is still noise generated by auxiliary plant processes and vehicle movements around the site road. One of the four cooling tower pumps is operated to maintain circulation around the system and is responsible for the generation of waterfall noise from the cooling tower ponds.

L_{Aeq} and L_{A90} levels collected during these intervals were compared to the diurnal variation in noise levels that occurred when the plant was not on load (Figure 16). The line joins the median (50 %) values and box spans the Interquartile (25 %–75 %) range of values measured in a given hour for the operational state “Off” (off-load) or “On-Load”.

NCC received 16.07.2020

Figure 16: Diurnal Variation of L_{Aeq} and L_{A90} at Receptors [A] to [D]
(Power Station off-load or on-load)

At the four residential locations where continuous monitoring was undertaken, the L_{Aeq} and L_{A90} levels measured did not exhibit any particular sensitivity to the generation activities on the site. During the limited day and evening periods when Unit 1 was on-load, the L_{Aeq} and L_{A90} measured were typically within the range of levels that occurred when the plant was off-load. In some circumstances, the measured levels were lower and this is likely to be attributable to the particular meteorological and sound propagation conditions that occurred.

Whilst the residual noise that prevailed during these recent circumstances prevent a quantification of the additional contribution from the on-load operation, additional noise is generated by this activity. In the absence of other more recent data, the potential 4 dB increase over off-load emissions identified above is considered appropriate.

Future Baseline Levels

The current operations of the plant, whether associated with being on-load or off-load whilst still being maintained in a state of operational readiness, are a source of environmental noise. As the plant was never completely shut down at any point during the survey, all the baseline measurements contain a steady noise contribution from the site across day and night periods. This varies considerably between the receptors, with Middle Gate Cottage being most impacted due to noise from the water flow through the cooling towers. The future baseline assumes that the Power Station has been decommissioned and the site cleared of the majority of plant buildings. This will remove the Power Station noise contribution from the future baseline noise in the community.

At those receptors where the Power Station's noise is discernible during quieter times of the day, the future baseline noise level will reduce once the plant is decommissioned. It is not possible to rigorously quantify the magnitude of any future background L_{A90} level at the receptors. It is anticipated that the following qualitative changes in background noise level are likely to arise once the plant is decommissioned and when the level mainly depends upon traffic noise:

- [A] Redhill Marina and Redhill Farm – Due to its proximity to the Power Station site, a reduction in baseline noise level is anticipated under the future baseline scenario. However, during the circumstances that prevailed during the attended survey on 15–16 March 2020, distant road traffic noise predominated and the Power Station was not discernible at the monitoring position.

- [B] Middle Gate Cottage – Due to its proximity to continuously operating cooling towers, a reduction in baseline noise level is anticipated at this position.

- [C] Thrumpton – A general industrial noise from direction of the Power Station was discernible during both the attended measurement surveys, and it was the main source of steady noise overnight. It is anticipated that under the future baseline scenario, the baseline L_{A90} noise level overnight will be lower than currently occurs.

- [D] Winking Hill Farm – During both of the attended measurement surveys, the noise from the Power Station was discernible during lulls in the traffic flow. It is anticipated that under the future baseline scenario, the baseline L_{A90} noise level overnight will be lower than currently occurs.

- [E] Ratcliffe-on-Soar Village – No significant decrease in baseline noise level is anticipated at this position due to the proximity to the M1 and A453 and its relative separation from the operational parts of the Power Station site.

NCC received 16.07.2020

At all monitoring positions, the median L_{Aeq} and L_{A90} are lowest between 1 a.m. and 3 a.m. when traffic noise contributions subside to a minimum. It is during these periods that any noise contribution from the Power Station will be most prominent compared to the other noise sources. To estimate the future baseline noise level at each NSR, it is assumed that at these times of low traffic it is the steady noise from the auxiliary plant operations across the Power Station site that is setting the value of the measured L_{A90}.

As the noise emissions from the site are generally continuous and steady in nature, the lowest median L_{A90} can be used as an estimate of the specific noise level from the Power Station (Table 11).

Table 11: Estimation of Baseline 2 (Future) L_{Aeq} and L_{A90} Levels
(Power Station shut down and decommissioned)

NSR Position	Estimate of Specific Noise Level from Power Station [1] L_{Aeq} dB	Night time				Day time			
		Current Baseline L_{A90} dB	Future Baseline[4] L_{A90} dB	Current Baseline L_{Aeq} dB	Estimated Future Baseline[5] L_{Aeq} dB	Current Baseline L_{A90} dB	Future Baseline[4] L_{A90} dB	Current Baseline L_{Aeq} dB	Estimated Future Baseline[5] L_{Aeq} dB
[A] Red Hill Marina and Red Hill Farm	42	45	42	47	45	46	44	51	50
[B] Middle Gate Cottage[2]	46	46	42	48	45	47	44	50	50
[C] Thrumpton	35	37	33	41	40	39	37	45	44
[D] Winking Hill Farm	38	41	38	52	52	56	56	60	59
[E] Ratcliffe-on-Soar Village[3]	Not Applicable	44	50	44	50	56	56	59	59

Notes
1 Specific Noise Level from steady continuous noise from Power Station off-load activities estimated to be equal to typical lowest overnight L_{A90}.
2 Middle Gate Cottage noise level is largely fixed by nearby cooling towers. To estimate the future background/residual sound level it is conservatively assumed to be the same as Redhill Marina/Farm.
3 Ratcliffe-on-Soar Village is remote from both the Proposed Development and the Power Station operational plant. As the Power Station was not discernible during any of the attended surveys, it is assumed that the baseline will remain unchanged following the decommissioning and clearing of the Power Station.
4 Future Baseline L_{A90} Level = logarithmic subtraction of estimated specific noise level for Power Station site from Current Baseline L_{A90} level.
5 Future Baseline Residual L_{Aeq} Level = logarithmic subtraction of estimated specific noise level for Power Station site from Current baseline residual L_{Aeq} level.

The removal of the majority of the current plant buildings will mean that there are fewer structures to act as barriers to noise propagation from the proposed development site. The specific noise level at the affected receptors will increase relative to the current baseline. See noise contour maps in Appendix 7-7.

NCC received 16.07.2020

APPENDIX 7-5: CONSTRUCTION PLANT INVENTORY

Table 12: Construction Plant Noise Emissions and Activity for Main Phases of Construction

Construction Phase	Sound Power Level L_{WA} dB	% Operating Time	Activity Equivalent Sound Power L_{WA} dB
Earthworks:			
Dozer	106	80	105
Excavator/Loader	103	80	102
Dump Truck	107	80	106
8 Wheel Tipper	107	80	106
Lorry	98	10	88
		Combined Activities	111
Piling:			
Piling Rig (percussive)	116	100	116
Truck Mixer	107	100	107
Concrete Pump	110	100	110
Lorry	103	20	96
		Combined Activities	117
General Site Noisy Activities:			
Excavator	104	100	104
HGV	98	20	91
Dumper	104	100	104
Telehandler	105	100	105
Compressor	95	100	95
Generator	103	100	103
Mobile Crane	94	100	94
		Combined Activities	110
Infrastructure Construction:			
Asphalt Melter	103	100	103
Asphalt Spreader	96	100	96
Road Roller	102	100	102
Lorry	103	100	103
Poker Vibrator	106	100	106
Concrete pump	103	100	103
Compressor	95	100	95
		Combined Activities	111
Building Construction:			
Excavator	106	100	106
Steelwork Erection	108	100	108
Concrete Pump	103	100	103
Concrete Vibrators	106	100	106
HGV	103	50	100
Cutting/Grinding	107	100	107
Hydraulic Pump	106	100	106
		Combined Activities	114

NCC received 16.07.2020

Construction Noise Model Assumptions

The construction noise model assumptions were as follows:

- Calculation was undertaken following the BS 5228 calculation methodology;
- Simplified topography (affecting propagation to [C] Thrumpton and [A] Redhill Marina – i.e. only where there is a significant disruption to the line of sight from the receptor to the site);
- No significant barrier effect is assumed for other locations where line of sight to the construction site is not so obviously obscured by intervening ground features; and
- The existing Power Station's main buildings have been retained in the noise prediction model as the construction is planned to occur while the plant is still operational and buildings still present.

The combined equivalent continuous sound power level is assumed to be generated at the centre of the Proposed Development. A range of values is then calculated based on a distance correct for all the activity theoretically occurring at the closest and furthest position on the site, relative to each noise sensitive receptor.

NCC received 16.07.2020

APPENDIX 7-6: ASSUMED NOISE LEVELS FOR SITE PLANT AND CLADDING PERFORMANCE

Table 13: Noise Levels for Site Plant and Cladding Performance (including additional noise mitigation measures)

Plant Type or Area	Treatment (Cladding Performance R'w) dB[1]	Sound Power (SWL)[1] Sound Pressure Level (SPL) at roof/ walls/vents/ doors dB(A)	Assumed % Operating Time	Period of Operation
Bunker (walls/roof)	26 (composite)	85 (SPL)	100	Day/Night
Boiler House(walls/roof)	26 (composite)	85 (SPL)	100	Day/Night
Tipping Hall (walls/roof)	26 (composite)	85 (SPL)	100	Day
Flue Gas Treatment Area (walls/roof)	26 (composite)	85 (SPL)	100	Day/Night
Ash Handling (walls/roof)	26 (composite)	75 (SPL)	100	Day/Night
Steam Turbine Building (walls/roof)	38 (composite)	95 (SPL)	100	Day/Night
Fan Stack (top)	Silencer	95 (SWL)	100	Day/Night
Boiler Vents (roof)	Silencer	95 (SWL)	100	Day/Night
Turbine Vents (roof)	Silencer	95 (SWL)	100	Day/Night
Workshop (walls/roof)	26 (composite)	85 (SPL)	100	Day/Night
Ventilation Louvres	25	85 (SPL)	100	Day/Night
Turbine Access Doors	29	95 (SPL)	100	Day/Night
Access Doors (Other)	18 (Min)	85 (SPL)	100	Day/Night
11/33 kV Transformer	-	85 (SWL)	100	Day/Night
33/132 kV Transformer	-	95 (SWL)	100	Day/Night
HGV[2]	-	103 (SWL)	13 per hour	Day
Tipping Hall Doors	18 (auto action type)	85 (SPL)	100	Day/Night
Air Cooled Condenser Fans	Wind Screen above fans	94 (SWL) Each fan. 8 Fans 103 (SWL)	100	Day/Night
Turbine Air Cooler Fans	-	90 (SWL) Each (4 units, 96 (SWL))	100	Day/Night
Safety Valve	Silencer	126 (unsilenced SWL)	Occasional	Day (where non-emergency)
Noise Character (i.e. tonal, impulsivity and intermittency)	Detailed design of plant to ensure no perceptible noise character at NSRs		100	Day/Night

Note 1 Exact sound power levels of plant and performance of cladding/silencers and noise control treatment will be identified during future detailed design studies. The final installed configuration may differ from the nominal values presented in the table, but overall the design target will be consistent with achieving a comparable operational noise level and impacts as described in Chapter 7.4.

Note 2 During plant operation 155 HGV movements will occur between 06:00 and 18:00, which equates to an average of approximately 13 HGVs per hour. For the purpose of quantifying their contribution to the operational noise emission from the site, it is assumed that there are 2 HGVs moving around the site at any one time. Each HGV is represented in the noise model as series of line segments along the HGV route with an overall sound power level of 103 dB L_{WA}.

NCC received 16.07.2020

ISO 9613-2 Noise Model Assumptions

Ground Type (G) for Proposed Development Area	0 (Hard)
Ground Type (G) for area between site area and Receptors	0.5 (Mixed)
Relative Humidity	70 %
Air Temperature	10 °C
Propagation Condition	Downwind
Number of Reflections	1

Terrain/Topography

Ordnance survey contours have been sourced for the area surrounding the Proposed Development and interpolated into contours at 2 m intervals using the QGIS application. Some contours for the topography between the Proposed Development and receptors to the east, south and south-west have been excluded from the noise model. This prevents their presence from overly influencing the prediction when professional judgement suggests that the intervening ground would significantly obscure line of sight to the Proposed Development.

DTM Ground Elevation Data from https://environment.data.gov.uk/DefraDataDownload/?Mode=survey.

NCC received 16.07.2020

APPENDIX 7-7: NOISE MAPPING

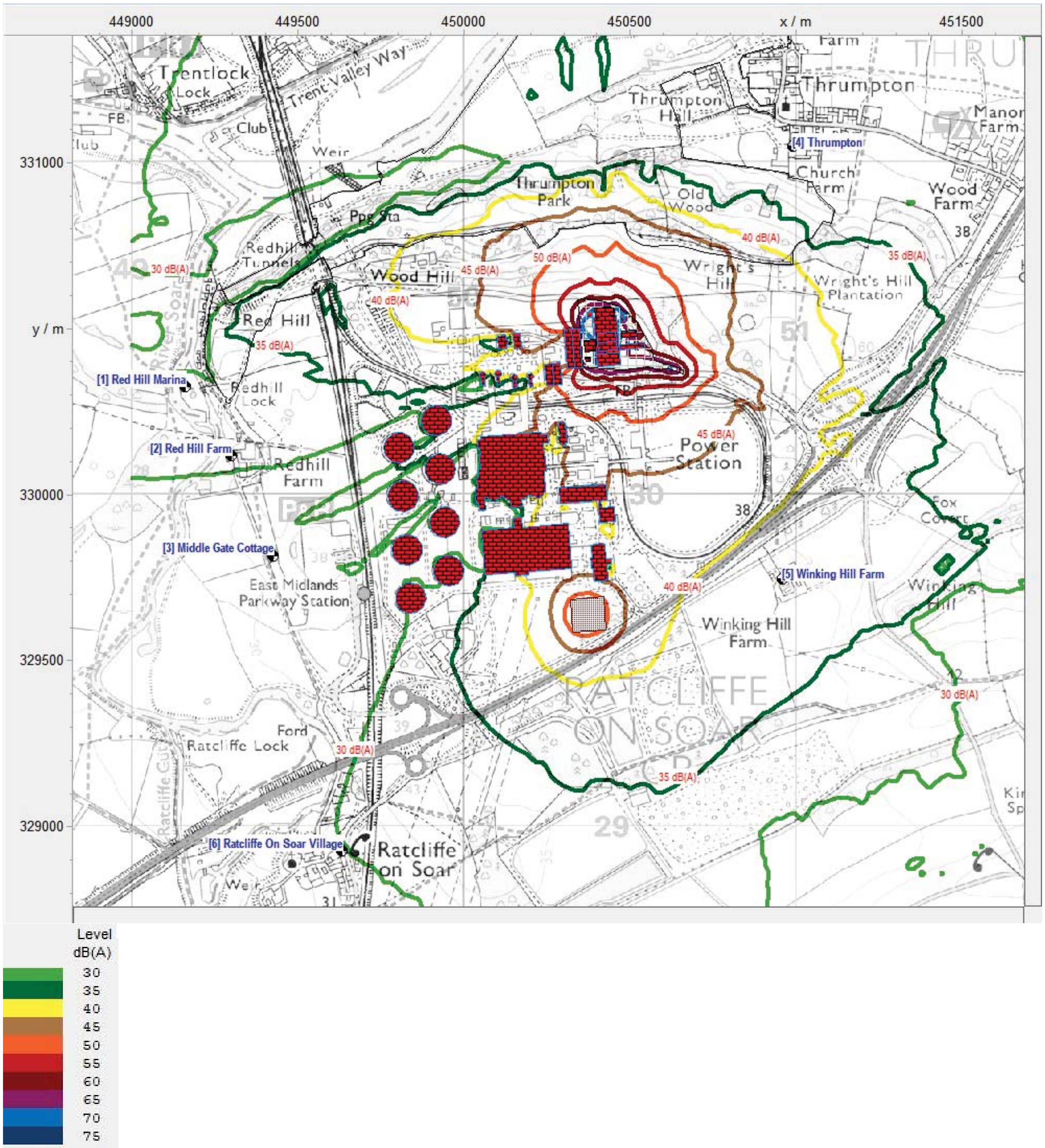


Figure 17: Noise Map of Daytime Levels – Baseline 1 (Current) with All Power Station Buildings Present

NCC received 16.07.2020

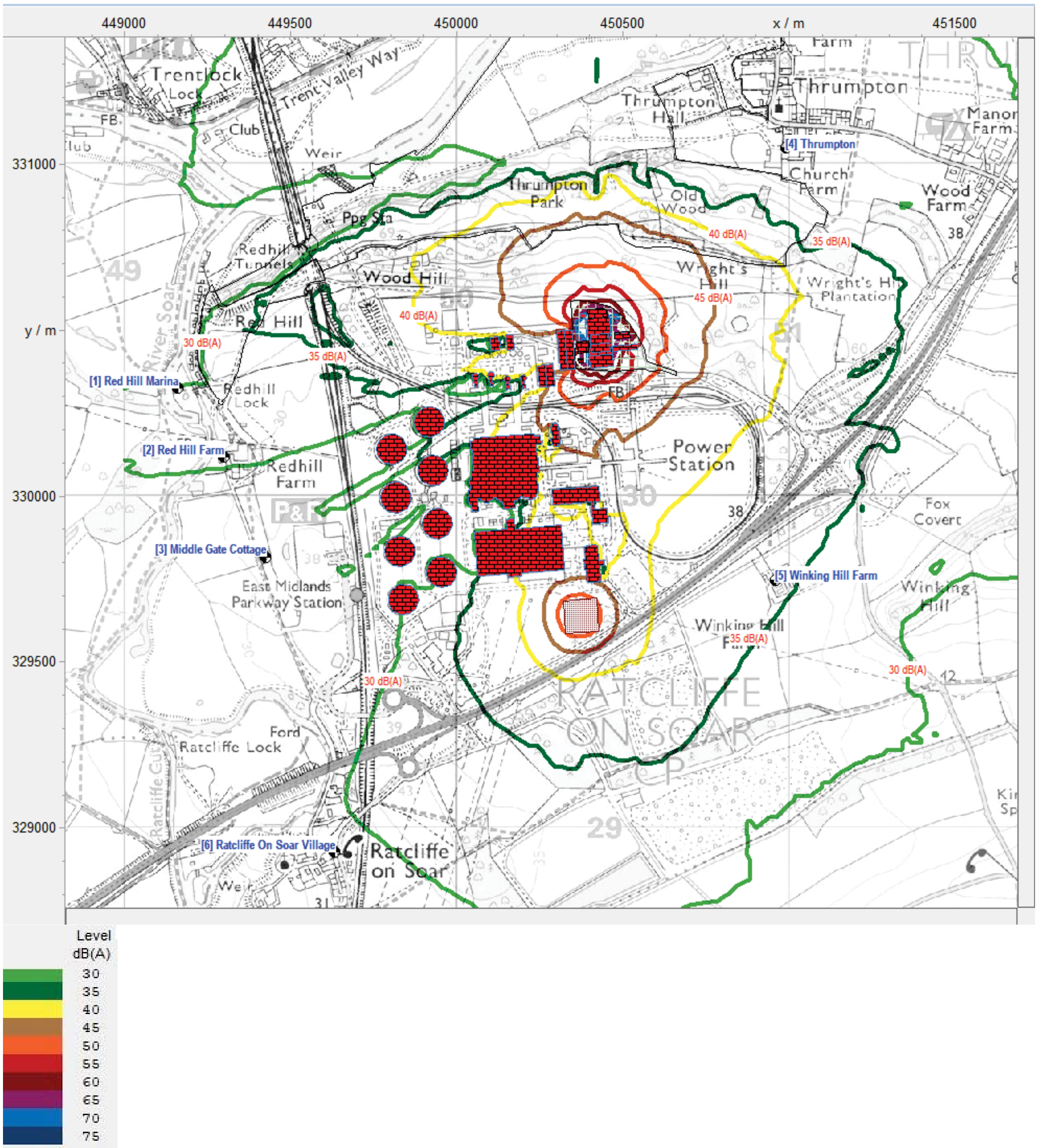


Figure 18: Noise Map of Night-time Levels – Baseline 1 (Current) with All Power Station Buildings Present

NCC received 16.07.2020

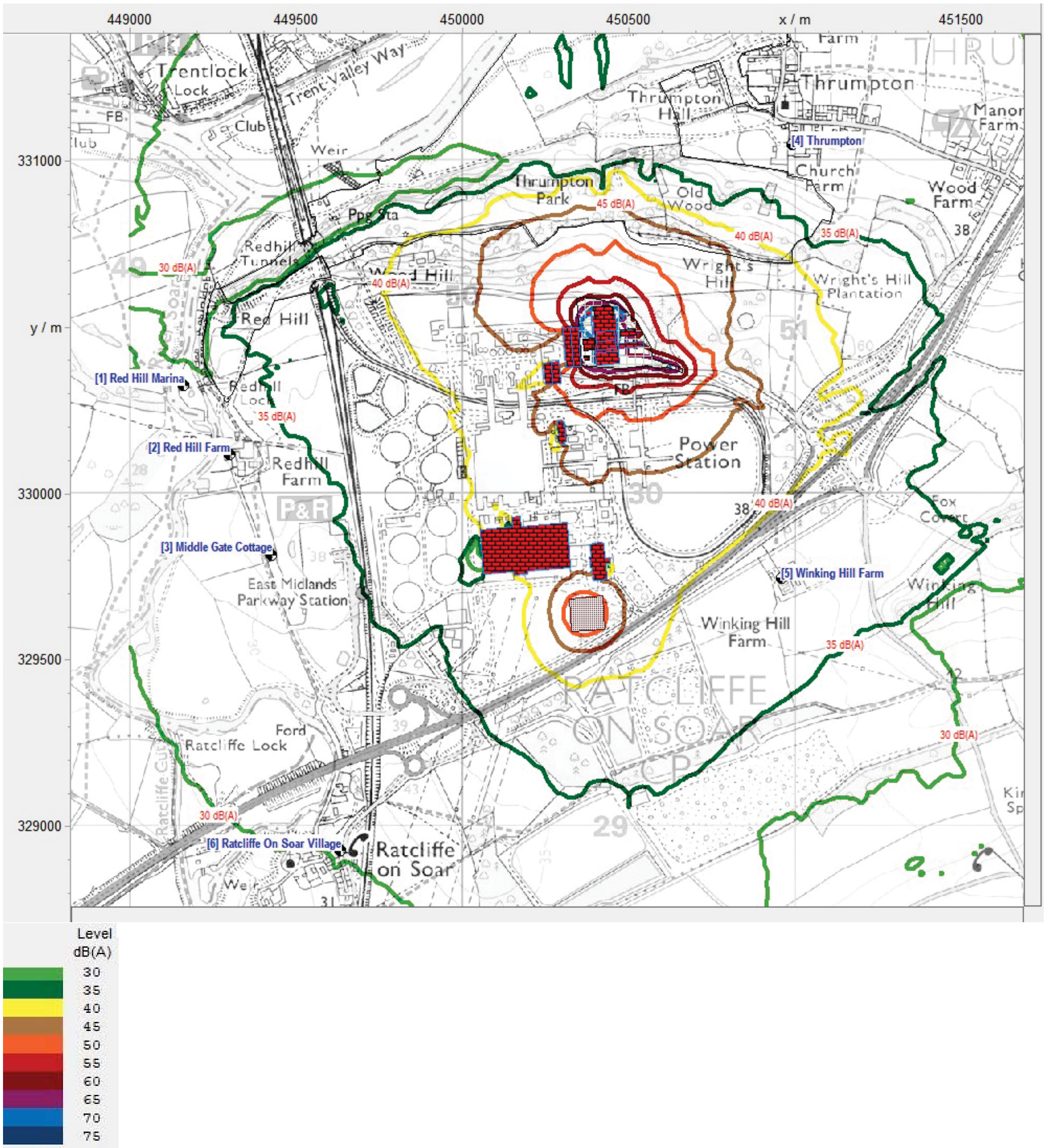


Figure 19: Noise Map of Daytime Levels – Baseline 2 (Future) with Majority of Power Station Buildings Removed

NCC received 16.07.2020

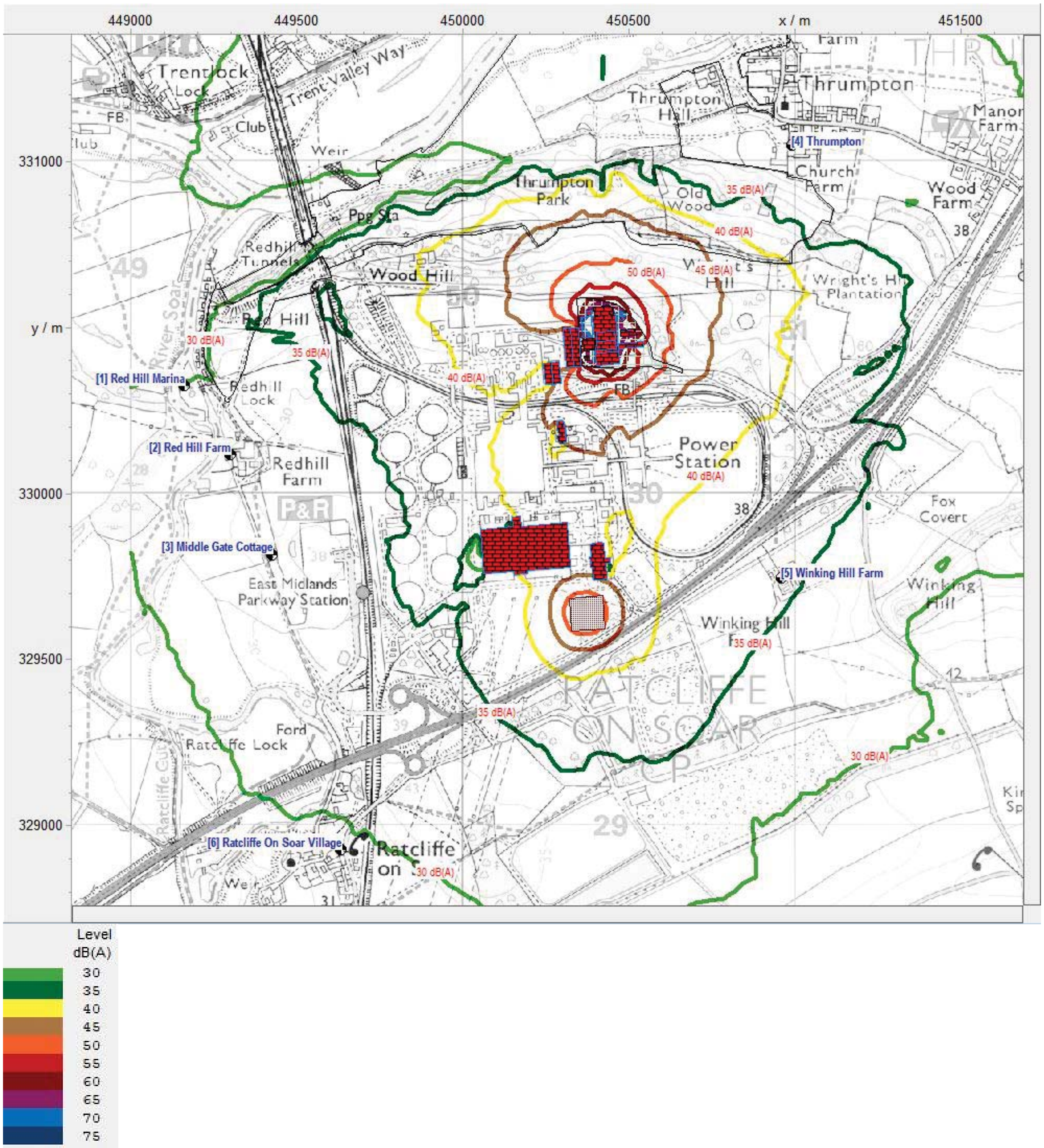


Figure 20: Noise Map of Night-time Levels – Baseline 2 (Future) with Majority of Power Station Buildings Removed

NCC received 16.07.2020

APPENDIX 7-8: ECOLOGICAL/LOCAL WILDLIFE SITE MONITORING

In response to the Request for Scoping Opinion, the NCC Ecologist advised that the assessment methodology needed to consider the potential impact from the Proposed Development on nearby Local Wildlife Sites (LWS). Monitoring of current noise levels and modelling of potential noise levels arising during the construction phase have been undertaken. The exercise has focussed on the nearest LWS (Thrumpton Park) in the expectation that impacts at more distant sites will be lower.

Thrumpton Park is the nearest LWS to the Site and extends over and area of approximately 76 hectares. Relative to the centre of the site, the nearest part of LWS is approximately 350 m north and furthest part is approximately 1150 m to the west.

Noise Survey

Monitoring was undertaken using the same methodology as followed for continuous monitoring at the human NSRs [A] to [D], i.e. 5-minute duration samples of L_{Aeq}, L_{A10}, L_{A90} and L_{Amax}.

Photograph 9: Thrumpton Park Local Wildlife Site Continuous Monitoring Position

NCC received 16.07.2020

LWS Noise Survey Results

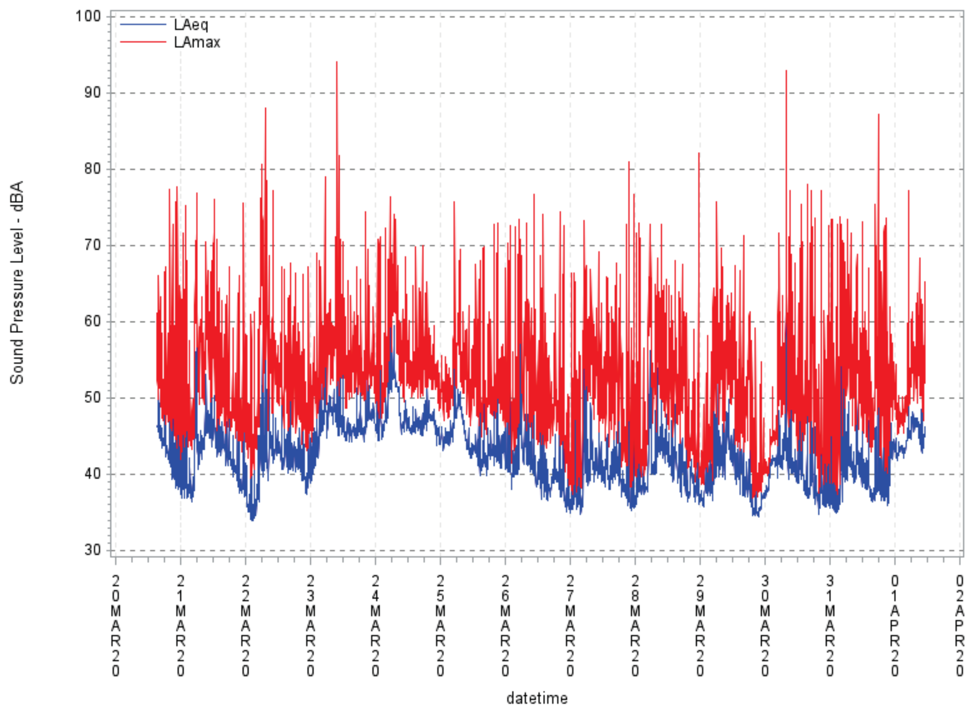


Figure 21: Timeseries of L_{Aeq} and L_{Amax} Levels at Thrumpton Local Wildlife Site

	LAeq	LA01	LAmax
N	3403	3403	3403
Min	33.9	36.1	36.8
25%ile	39.4	43.7	47.3
Median	42.4	47.4	51.7
75%ile	45.6	51.4	56.7
90%ile	48.1	56.2	63.1
95%ile	51.1	60.7	68
99%ile	57.9	70	75.6
Max	63.8	76.5	94.2
Mean	42.8	48.2	52.6
Std	4.7	6.6	7.9

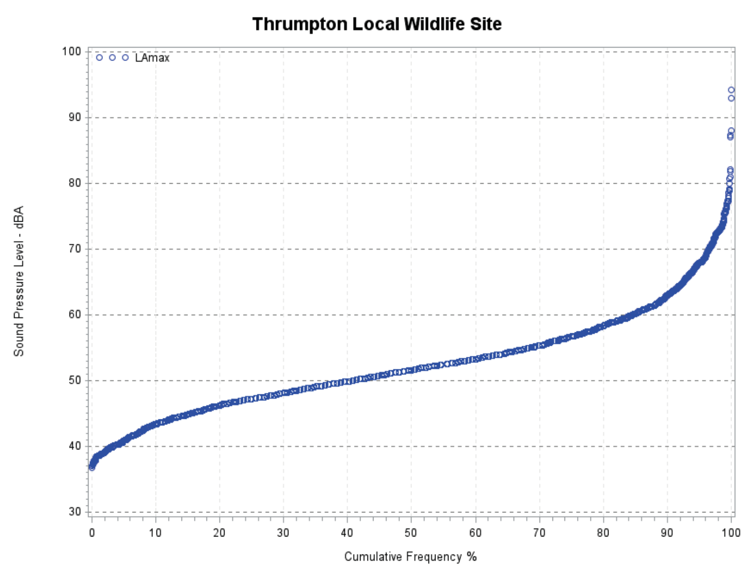


Figure 22: Statistics and Cumulative Distribution of L_{Amax} Levels at Thrumpton Local Wildlife Site

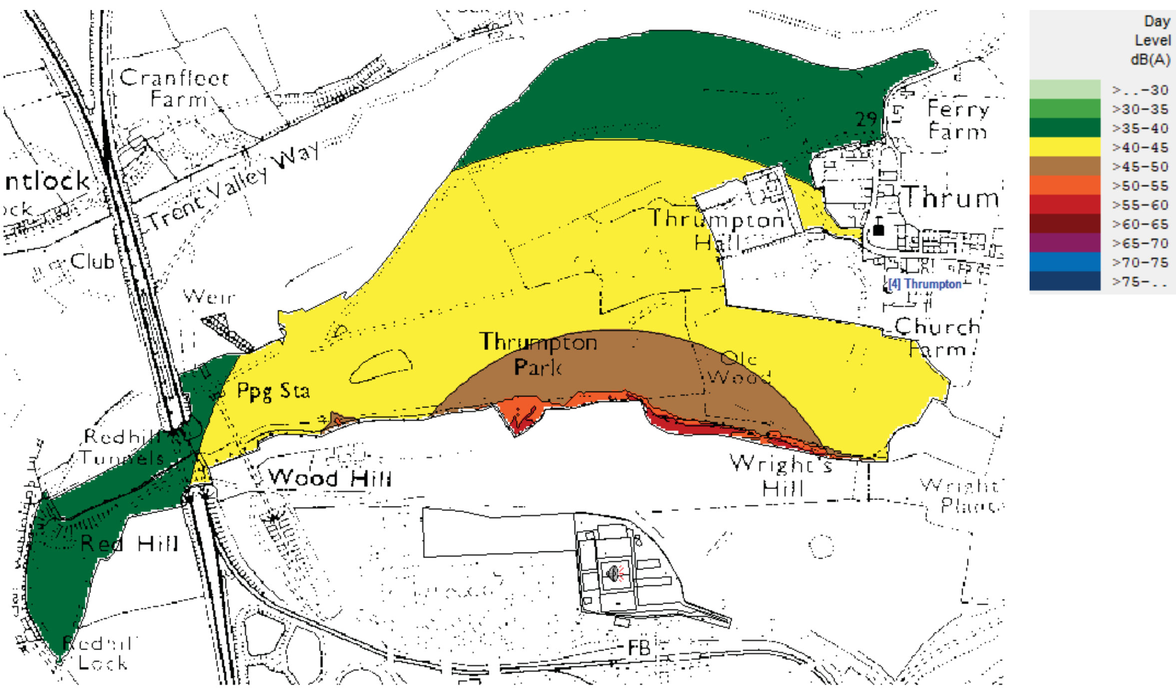
NCC received 16.07.2020

Construction Noise Predictions at LWS

The extent of the nearest Local Wildlife Sites (Thrumpton Park and Red Hill) has been identified within the noise model by tracing their perimeter coordinates from maps taken from the Nottingham City Council mapping website (https://maps.nottinghamcity.gov.uk/insightmapping/# [Environment/Local Wildlife Sites Layers]).

Noise level predictions based on the Piling construction activity (combined sound power level of 117 dB L_{WA}) taking place at the nominal centre of the proposed development have been calculated using the BS5228 methodology. In addition, a supplementary calculation using the ISO 9613-2 methodology has been undertaken – which includes a more realistic representation of the probable barrier attenuation due to intervening topography. A receptor height of 30 cm is assumed in the model to represent ground nesting birds.

The areas of the LWS area predicted to experience ranges of L_{Aeq} levels are shown as noise maps and quantified in terms of percentage of LWS area (see Figure 23 and Figure 24).



BS5228 Prediction: Percentage of LWS Area experiencing L_{Aeq} dB Level during Piling Phase (LWA = 117 dB)

	Approximate Area/m²	L_{Aeq} Sound Pressure Level Range dB						
		<35	35-40	40-45	45-50	50-55	55-60	Total
Redhill LWS	53075	0	96.6	3.4	0	0	0	100
Thrumpton LWS	766375	0	26	59.9	11.5	1.7	1	100

Figure 23: Noise Map of Piling Noise Levels Across Local Wildlife Sites (BS5228 Methodology)

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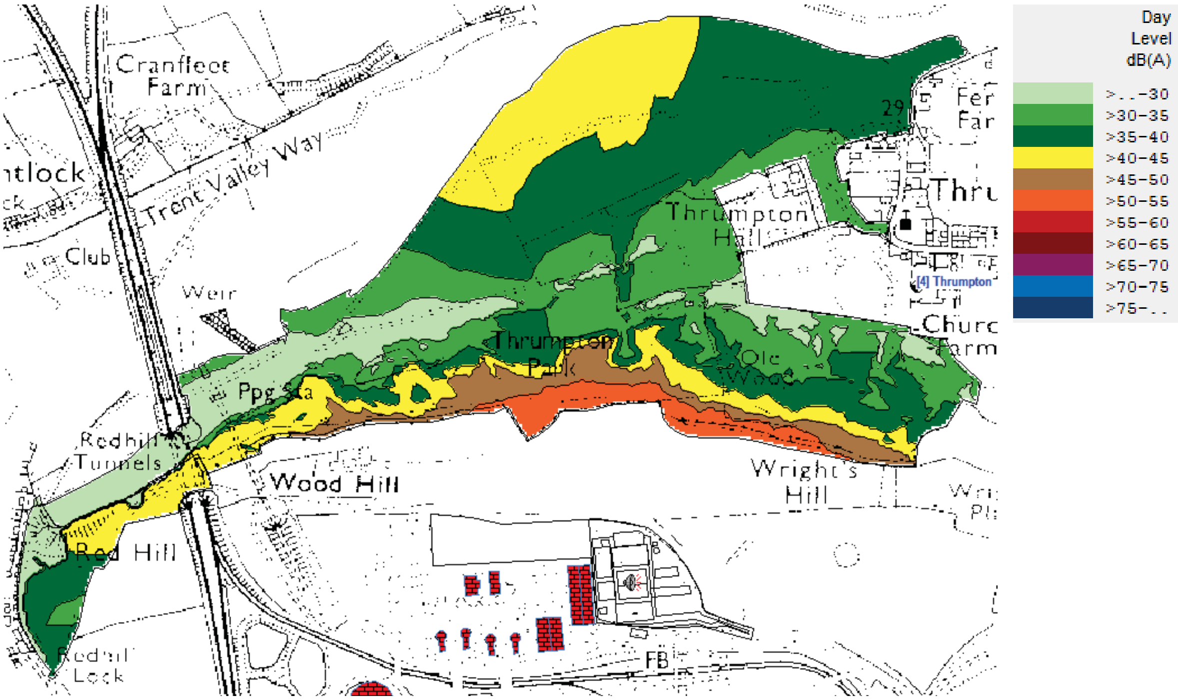

ISO 9613/2 Prediction: Percentage of LWS Area experiencing L_{Aeq} dB Level during Piling Phase (L_{WA} = 117 dB, assuming piling noise generated at an elevation of 10 m above ground)

LWS	Approximate Area/m^2	L_{Aeq} Sound Pressure Level Range dB						
		<35	35-40	40-45	45-50	50-55	55-60	Total
Redhill LWS	53075	29	34.5	36.6	0	0	0	100
Thrumpton LWS	766375	37.7	34	18.3	5.7	4.3	0	100

Figure 24: Noise Map of Piling Noise Levels Across Local Wildlife Sites (ISO 9613-2 Methodology)

The monitoring results indicate a mean L_{Aeq} of approximately 43 dB and 5 % of the 5-minute interval periods contained L_{Amax} levels in excess of 68 dB.

The ISO 9613-2 based predictions indicates that 4.3 % of the Thrumpton LWS area is likely to experience levels in the 50–55 dB L_{Aeq} range.

The BS 5228 based predictions indicates that 2.7 % of the Thrumpton LWS area is likely to experience levels above 50 dB L_{Aeq} when piling is taking place at centre of the Site.

As the ISO 9613-2 methodology takes into account additional attenuation arising from the intervening topography acting as a barrier to propagation, generally lower levels are predicted for those parts of the LWS without line of sight to the Proposed Development site.

Of the wildlife, birds are likely to be the most sensitive to noise and an assessment of the potential impact of these levels is provided in Chapter 6.0 Ecology and Nature Conservation.

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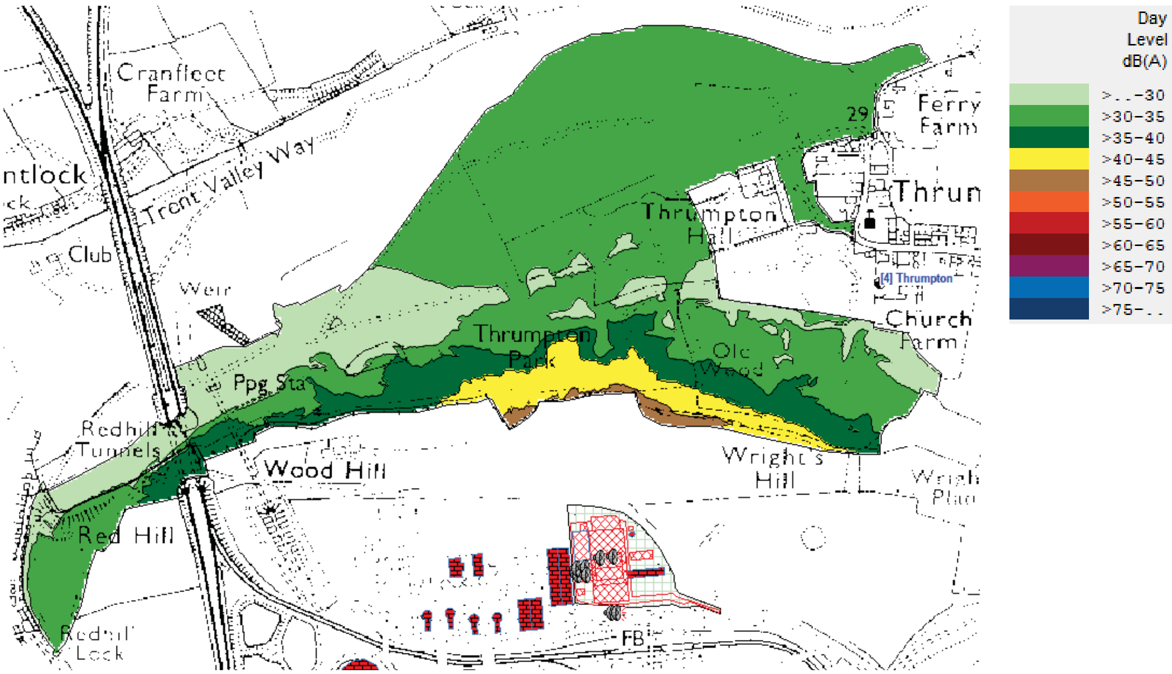
Operational Noise Predictions at LWS

For the operational phase of the Proposed Development, the sections of the LWS area predicted to experience ranges of L_{Aeq} levels arising from it are shown in a noise map and quantified in terms of percentage of LWS area (Figure 25).



ISO 9613-2 Prediction: Percentage of LWS Area Experiencing L_{Aeq} dB Level during Operation of the Proposed Development

LWS	Approximate Area/m²	L_{Aeq} Sound Pressure Level Range dB						Total
		<30	30-35	35-40	40-45	45-50	50-55	
Redhill LWS	53075	14.6	69.9	15.5	0	0	0	100
Thrumpton LWS	766375	19.2	62.4	10.9	6.3	1.2	0	100

Figure 25: Noise Map of Operational Noise Levels Across Local Wildlife Sites (ISO 9613-2 Methodology)

The steady noise arising from the operation of the Proposed Development is estimated to not give rise to levels above 50 dB L_{Aeq} at any part of the LWS.

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APPENDIX 7-9: ROAD TRAFFIC NOISE SENSITIVITY

The Transport Assessment, Chapter 11.0, gives details of the additional traffic flows associated with the construction and operation of the proposed development. All HGVs and the overwhelming majority of the cars/vans will travel to and from the site via the A453 from the northeast or southwest and road leading to the Site access. From an environmental noise impact perspective, a basic sensitivity study has been undertaken into the relative noise contributions at residential NSRs arising from vehicles on these three sections of road.

An average of 30 vehicles movements per hour on the road accessing the Site occur during construction, which is below the 50 per hour lower limit for a CRTN calculation. For this sensitivity test an increased average flow of 50 vehicles per hour (20 % HGVs) is assumed.

Modelling Assumptions

- Calculation Method: CRTN – Calculation of Road Traffic Noise
- IMMI Noise Prediction Software
- 2 way traffic flow
- 2023 Baseline with committed development trips
- All Power Station buildings present
- Simplified road geometry (No junctions/slip-roads)
- Terrain – only the significant topographic features that are present between the Site and Thrumpton village are considered.

Road Section Data

Section 1: Access Road to the Site (30 km/h)

- 06:00–24:00 50 veh./h, 20 % HGV
- 00:00–06:00 50 veh./h, 20 % HGV

Note: The average 2-way flow during construction CRTN calculation methodology

Section 2: A453 (SW of Access Road, 97 km/h)

- 06:00–24:00 2068 veh./h, 9.7 % HGV (equivalent to 37226 vehicles over 18 hour period)
- 00:00–06:00 348 veh./h, 10.8 % HGV (equivalent to 2086 vehicles over 6 hour period)

Section 3: A453 (NE of Access Road, 97 km/h)

- 06:00–24:00 1862 veh./h, 9.8 % HGV (equivalent to 33508 vehicles over 18 hour period)
- 00:00–06:00 317 veh./h, 11.1 % HGV (equivalent to 1897 vehicles over 6 hour period)

Results

The CRTN predicted $L_{A10,1hr}$ noise levels are shown in Figure 26 and details of the contributions from the three key road sections at each of the six residential NSRs are summarised in Table 14.

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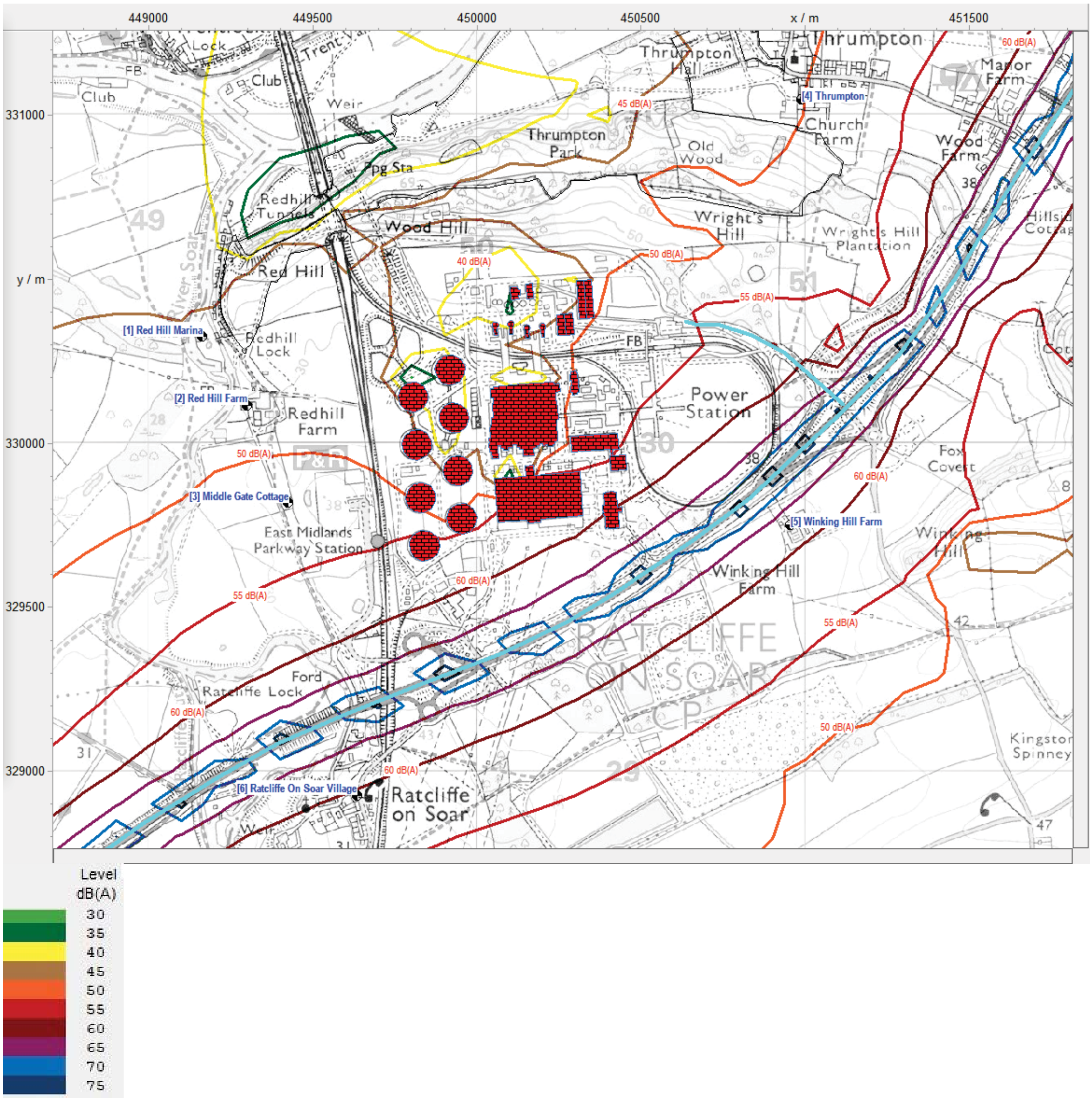

Figure 26: Noise Map of average $L_{A10,1hr}$ Levels during 06:00–24:00 Period

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Table 14: Road Section Contributions to $L_{A10,1hr}$ for 2023 Baseline and Committed Development Flows and 50 veh./h to the Site

	Period 06:00–24:00					Period 00:00–06:00				
	A343					A453				
Location	NE	SW	Total	Access Road to Site	Access Road minus Total A453 ▲dB	NE	SW	Total	Access Road to Site	Access Road minus Total A453 ▲dB
[1] Red Hill Marina	31	46	46	16	-30	23	38	38	16	-22
[2] Red Hill Farm	24	48	48	-3	-51	16	41	41	-3	-44
[3] Middle Gate Cottage	22	52	52	4	-48	14	44	44	4	-40
[4] Thrumpton	50	31	50	13	-37	42	24	42	13	-29
[5] Winking Hill Farm	46	62	62	34	-28	38	55	55	34	-21
[6] Ratcliffe on Soar	38	59	59	19	-40	30	52	52	19	-33

Due to the considerably higher flows and vehicle speeds on the A453 segments, their contributions dominate the level of road traffic noise prediction at all the receptors. The contribution from access road to the Site is at least 21 dB lower than the A453 contribution at any receptor during 06:00–24:00 and 00:00–06:00 periods. The traffic flow along the access road would have to increase by a factor of 10 from the 50 vehicles/h assumed in this sensitivity test before the contribution from the section would require consideration. Traffic flows of this magnitude are not predicted to occur at any point in the construction or operation of the Proposed Development.

Overall, due to its relative short length, lower speed and remoteness from residential receptors, the contribution from vehicles using the access road can be considered to be insignificant within the road noise impact assessment. Consequently, it is appropriate to adopt a simplified approach to assessment and only consider the increase in noise associated with the increased flow volumes and HGV percentages on the north-east and south-west segments of the A453 dual carriageway.

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APPENDIX 8-1: AIR QUALITY ASSESSMENT

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UTG/20/PMP/386/R
Job No: 2122.C91164.001
June 2020

AIR QUALITY ASSESSMENT FOR THE PROPOSED EMERGE CENTRE AT RATCLIFFE-ON-SOAR
prepared for
DR A READ, RATCLIFFE-ON-SOAR REDEVELOPMENT MANAGER
by
V Kulambi & S J Griffiths

SUMMARY

Uniper is proposing building an energy recovery facility, the East Midlands Energy Re-Generation (EMERGE) Centre, on the Ratcliffe-on-Soar power station site. An air dispersion modelling study has been undertaken to evaluate the significance of any air quality effects that may arise from the Proposed Development. Where it was necessary to make assumptions and approximations, a worst-case approach has been adopted to ensure that the modelled concentrations are likely to be overestimates rather than underestimates.

This study concludes that no human health based ambient air quality standards or guidelines are predicted to be exceeded due to emissions from the Proposed Development and hence there will be no significant adverse effects on human health.

This study also concludes that there will be no significant adverse effects on the sensitive features at local ecological sites due to emissions from the Proposed Development.

Prepared by | **Approved for publication**

Master copy signed by J M Lines (pp V Kulambi) & S J Griffiths (19/06/2020)

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CLIENT DISTRIBUTION LIST

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ABBREVIATIONS / NOMENCLATURE

ADMS	Air Dispersion Modelling System
AEL	Associated Emission Level
AQAL	Air Quality Assessment Level
AQS	Air Quality Strategy
As	Arsenic
BAT	Best Available Techniques
BREF	Best Available Techniques Reference Document
Cd	Cadmium
CO	Carbon Monoxide
Co	Cobalt
Cr	Chromium
Cu	Copper
CLv	Critical Level
CL_{MaxN}	Acid Critical Load
CL_{NutN}	Nutrient Nitrogen Critical Load
EA	Environment Agency
EAL	Environmental Assessment Level
ELV	Emission Limit Value
EPUK	Environmental Protection UK
GT	Gas Turbine
HCl	Hydrogen Chloride
HF	Hydrogen Fluoride
Hg	Mercury
IAQM	Institute of Air Quality Management
IED	Industrial Emissions Directive
IPPC	Integrated Pollution Prevention and Control
LCP BREF	Large Combustion Plant BREF
LNR	Local Nature Reserve
LWS	Local Wildlife Site
Mn	Manganese
NH_3	Ammonia
Ni	Nickel
NNR	National Nature Reserve
NO	Nitric Oxide
NO_2	Nitrogen Dioxide
PAH	Polycyclic Aromatic Hydrocarbon
Pb	Lead
PC	Process Contribution
PCB	PolyChlorinated Biphenyl
PEC	Predicted Environmental Concentration
PM_{10}	Particulate Matter (< 10 μm diameter)
$PM_{2.5}$	Particulate Matter (< 2.5 μm diameter)
PS	Primary School
SAC	Special Area of Conservation
Sb	Antimony
SO_2	Sulphur Dioxide
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
Tl	Thallium
TOC	Total Organic Carbon
V	Vanadium
VOC	Volatile Organic Carbon
WI BREF	Waste Incineration BREF

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1 INTRODUCTION

This air quality dispersion modelling report quantifies the potential impact of the proposed East Midlands Energy Re-Generation (EMERGE) Centre to be located on the Ratcliffe-on-Soar power station site.

Emissions to air from the Proposed Development have the potential to adversely affect human health and sensitive ecosystems. This report details the results of a dispersion modelling assessment of emissions from the process.

The magnitude of air quality impacts at sensitive human receptors are quantified for pollutants emitted from the main stacks of the Proposed Development. The impact of emissions on sensitive ecological receptors is considered in the context of relevant critical loads or critical levels for designated nature sites.

The assessment considers emissions from the Proposed Development during normal operational conditions. Non-routine emissions, such as those which may occur during the commissioning process or other short-term events, typically only occur infrequently. These are detected by the process control system, rectified within a short time period and tightly regulated by the Environment Agency (EA). For this reason, no detailed consideration of impacts associated with non-routine or emergency events are included within this assessment. Abnormal operation will, however, be considered as part of the environmental permit application process.

2 SCOPE

This assessment considers the impact of process emissions on local air quality, under normal operating conditions, from the main stacks serving the combustion process. This study has been designed to assess the potential effects of emissions to air on the local population and ecosystems from the Proposed Development. This has been carried out by comparing ground level concentrations of released substances with standards and guidelines for ambient air quality, taking background levels of these substances into account. Standards and guidelines which have been specified with regard to potential human health effects have been included together with guidelines for vegetation and ecosystems for assessing the impact of emissions on designated conservation sites.

The impact of emissions for which the primary human exposure route is via ingestion are considered separately in the human health risk assessment in Appendix 8-2 of the ES.

The pollutants considered within this assessment from the main stacks are those regulated under the Industrial Emissions Directive and the associated Waste Incineration Best Available Techniques Reference (WI BREF) document, namely:

- Oxides of Nitrogen (NO_x), as Nitrogen Dioxide (NO_2);
- Sulphur Dioxide (SO_2);
- Carbon Monoxide (CO);
- Particulate Matter (as PM_{10} and $PM_{2.5}$ size fractions);
- Hydrogen Chloride (HCl);
- Hydrogen Fluoride (HF);
- Ammonia (NH_3);
- Volatile Organic Compounds (VOCs) as Benzene and 1,3-butadiene;
- Polycyclic Aromatic Hydrocarbons (PAH) as benzo[a]pyrene;

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- Polychlorinated Biphenyls (PCB);
- Twelve metals (Cadmium (Cd), Thallium (Tl), Mercury (Hg), Antimony (Sb), Arsenic (As), Lead (Pb), Chromium (Cr), Cobalt (Co), Copper (Cu), Manganese (Mn), Nickel (Ni) and Vanadium (V)); and
- Polychlorinated dibenzo-para-dioxins and polychlorinated dibenzo furans (referred to as dioxins and furans).

Where data is available, cumulative impacts from existing sources of pollution in the area have been accounted for in the adoption of site-specific background pollutant concentrations from air quality monitoring networks in the local vicinity to the Proposed Development. Additional modelling, including the cumulative impact of the Proposed Development with operation of the open cycle gas turbines (OCGTs) and / or the coal-fired power station at Ratcliffe-on-Soar, has been included. These modelling assessments will include some double accounting for emissions from the OCGTs and the coal-fired power station as the impact of the two existing installations on ground level concentrations will be included in the local monitoring data.

The High-Speed Rail development (HS2) has not been considered in this assessment as the long-term air quality impacts from the High-Speed Rail development are negligible.

3 ASSESSMENT CRITERIA

3.1 Air Quality Assessment Levels (AQALs)

European air quality legislation is consolidated under the Ambient Air Quality Directive (Directive 2008/50/EC) (Council of European Communities, 2008), which came into force on 11 June 2008. This Directive consolidates previous legislation which was designed to deal with specific pollutants in a consistent manner and provides Ambient Air Directive (AAD) Limit Values for sulphur dioxide, nitrogen dioxide, benzene, carbon monoxide, lead and particulate matter with a diameter of less than 10 µm (PM_{10}) and a new AAD Target Value and Limit Value for fine particulates (those with a diameter of less than 2.5 µm ($PM_{2.5}$)).

The fourth daughter Directive – 2004/107/EC (Council of European Communities, 2004) – was not included within the consolidation. It sets health-based Target Values for polycyclic aromatic hydrocarbons (PAHs), cadmium, arsenic, nickel and mercury, for which there is a requirement to reduce exposure to as low as reasonably achievable. Directives 2008/50/EC (Council of European Communities, 2008) and 2004/107/EC (Council of European Communities, 2004) are transposed into UK Law into the Air Quality Standards Regulations (HMSO, The AIr Quality Standards Regulations 2010, UK Statutory Instruments 2010 No. 1001 http://www.legislation.gov.uk/uksi/2010/1001/contents/made, 2010) and subsequent amendments.

The UK Government and the devolved administrations are required under the Environment Act (HMSO, 1995) to produce a national air quality strategy. This was last reviewed and published in 2007 (DEFRA and the Devolved Administrations, 2007). The Air Quality Strategy (AQS) sets out the UK's air quality objectives and recognises that action at national, regional and local level may be needed, depending on the scale and nature of the air quality problem. This includes additional targets and limits for 15-minute sulphur dioxide and 1,3-butadiene and more stringent requirements for benzene and PAHs, known as AQS Objectives.

Environmental Assessment Levels (EALs) for other pollutants are presented on the gov.uk website as part of the Environment Agency's Environmental Management Guidance (Environment Agency, 2016a), which was last updated on 2 August 2016. AAD Target and Limit Values, AQS Objectives,

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and EALs are set at levels well below those at which significant adverse health effects have been observed in the general population and sensitive groups. For the remainder of this assessment these are collectively referred to as Air Quality Assessment Levels (AQALs).

Local Air Quality Management Technical Guidance (DEFRA, 2016) referred to as LAQM.TG(16), outlines that the AQALs apply in the following locations:

- Annual mean – all locations where members of the public might be regularly exposed – i.e. building facades of residential properties, schools, hospitals, care homes, etc.

- 24-hour mean and 8-hour mean – all locations where the annual mean objective would apply together with hotels and gardens of residential properties.

- 1-hour mean – all locations where the annual mean, 24-hour and 8-hour mean apply together with kerbside sites and any areas where members of the public might be reasonably expected to spend one hour or more.

- 15-minute mean – all locations where members of the public might reasonably be exposed for a period of 15 minutes or more.

Table 1 shows the AQALs used in this assessment. There are no AQALs for Thallium or Cobalt; therefore, these pollutants have not been considered further in this assessment.

3.2 Industrial Pollution Regulation

Atmospheric emissions from industrial processes are controlled in the UK through the Environmental Permitting (England and Wales) Regulations (HMSO, 2010), and subsequent amendments. The Proposed Development will be regulated by the Environment Agency and so will need an Environmental Permit to operate. The Environmental Permit will include conditions to prevent fugitive emissions of dust and odour beyond the boundary of the installation. The Environmental Permit will also include limits on emissions to air.

The Industrial Emissions Directive (IED) (Directive 2010/75/EU) (European Commission, 2010), was adopted on 7 January 2013, and is the key European Directive which covers almost all regulation of industrial processes in the EU. Annex VI of the IED sets emission limit values (ELVs) which must be met by all waste incineration and co-incineration plants. These are set as daily and half hourly averages for emissions which require continuous monitoring and as sampling period averages for heavy metals.

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Table 1: Air Quality Assessment Levels (AQALs)

Pollutant	AQAL ($\mu g/m^3$)	Averaging Period	Frequency of exceedance	Source
Nitrogen dioxide	200	1 hour	18 times per year (99.79th percentile)	AAD Limit Value
	40	Annual	-	AAD Limit Value
Sulphur dioxide	266	15 minutes	35 times per year (99.9th percentile)	AQS Objective
	350	1 hour	24 times per year (99.73rd percentile)	AAD Limit Value
	125	24 hours	3 times per year (99.18th percentile)	AAD Limit Value
	50	Annual	-	WHO guideline
Carbon monoxide	30,000	1 hour	-	EA (2016)
	10,000	8 hour rolling	-	AAD Limit Value
Particulate matter (PM_{10})	50	24 hours	35 times per year (90.41st percentile)	AAD Limit Value
	40	Annual	-	AAD Limit Value
Particulate matter ($PM_{2.5}$)	25	Annual	-	AAD Limit Value
Hydrogen chloride	750	1 hour	-	EA (2016)
Hydrogen fluoride	160	1 hour	-	EA (2016)
	16	Annual	-	EA (2016)
Ammonia	2,500	1 hour	-	EA (2016)
	180	Annual	-	EA (2016)
Benzene	195	1 hour	-	EA (2016)
	5	Annual	-	AQS Objective
1,3-butadiene	2.25	Annual rolling	-	AQS Objective
PAHs – benzo[a]pyrene	0.00025	Annual	-	AQS Objective
PCBs	6	1 hour	-	EA (2016)
	0.2	Annual	-	EA (2016)
Cadmium	0.005	Annual	-	EA (2016)
Thallium	-	-	-	No AQAL
Mercury	7.5	1 hour	-	EA (2016)
	0.25	Annual	-	EA (2016)
Antimony	150	1 hour	-	EA (2016)
	5	Annual	-	EA (2016)
Arsenic	0.003	Annual	-	EA (2016)
Chromium (II & III)	150	1 hour	-	EA (2016)
	5	Annual	-	EA (2016)
Chromium (VI)	0.0002	Annual	-	EA (2016)
Cobalt	-	-	-	No AQAL
Copper	200	1 hour	-	EA (2016)
	10	Annual	-	EA (2016)
Lead	0.25	Annual	-	EA (2016)
Manganese	1,500	1 hour	-	EA (2016)
	0.15	Annual	-	EA (2016)
Nickel	0.02	Annual	-	EA (2016)
Vanadium	1	1 hour	-	EA (2016)
	5	Annual	-	EA (2016)

Within the IED, the requirements of the relevant sector BREF (Best Available Techniques Reference Document) become binding as BAT (Best Available Techniques) guidance, as follows:

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- Article 15, paragraph 2 of the IED requires that Emission Limit Values (ELVs) are based on best available techniques, referred to as BAT.
- Article 13 of the IED requires that ‘the Commission’ develops BAT guidance documents (referred to as BREFs).
- Article 21, paragraph 3 of the IED requires that when updated BAT conclusions are published, the Competent Authority (in England this is the Environment Agency) has up to four years to revise permits for facilities covered by that activity to comply with the requirements of the sector specific BREF.

The Waste Incineration BREF was finalised by the European IPPC (Integrated Pollution Prevention and Control) Bureau in December 2019 (European Commission, 2019). The WI BREF introduces BAT AELs (Best Available Techniques Associated Emission Levels) which are more stringent than those currently set out in the IED. These are set as daily averages for emissions which require continuous monitoring and as sampling period averages for those that do not.

The Proposed Development will be designed to comply with the IED ELVs and BAT-AELs set out in the Waste Incineration BREF for new plant, with the most stringent limit applying where these overlap. It should be noted that the BAT AELs are, in most cases, specified as a range of concentration values. Where this applies, the modelling has been based on the higher end of the range as a worst-case approach.

3.3 Significance Criteria

3.3.1 Significance Criteria for Long-Term Concentration Statistics

The EPUK (Environment Protection UK) & IAQM (Institute of Air Quality Management) 2017 Guidance (EPUK & IAQM, 2017) provides a matrix which should be used to describe the air quality impact based on the change in the concentration relative to the Air Quality Standard (AQS) objective/EAL and the overall predicted concentration with the Proposed Development (i.e. the future baseline plus the process contribution (PC)). The appropriate Air Quality Standard, AQS Objective or EAL is referred to as an Air Quality Assessment Level (AQAL) in the matrix shown in Table 2. The matrix is designed to be used with annual mean concentrations and is not applicable to short-term concentrations.

Table 2: Magnitude of change descriptors for use with annual mean concentrations

Long term average concentration at receptor in assessment year	Percentage change in concentration relative to AQAL			
	1 %	**2–5 %**	**6–10 %**	**> 10 %**
≤ 75 % of AQAL	Negligible	Negligible	Slight	Moderate
76–94 % of AQAL	Negligible	Slight	Moderate	Moderate
95–102 % of AQAL	Slight	Moderate	Moderate	Substantial
103–109 % of AQAL	Moderate	Moderate	Substantial	Substantial
≥ 110 % of AQAL	Moderate	Substantial	Substantial	Substantial

The matrix is intended to be used by rounding percentage pollutant concentrations up or down to the nearest whole number, to make it clear which category the impact falls within. Therefore, any impact which is between 0.5 % and 1.5 % would be classified as a 1 % change in concentration. An impact of less than 0.5 % is described as negligible, irrespective of baseline concentrations.

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The EPUK & IAQM 2017 Guidance (EPUK & IAQM, 2017) stresses two points that are worth reiterating here:

- “It is unwise to ascribe too much accuracy to incremental changes or background concentrations, and this is especially important when total concentrations are close to the AQAL. For a given year in the future, it is impossible to define the new total concentration without recognising the inherent uncertainty, which is why there is a category that has a range around the AQAL, rather than being exactly equal to it.

- The overall significance is determined using professional judgement. For example, a ‘moderate’ adverse impact at one receptor may not mean that the overall impact has a significant effect. Other factors need to be considered.”

3.3.2 Significance Criteria for Short-Term Concentration Statistics

The EPUK & IAQM 2017 Guidance (EPUK & IAQM, 2017) does not provide impact descriptors for short-term concentrations (i.e. averaging periods of less than a year). For assessment against short-term AQALs, the Environment Agency guidance “Air emissions risk assessment for your environmental permit” on the gov.uk website has been used (Environment Agency, 2016a). This states that impacts can be considered insignificant if:

- The short-term process contribution (PC) is < 10 % of the AQAL.

Where an impact cannot be screened out as “insignificant” based on the outputs of the initial screening and modelling, the significance of the effect has been determined based on professional scientific judgement of the likelihood of emissions causing an exceedance of an AQAL. This is a standard approach which allows the risk and likelihood of exceedance to be investigated and assessed in detail, following the first stage assessment.

3.3.3 Additional Significance Criteria for Metals

In addition, the Environment Agency guidance document ‘Guidance on assessing group 3 metals stack emissions from incinerators – V.4 June 2016’ (Environment Agency, 2016b) for assessing the impact of emissions of metals relative to their respective AQALs, states that where the PC for any metal exceeds 1 % of the long term or 10 % of the short term environmental standard (in this case the AQAL), this is considered to have potential for significant pollution. Where the PC exceeds these criteria, the Predicted Environmental Concentration (PEC) (i.e. the PC plus background concentrations) should be compared to the environmental standard. The PEC can be screened out where the PEC is less than the environmental standard. Where the impact is within these parameters, it can be concluded that there is no risk of exceeding the AQAL and, as such, the magnitude of change and significance of effect is considered negligible.

4 ASSESSMENT METHODOLOGY

An atmospheric dispersion model has been used to calculate the contribution of the Proposed Development to ground level concentrations of the released substances. The assessment methodology for air quality impacts is described in the following sections. The assessment methodology for impacts on local ecological sites is described in Section 7.

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4.1 Dispersion Model Selection

The atmospheric dispersion model ADMS (Air Dispersion Modelling System) version 5.2 has been used. ADMS is used extensively by power station operators and the Environment Agency and by many other industries and consultancies. ADMS was developed by CERC (Cambridge Environmental Research Consultants) and has been verified extensively against measurements.

4.2 Modelled Scenarios

Subject to securing the required consents, it is anticipated that the Proposed Development would begin operation early in 2025. In line with UK Government policy, the existing coal-fired power station at Ratcliffe-on-Soar will be required to close by October 2025. There is therefore a potential operational overlap of around 9 months for the existing power station and the Proposed Development. The wider Ratcliffe-on-Soar site also includes a pair of OCGTs which may be retained following closure of the existing power station. The wider site also includes a number of large buildings, such as the boiler house and cooling towers, which could potentially affect dispersion of the plume from the Proposed Development. Although the intention is to demolish and remove these buildings, they could remain in place for a significant period following closure of the existing station.

In order to fully account for these iterations, this assessment considers four scenarios:

- Scenario A: The Proposed Development operating continuously including only the buildings associated with the Proposed Development;
- Scenario B: The Proposed Development and the OCGTs operating continuously including only the buildings associated with the Proposed Development;
- Scenario C: The Proposed Development and the OCGTs operating continuously including the Proposed Development buildings and buildings on the Ratcliffe site above 30 m in height (above 1/3 of the lowest stack height); and
- Scenario D: The Proposed Development, the OCGTs and the coal-fired power station all operating continuously including the Proposed Development buildings and buildings on the Ratcliffe site above 30 m in height (above 1/3 of the lowest stack height).

The Proposed Development is anticipated to run with an annual load factor of 90 %, but has been assumed to operate with a 100 % annual load factor as a worst-case assumption.

The scenarios include worst-case assumptions in relation to operation of both the existing power station and the OCGTs. The existing power station is assumed to operate all four units at full load for the entire year (i.e. a 100 % annual load factor). In practice, the station has operated well below this level over recent years, averaging a 17 % load factor from 2015 to 2019.

The current power station environmental permit limits operation of the OCGTs to a maximum of 500 hours of operation per year (i.e. a 6 % annual load factor), but they are assumed to operate for the entire year in the modelling.

For the assessment of short-term effects (24 hours or less), it is possible, although highly unlikely, that the existing station and the OCGTs could be operating at full load simultaneously. For the assessment of long-term effects (i.e. annual impacts), the assessment will substantially overestimate the impacts of both the power station and the OCGTs.

As such, the modelling results in Scenarios B, C and D should not be interpreted as indicative of the current or expected impacts of the OCGTs and existing power station.

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4.3 Emission Characteristics

4.3.1 Emissions from the Proposed Development

The Proposed Development stacks would be the primary source of combustion emissions. There would be two stacks, one for each combustion line, which have been modelled as one combined stack at a height of 110 m above ground level with an internal diameter of 2.75 m (the height considered to represent BAT for the Proposed Development based on a range of stack heights assessed – see Appendix A).

The long-term modelled pollutant emission rates (in g/s) are determined by the higher end of the daily average BAT-AEL values set out within the Waste Incineration BREF (European Commission, 2019) whereas the short-term emission rates are based on the 30-minute ELVs set out within the IED (European Commission, 2010). For species which will not require continuous monitoring, such as heavy metals, PCBs and dioxins and furans, emissions are based on the WI BREF BAT AEL.

Emissions of benzo[a]pyrene from the stacks are not included in the IED. The highest recoded emission concentration of benzo[a]pyrene from the Environment Agency's public register is 0.000105 mg/Nm^3 (11 % oxygen, dry, 273.15 K). This has been multiplied by a safety factor of two (i.e. 0.00021 mg/Nm^3) which is assumed to be the emission concentration for the Proposed Development.

This assessment assumes that the Proposed Development would operate continuously (8760 hours per year).

ELVs and BAT AELs are set for total dust, as opposed to the specific size fractions for which AQALs are set. For the purposes of this assessment the PM_{10} and $PM_{2.5}$ emissions have been set to those of total dust. This approach will result in the overestimation of impacts of PM_{10} and $PM_{2.5}$.

Emissions of the Group 1 metals (Cd and Tl) from the stacks have individually been taken to be emitted at the Environmental Standard for the whole group.

In April 2010 the EA published revised Environmental Standards for arsenic, nickel and chromium (VI) in its EA Permit Guidance. The new guidelines are lower than earlier Environmental Standards. In particular, the use of conservative assumptions for the assessment of Group 3 metal emissions make it possible that the assessment would identify theoretical risks that the Environmental Standard value could be exceeded in the case of arsenic, nickel and chromium (VI). The EA has, therefore, provided guidance on the assessment of Group 3 metal releases from waste combustion processes (Environment Agency, 2016b).

In the first instance, a worst-case screening step is carried out, whereby each substance is modelled as being emitted at the ELV, 0.3 mg/Nm^3 for all nine Group 3 metals. Actual emission rates at comparable facilities are normally well below the BAT-AEL, and as such the worst-case screening step is very conservative. Where the initial results from the model show the Process Contribution exceeds 1 % of the long-term AQAL or 10 % of the short-term AQAL for that substance, then the PEC which includes the background concentration is compared with the AQAL. Where the PEC is greater than 100 % of the AQAL, then the emissions of those substances have been considered further in accordance with the second step of the guidance.

The second step of the guidance requires the predictions to be revised with reference to a range of measured values recorded from testing on 18 operational municipal waste incinerators and waste

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wood incinerators between 2007 and 2015. As in the first step, where the PC exceeds 1 % of the long-term AQAL or 10 % of the short-term AQAL for that substance, then the PEC is compared with the AQAL. This can be screened out where the PEC is less than 100 % of the AQAL. Further justification is required to be made to the EA if data lower than the listed maximum emission concentrations are used in the assessment.

4.3.2 Emissions from the Existing Coal-fired Power Station

The existing coal-fired power station will be subject to the requirements of the IED and the Large Combustion Plant BREF document by the time the Proposed Development begins operation. It should be noted that the existing station applied for several derogations under the LCP BREF related permit review process (Regulation 61 submission) to allow operation above the LCP BREF BAT AELs due to the limited remaining operational lifetime, whilst remaining consistent with the IED ELV requirements. Emissions have been modelled based on the Regulation 61 application emission levels as a worst-case assumption and include all species which will be regulated in the revised permit.

4.3.3 Emissions from the OCGTs

Due to the limited operating hours, the OCGTs do not currently have ELVs set within the power station permit and emission limits are not required under the IED or LCP BREF. Representative emissions for these units for SO_2, NO_x, dust and CO have been included based on a review of the emission performance of OCGTs that operate less than 500 hours per year, which included the gas-oil fired turbine models installed at Ratcliffe (Graham & Duncan, 2018).

4.3.4 Emissions Summary

The emission parameters and emission limits assumed to apply to the Proposed Development are shown in Table 3. The emission concentrations are quoted at 11 % oxygen, dry, 273.15 K in line with the IED and WI BREF.

For Scenarios B, C and D, emission parameters for the OCGTs and the coal-fired power station are required and are shown in Table 4. The emission concentrations for the coal plant are quoted at 6 % oxygen, dry, 273.15 K and the emission concentrations for the OCGTs are quoted at 15 % oxygen, dry, 273.15 K in line with the IED and WI BREF.

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Table 3: Emission parameters for the Proposed Development (11 % oxygen, dry, 273.15 K)

Parameter	Value	
Stack location	450435, 330403	
Stack height (m)	110	
Internal effective diameter (m)	2.75	
Temperature (°C)	140	
Reference oxygen content (% volume)	11 %	
Water content (% volume)	6.41 %	
Oxygen content (% volume, dry)	17.4 %	
Volume flow rate (Nm^3/s)	94.8	
Volume flow rate (Am^3/s)	118.7	
Flue gas exit velocity (m/s)	20	
	Long-term	**Short-term**
Oxides of nitrogen (as NO_2) emission concentration (mg/Nm^3)	120	400
Sulphur dioxide emission concentration (mg/Nm^3)	30	200
Carbon monoxide emission concentration (mg/Nm^3)	50	100
PM_{10} emission concentration (mg/Nm^3)	5	30
$PM_{2.5}$ emission concentration (mg/Nm^3)	5	30
Hydrogen chloride emission concentration (mg/Nm^3)	6	60
Hydrogen fluoride emission concentration (mg/Nm^3)	1	4
Ammonia emission concentration (mg/Nm^3)	10	10
Volatile organic compounds (as TOC) emission concentration (mg/Nm^3)	10	20
Benzo[a]pyrene (PAHs) emission concentration (mg/Nm^3)	0.00021	0.00021
PCBs emission concentration (mg/Nm^3)	6×10^{-8}	8×10^{-8}
Cadmium and Thallium emission concentration (mg/Nm^3)	0.02	0.02
Mercury emission concentration (mg/Nm^3)	0.02	0.04
Other metals emission concentration (mg/Nm^3)	0.3	0.3
Dioxins and furans emission concentration (mg/Nm^3)	4×10^{-8}	6×10^{-8}
Oxides of nitrogen (as NO_2) emission rate (g/s)	11.4	37.9
Sulphur dioxide emission rate (g/s)	2.8	19.0
Carbon monoxide emission rate (g/s)	4.7	9.5
PM_{10} emission rate (g/s)	0.5	2.8
$PM_{2.5}$ emission rate (g/s)	0.5	2.8
Hydrogen chloride emission rate (g/s)	0.6	5.7
Hydrogen fluoride emission rate (g/s)	0.09	0.38
Ammonia emission rate (g/s)	0.95	0.95
Volatile organic compounds (as TOC) emission rate (g/s)	0.95	1.90
Benzo[a]pyrene (PAHs) emission rate (g/s)	2×10^{-5}	2×10^{-5}
PCBs emission rate (g/s)	6×10^{-9}	8×10^{-9}
Cadmium and Thallium emission rate (g/s)	0.0019	0.0019
Mercury emission rate (g/s)	0.0019	0.0033
Other metals[1] emission rate (g/s)	0.03	0.03
Dioxins and furans emission rate (g/s)	4×10^{-9}	6×10^{-9}

[1] Other metals consist of antimony (Sb), arsenic (As), lead (Pb), chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni) and vanadium (V).

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Table 4: Emission parameters for the OCGTs and the coal-fired power station

Parameter	OCGTs	Coal-fired power station	
Stack location	450279, 330183	450139, 330199	
Stack height (m)	95	199	
Internal effective diameter (m)	4.6 (assuming both OCGTs operating)	14.2 (assuming all 4 units operating)	
Temperature (°C)	460	79	
Reference oxygen content (% volume)	15 %	6 %	
Water content (% volume)	3.6 %	8.9 %	
Oxygen content (% volume, dry)	17 %	5.9 %	
Volume flow rate (Nm^3/s)	119.4	1931.2	
Volume flow rate (Am^3/s)	503.1	2715.1	
Flue gas exit velocity (m/s)	29.8	17.1	
		Long-term	**Short-term**
Oxides of nitrogen (as NO_2) emission concentration (mg/Nm^3)	225	200	400
Sulphur dioxide emission concentration (mg/Nm^3)	55	200	400
Carbon monoxide emission concentration (mg/Nm^3)	100	400	400
PM_{10} emission concentration (mg/Nm^3)	6	20	40
$PM_{2.5}$ emission concentration (mg/Nm^3)	6	20	40
Hydrogen chloride emission concentration (mg/Nm^3)	-	20	20
Hydrogen fluoride emission concentration (mg/Nm^3)	-	7	7
Ammonia emission concentration (mg/Nm^3)	-	5	5
Mercury emission concentration (mg/Nm^3)	-	4	4
Oxides of nitrogen (as NO_2) emission rate (g/s)	26.9	386.2	772.5
Sulphur dioxide emission rate (g/s)	6.6	386.2	772.5
Carbon monoxide emission rate (g/s)	11.9	772.5	772.5
PM_{10} emission rate (g/s)	0.72	38.6	77.2
$PM_{2.5}$ emission rate (g/s)	0.72	38.6	77.2
Hydrogen chloride emission rate (g/s)	-	38.6	38.6
Hydrogen fluoride emission rate (g/s)	-	13.5	13.5
Ammonia emission rate (g/s)	-	9.7	9.7
Mercury emission rate (g/s)	-	7.7	7.7

4.4 Meteorological Data

Meteorological data for the dispersion modelling study were obtained from the Meteorological Office. Five years of data from 2015 to 2019 has been used in the assessment from the meteorological site at Sutton Bonington (cloud cover data was taken from Nottingham Watnall). Sutton Bonington is located approximately 3.5 km to the south of the Proposed Development. This meteorological site was recommended by the Meteorological Office as the most representative site for modelling a development at the Ratcliffe power station site. The wind roses are shown in Appendix B.

4.5 Grids

For the human health and the assessment of impacts at sensitive habitats, ground level concentrations have been calculated on a regular grid of 101 × 101 points extending 5000 m north, east, south and west of the Proposed Development. The spacing between points was 100 m.

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4.6 Surface Roughness

Surface roughness length is a measure of the influence of surface features on dispersion. A value of 0.35 m has been used for the modelling assessment which is appropriate for predominantly agricultural areas. This reflects the land use within the study area.

The Meteorological Office advised that a surface roughness length of 0.20–0.22 m in winter and 0.26 m in summer is appropriate for the meteorological site at Sutton Bonington due to the change in agriculture in the different seasons. Therefore, a value of 0.25 m has been used for the Meteorological site.

4.7 Terrain

There is a small hill to the north of the proposed location of the Proposed Development. To ensure that this does not have a detrimental impact on the dispersion of flue gases from the Proposed Development, terrain has been included within the model. The terrain grid has a spacing of 50 m and extends beyond the output grid.

4.8 Buildings

The dispersion of substances released from an elevated point source such as the Proposed Development can be influenced by the presence of buildings close to the source. The buildings can interrupt the wind flows and give higher ground level concentrations close to the source than would arise in the absence of the buildings.

Buildings will have a significant effect on dispersion if they are significantly taller than approximately one third of the stack height. The dimensions of the buildings from the Proposed Development that have been considered in the model are detailed in Table 5.

There are several buildings on the Ratcliffe power station site that are remaining on site after demolition of the coal-fired power station as discussed in Chapter 1.0. All these buildings are below one third of the lowest stack to be modelled (all buildings remaining on the Ratcliffe power station site after demolition of the power plant are below 30 m). Therefore, these buildings have not been included in the modelling.

The Ratcliffe coal-fired power station could still be operating when the Proposed Development is commissioned and, even if the power station is not operating, it is very unlikely that all of the buildings on the site will have been demolished by the time the Proposed Development is operating. Therefore, the buildings on the Ratcliffe coal-fired power station site that are above 30 m have been included in Scenarios C and D. The details of these buildings are also included in Table 5.

The main buildings used in the assessment for each source are listed below for each scenario:

- Scenario A: Main building is the boiler hall for the Proposed Development;
- Scenario B: Main building is the boiler hall for the Proposed Development and the OCGTs;
- Scenario C: Main building is the boiler hall for the Proposed Development and the Ratcliffe boiler house for the OCGTs; and
- Scenario D: Main building is the boiler hall for the Proposed Development and the Ratcliffe boiler house for the OCGTs and the coal-fired power station.

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Table 5: Building dimensions

Building	Coordinates of building centre (m)	Height (m)	Length/ Diameter (m)	Width (m)	Building orientation (angle between building length and north) (˚)
Proposed Development Buildings					
Boiler hall	450431, 330461	49.5	71.5	72.8	355.7
Flue gas treatment	450435, 330406	35	38.3	72.8	355.7
Waste bunker hall	450427, 330517	35	40.4	72.8	355.7
Ratcliffe Coal-Fired Power Station Buildings					
Boiler House	450138, 330122	63	117	204.5	355.7
Turbine Hall	450146, 330012	33	104	204.5	355.7
Cooling Tower 1	449917, 330223	114	94	-	-
Cooling Tower 2	449805, 330141	114	94	-	-
Cooling Tower 3	449929, 330078	114	94	-	-
Cooling Tower 4	449816, 329995	114	94	-	-
Cooling Tower 5	449941, 329917	114	94	-	-
Cooling Tower 6	449828, 329834	114	94	-	-
Cooling Tower 7	449953, 329771	114	94	-	-
Cooling Tower 8	449839, 329688	114	94	-	-
Absorber 1	450056, 330349	44	41	20	355.7
Absorber 2	450103, 330353	44	41	20	355.7
Absorber 3	450153, 330342	44	41	20	355.7
Absorber 4	450201, 330345	44	41	20	355.7
Limestone Mill	450116, 330458	32	39	31	355.7

4.9 NO_x Chemistry

The Air Quality Strategy objectives for the protection of human health relate to the concentrations of the nitrogen dioxide (NO_2) component of nitrogen oxides (NO_x). The Proposed Development will release both nitrogen dioxide and nitric oxide (NO). Once released, nitric oxide can be converted to nitrogen dioxide by reaction with low level ozone in the atmosphere. The process is reversible in sunlight and the new rate of conversion of NO to NO_2 in the plume is, therefore, a function of the rate of dilution of the plume by ambient air, trace gas concentrations in the air and meteorology.

Ground level NO_x concentrations have been predicted through dispersion modelling. Nitrogen dioxide concentrations reported in the results section assume 70 % conversion from NO_x to nitrogen dioxide for annual means and a 35 % conversion for short-term (hourly) concentrations, based upon the worst-case scenario in the Environment Agency methodology. Given the short plume travel time to the areas of maximum concentrations, this approach is considered conservative.

4.10 Human Receptor Points

As shown in Figure 1, there are a number of residential receptors within 3 km of the location of the Proposed Development. Given the locality, assessment of air quality impacts at the location of the highest impact will provide the most precautionary approach to the assessment of human exposure. Additionally, sixteen receptor points representing local properties, farms and schools have been modelled. Additionally, assessment of air quality impacts at the location of the highest

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impact has been included as the most precautionary approach to the assessment of human exposure. The receptor locations are shown in Table 6 and Figure 1.

Table 6: Modelled Human Receptors

Reference	Description	OS Grid Reference	Distance from the Proposed Development (km)
R1	Church Lane, Thrumpton	451059, 331118	0.9
R2	Wood Farm, Thrumpton	451487, 330914	1.2
R3	Hillside Cottage	451869, 330662	1.4
R4	Stonepit Farm	452143, 329669	1.8
R5	Winking Hill Farm	450969, 329726	0.8
R6	Gotham Primary School	453241, 330149	2.8
R7	Main Street, Ratcliffe-on-Soar Village	449619, 329082	1.6
R8	Lock Lane, Sawley	449231, 330563	1.2
R9	Redhill Marina and Redhill Farm, Sawley	449353, 330111	1.1
R10	Kingston Hall, Gotham Road	450696, 327912	2.5
R11	Middlegate Farm	449420, 329814	1.2
R12	Little Lunnon, Barton-in-Fabis	452175, 332499	2.7
R13	Kegworth Road, Kingston -on-Soar	449943, 327760	2.7
R14	Cranfleet Farm	449485, 331365	1.4
R15	Trent Lock	448961, 331206	1.7
R16	Ludford Close, Long Eaton	449413, 331970	1.9

Additionally, there have been four Air Quality Management Areas (AQMAs) declared within 5 km of the Proposed Development (North West Leicestershire District Council, 2019), (Erewash Borough Council, 2019), (Nottingham City Council, 2018). These have been considered as receptors within the assessment and are listed in Table 7 and shown in Figure 1.

Table 7: AQMAs within 5 km of the Proposed Development

AQMA	Authority	Air Quality Standard	Approximate Distance from Proposed Development	Receptor points used in the model
Kegworth AQMA	North West Leicestershire District Council	Annual mean NO_2	4 km	448170, 327119 448604, 326826 448773, 326407
M1 AQMA	North West Leicestershire District Council	1-hour and annual mean NO_2	5 km	447367, 326372 447081, 325420
AQMA No.2	Erewash Borough Council	Annual mean NO_2	4.4 km	447155, 334561 447264, 333443
AQMA No.2	Nottingham City Council	Annual mean NO_2	4.3 km	454332, 333626

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5 BASELINE CONDITIONS

5.1 Estimated Background Concentrations: Human Health Assessment

Consideration has been given to existing background concentrations arising from sources to take account of the potential adverse effects arising from total exposure to pollutant concentrations. Measurements of existing air quality in the vicinity of the proposed location of the Proposed Development are summarised in Appendix C. Based on measurements presented, values to represent background annual mean concentrations for the study area have been estimated and are presented in Table 8.

Table 8: Estimated Background Annual Mean Concentrations

Pollutant	Estimated background annual Mean Concentration (µg/m^3)	Justification
Nitrogen dioxide	24.6	Maximum mapped background concentration from across the modelling domain – DEFRA 2017 dataset
Sulphur dioxide	2.4	Maximum monitored concentration locally to the Proposed Development 2015–2019
Carbon monoxide	458	Maximum mapped background concentration from across the modelling domain – DEFRA 2001 dataset
Particulate matter (PM_{10})	18.7	Maximum mapped background concentration from across the modelling domain – DEFRA 2017 dataset
Particulate matter ($PM_{2.5}$)	11.9	Maximum mapped background concentration from across the modelling domain – DEFRA 2017 dataset
Hydrogen chloride	0.42	Maximum monitored concentration at Sutton Bonington 2011–2015
Hydrogen fluoride	2.35	Maximum measured concentration from EPAQS report
Benzene	0.81	Maximum mapped background concentration from across the modelling domain – DEFRA 2001 dataset
1,3-butadiene	0.35	Maximum mapped background concentration from across the modelling domain – DEFRA 2001 dataset
Ammonia	5.3	Maximum monitored concentration at Sutton Bonington 2015–2019
Cadmium	0.0025	Maximum monitored concentration at all urban industrial sites across the UK 2014–2018
Mercury	0.019	
Arsenic	0.0012	
Antimony	0.0015	Maximum monitored concentration at Beacon Hill 2010–2013
Chromium	0.015	Maximum monitored concentration at all urban industrial sites across the UK 2014–2018
Chromium (VI)	0.003[1]	
Copper	0.08	
Lead	0.063	
Manganese	0.11	
Nickel	0.0041	Maximum monitored concentration at all urban industrial sites across the UK 2014–2018 (excluding Portardawe Tawe Terrace – see Appendix C)
Vanadium	0.012	Maximum monitored concentration at all urban industrial sites across the UK 2014–2018
Benzo[a]pyrene	0.0036	Maximum monitored concentration at all urban industrial sites across the UK 2014–2018
PCBs	0.000129	Maximum monitored concentrations across the UK 2014–2018

[1] 20 % of total chromium is assumed to be in the form of Chromium VI (see Appendix C).

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6 AIR QUALITY IMPACT ASSESSMENT

This section presents the results of the air quality impact assessment.

For each substance and concentration statistic, the tables show:

- The AQS objective or Environmental Assessment Level (EAL) that concentrations are compared against;
- Typical background annual mean concentrations in the study area;
- The contribution of the station to ground level concentrations, the Process Contribution (PC);
- The PC expressed as a percentage of the AQS objective or EAL;
- The Predicted Environmental Concentration (PEC), the combination of the process contribution and background concentrations;
- The PEC expressed as a percentage of the AQS objective or EAL; and
- A significance descriptor based on the PC/AQAL to determine if the PC can be classed as negligible for annual mean impacts (PC/AQAL < 0.5 %, see Section 3.3.1) or insignificant for short-term impacts (PC/AQAL < 10 %, see Section 3.3.2).

Table 9 to Table 12 present the results of the dispersion modelling of process emissions for each scenario modelled at the point of maximum impact.

For short-term impacts, background concentrations are based on twice the annual mean background concentrations (from Table 8) in line with Environment Agency guidance.

Note that the results for Scenario B are only presented for species where emissions were modelled for both the Proposed Development and the OCGTs, as the results for other species would be identical to Scenario A.

Similarly, the results for Scenario D are only presented for species where emissions were modelled for both the Proposed Development and the existing power station (which includes species also emitted by the OCGTs), as the results for other species would be identical to Scenario C.

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Table 9: Scenario A – Dispersion Modelling Results – point of maximum impact

Pollutant	Statistic	AQAL (µg/m^3)	Back-ground conc (µg/m^3)	PC (µg/m^3)	PC/ AQAL (%)	PEC (µg/m^3)	PEC/ AQAL (%)	PC/AQAL descriptor Annual mean < 0.5 % – negligible Short-term < 10 % – insignificant
Nitrogen dioxide	Annual mean	40	24.6	0.23	0.58 %	24.83	62 %	-
	99.79th %ile of hourly means	200	49.2	11.5	5.7 %	60.7	30 %	Insignificant
Sulphur dioxide	Annual mean	50	2.4	0.08	0.16 %	2.48	5 %	Negligible
	99.9th %ile of 15-minute means	266	4.8	21.7	8.2 %	26.5	10 %	Insignificant
	99.73rd %ile of hourly means	350	4.8	15.0	4.3 %	19.8	6 %	Insignificant
	99.18th %ile of daily means	125	4.8	6.3	5.0 %	11.1	9 %	Insignificant
Carbon monoxide	8 hour running mean	10,000	916	8.4	< 0.1 %	924.4	9 %	Insignificant
	Hourly mean	30,000	916	14.2	< 0.1 %	930.2	3 %	Insignificant
PM_{10}	Annual mean	40	18.7	0.015	< 0.1 %	18.72	47 %	Negligible
	90.41st %ile of daily mean	50	37.4	0.29	0.6 %	37.7	75 %	Insignificant
$PM_{2.5}$	Annual mean	25	11.9	0.015	< 0.1 %	11.92	48 %	Negligible
Hydrogen chloride	Hourly mean	750	0.84	8.52	1.1 %	9.4	1 %	Insignificant
Hydrogen fluoride	Annual mean	16	2.35	0.0026	< 0.1 %	2.35	15 %	Negligible
	Hourly mean	160	4.7	0.57	0.36 %	527	3 %	Insignificant
Ammonia	Annual mean	180	5.3	0.028	< 0.1 %	5.33	3 %	Negligible
	Hourly mean	2,500	10.6	1.42	< 0.1 %	12.0	0.5 %	Insignificant
VOCs (as Benzene)	Annual mean	5	0.81	0.029	0.58 %	0.84	17 %	-
	Hourly mean	195	1.62	2.84	1.5 %	4.5	2 %	Insignificant
VOCs (as 1,3-butadiene)	Annual mean	2.25	0.35	0.029	1.3 %	0.38	17 %	-
PAHs (as Benzo[a]pyrene	Annual mean	0.00025	0.0036	5.8×10^{-7}	0.23 %	0.0036	1440 %	Negligible
PCBs	Annual mean	0.2	0.00013	1.7×10^{-10}	< 0.1 %	0.00013	< 0.1 %	Negligible
	Hourly mean	6	0.00026	1.2×10^{-8}	< 0.1 %	0.00026	< 0.1 %	Insignificant

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Table 9 (cont): Scenario A – Dispersion Modelling Results – point of maximum impact

Pollutant	Statistic	AQAL (µg/m³)	Back-ground conc (µg/m³)	PC (µg/m³)	PC/ AQAL (%)	PEC (µg/m³)	PEC/ AQAL (%)	PC/AQAL descriptor Annual mean < 0.5 % – negligible Short-term < 10 % – insignificant
Cadmium	Annual mean	0.005	0.0025	5.6×10^{-5}	1.11 %	0.0026	51 %	-
Mercury	Annual mean	0.25	0.019	5.6×10^{-5}	< 0.1 %	0.019	8 %	Negligible
	Hourly mean	7.5	0.038	0.005	< 0.1 %	0.043	0.6 %	Insignificant
Antimony	Annual mean	5	0.0015	0.00088	< 0.1 %	0.0024	< 0.1 %	Negligible
	Hourly mean	150	0.003	0.045	< 0.1 %	0.048	< 0.1 %	Insignificant
Arsenic	Annual mean	0.003	0.0012	0.00088	29 %	0.0021	69 %	-
Chromium	Annual mean	5	0.015	0.00088	< 0.1 %	0.0016	0.3 %	Negligible
	Hourly mean	150	0.03	0.045	< 0.1 %	0.075	< 0.1 %	Insignificant
Chromium (VI)	Annual mean	0.0002	0.003	0.00088	438 %	0.0039	1938 %	-
Copper	Annual mean	10	0.08	0.00088	< 0.1 %	0.081	0.8 %	Negligible
	Hourly mean	200	0.016	0.045	< 0.1 %	0.061	< 0.1 %	Insignificant
Lead	Annual mean	0.25	0.063	0.00088	0.35 %	0.064	26 %	Negligible
Manganese	Annual mean	0.15	0.11	0.00088	0.58 %	0.11	74 %	-
	Hourly mean	1,500	0.22	0.045	< 0.1 %	0.27	< 0.1 %	Insignificant
Nickel	Annual mean	0.02	0.0041	0.00088	4.38 %	0.005	25 %	-
Vanadium	Annual mean	5	0.012	0.00088	< 0.1 %	0.013	0.3 %	Negligible
	Hourly mean	1	0.024	0.045	4.5 %	0.069	7 %	Insignificant

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Table 10: Scenario B – Dispersion Modelling Results – point of maximum impact

Pollutant	Statistic	AQAL (µg/m³)	Back-ground conc (µg/m³)	PC (µg/m³)	PC/ AQAL (%)	PEC (µg/m³)	PEC/ AQAL (%)	PC/AQAL descriptor Annual mean < 0.5 % – negligible Short-term < 10 % – insignificant
Nitrogen dioxide	Annual mean	40	24.6	0.35	0.87 %	24.95	62 %	-
	99.79th %ile of hourly means	200	49.2	12.0	6.0 %	61.2	31 %	Insignificant
Sulphur dioxide	Annual mean	50	2.4	0.12	0.24 %	2.52	5 %	Negligible
	99.9th %ile of 15-minute means	266	4.8	22.0	8.3 %	26.8	10 %	Insignificant
	99.73rd %ile of hourly means	350	4.8	15.3	4.4 %	20.1	6 %	Insignificant
	99.18th %ile of daily means	125	4.8	6.7	5.4 %	11.5	9 %	Insignificant
Carbon monoxide	8 hour running mean	10,000	916	9.6	0.1 %	925.6	9 %	Insignificant
	Hourly mean	30,000	916	15.4	< 0.1 %	931.4	3 %	Insignificant
PM_{10}	Annual mean	40	18.7	0.019	< 0.1 %	18.72	47 %	Negligible
	90.41st %ile of daily mean	50	37.4	0.30	0.6 %	37.7	75 %	Insignificant
$PM_{2.5}$	Annual mean	25	11.9	0.019	< 0.1 %	11.92	48 %	Negligible

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Table 11: Scenario C – Dispersion Modelling Results – point of maximum impact

Pollutant	Statistic	AQAL (µg/m³)	Back-ground conc (µg/m³)	PC (µg/m³)	PC/ AQAL (%)	PEC (µg/m³)	PEC/ AQAL (%)	PC/AQAL descriptor Annual mean < 0.5 % – negligible Short-term < 10 % – insignificant
Nitrogen dioxide	Annual mean	40	24.6	0.54	1.35 %	25.14	63 %	-
	99.79th %ile of hourly means	200	49.2	15.6	7.8 %	64.8	32 %	Insignificant
Sulphur dioxide	Annual mean	50	2.4	0.19	0.38 %	2.59	5 %	-
	99.9th %ile of 15-minute means	266	4.8	22.0	8.3 %	26.8	10 %	Insignificant
	99.73rd %ile of hourly means	350	4.8	15.9	4.5 %	20.7	6 %	Insignificant
	99.18th %ile of daily means	125	4.8	7.9	6.3 %	12.7	10 %	Insignificant
Carbon monoxide	8 hour running mean	10,000	916	15.3	0.15 %	931.3	9 %	Insignificant
	Hourly mean	30,000	916	17.7	< 0.1 %	933.7	3 %	Insignificant
PM_{10}	Annual mean	40	18.7	0.025	< 0.1 %	18.73	47 %	Negligible
	90.41st %ile of daily mean	50	37.4	2.88	6 %	40.3	81 %	Insignificant
$PM_{2.5}$	Annual mean	25	11.9	0.025	0.1 %	11.93	48 %	Negligible
Hydrogen chloride	Hourly mean	750	0.84	8.52	1.1 %	9.36	1 %	Insignificant
Hydrogen fluoride	Annual mean	16	2.35	0.0026	< 0.1 %	2.35	15 %	Negligible
	Hourly mean	160	4.7	0.57	0.36 %	5.27	3 %	Insignificant
Ammonia	Annual mean	180	5.3	0.028	< 0.1 %	5.33	3 %	Negligible
	Hourly mean	2,500	10.6	1.42	< 0.1 %	12.0	0.5 %	Insignificant
VOCs (as Benzene)	Annual mean	5	0.81	0.029	0.58 %	0.84	17 %	-
	Hourly mean	195	1.62	2.84	1.5 %	4.5	2 %	Insignificant
VOCs (as 1,3-butadiene)	Annual mean	2.25	0.35	0.029	1.3 %	0.38	17 %	-
PAHs (as Benzo[a]pyrene	Annual mean	0.00025	0.0036	5.8×10^{-7}	0.23 %	0.0036	1440 %	Negligible
PCBs	Annual mean	0.2	0.00013	1.7×10^{-10}	< 0.1 %	0.00013	< 0.1 %	Negligible
	Hourly mean	6	0.00026	1.2×10^{-8}	< 0.1 %	0.00026	< 0.1 %	Insignificant

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Table 11 (cont): Scenario C – Dispersion Modelling Results – point of maximum impact

Pollutant	Statistic	AQAL (µg/m³)	Back-ground conc (µg/m³)	PC (µg/m³)	PC/ AQAL (%)	PEC (µg/m³)	PEC/ AQAL (%)	PC/AQAL descriptor Annual mean < 0.5 % – negligible Short-term < 10 % – insignificant
Cadmium	Annual mean	0.005	0.0025	5.6×10^{-5}	1.11 %	0.0026	51 %	-
Mercury	Annual mean	0.25	0.019	5.6×10^{-5}	< 0.1 %	0.019	8 %	Negligible
	Hourly mean	7.5	0.038	0.005	< 0.1 %	0.043	0.6 %	Insignificant
Antimony	Annual mean	5	0.0015	0.00088	< 0.1 %	0.0024	< 0.1 %	Negligible
	Hourly mean	150	0.003	0.045	< 0.1 %	0.048	< 0.1 %	Insignificant
Arsenic	Annual mean	0.003	0.0012	0.00088	29 %	0.0021	69 %	-
Chromium	Annual mean	5	0.015	0.00088	< 0.1 %	0.0016	0.3 %	Negligible
	Hourly mean	150	0.03	0.045	< 0.1 %	0.075	< 0.1 %	Insignificant
Chromium (VI)	Annual mean	0.0002	0.003	0.00088	438 %	0.0039	1938 %	-
Copper	Annual mean	10	0.08	0.00088	< 0.1 %	0.081	0.8 %	Negligible
	Hourly mean	200	0.016	0.045	< 0.1 %	0.061	< 0.1 %	Insignificant
Lead	Annual mean	0.25	0.063	0.00088	0.35 %	0.064	26 %	Negligible
Manganese	Annual mean	0.15	0.11	0.00088	0.58 %	0.11	74 %	-
	Hourly mean	1,500	0.22	0.045	< 0.1 %	0.27	< 0.1 %	Insignificant
Nickel	Annual mean	0.02	0.0041	0.00088	4.38 %	0.005	25 %	-
Vanadium	Annual mean	5	0.012	0.00088	< 0.1 %	0.013	0.3 %	Negligible
	Hourly mean	1	0.024	0.045	4.5 %	0.069	7 %	Insignificant

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Table 12: Scenario D – Dispersion Modelling Results – point of maximum impact

Pollutant	Statistic	AQAL (µg/m³)	Back-ground conc (µg/m³)	PC (µg/m³)	PC/ AQAL (%)	PEC (µg/m³)	PEC/ AQAL (%)	PC/AQAL descriptor Annual mean < 0.5 % – negligible Short-term < 10 % – insignificant
Nitrogen dioxide	Annual mean	40	24.6	0.67	1.68 %	25.27	63 %	-
	99.79th %ile of hourly means	200	49.2	32.0	16 %	81.2	41 %	-
Sulphur dioxide	Annual mean	50	2.4	0.57	1.14 %	2.97	6 %	-
	99.9th %ile of 15-minute means	266	4.8	105.6	40 %	110.4	42 %	-
	99.73rd %ile of hourly means	350	4.8	70.7	20 %	75.5	22 %	-
	99.18th %ile of daily means	125	4.8	23.4	19 %	28.2	23 %	-
Carbon monoxide	8 hour running mean	10,000	916	77.2	0.77 %	993.2	10 %	Insignificant
	Hourly mean	30,000	916	126.8	0.42 %	1042.8	3 %	Insignificant
PM_{10}	Annual mean	40	18.7	0.063	0.16 %	18.76	47 %	Negligible
	90.41st %ile of daily mean	50	37.4	3.15	6 %	40.55	81 %	Insignificant
$PM_{2.5}$	Annual mean	25	11.9	0.063	0.25 %	11.96	48 %	Negligible
Hydrogen chloride	Hourly mean	750	0.84	8.61	1.15 %	9.45	1 %	Insignificant
Hydrogen fluoride	Annual mean	16	2.35	0.018	0.11 %	2.37	15 %	Negligible
	Hourly mean	160	4.7	2.21	1.39 %	6.92	4 %	Insignificant
Ammonia	Annual mean	180	5.3	0.035	< 0.1 %	5.34	3 %	Negligible
	Hourly mean	2,500	10.6	1.76	< 0.1 %	12.36	0.5 %	Insignificant
Mercury	Annual mean	0.25	0.019	0.0098	3.92 %	0.029	12 %	-
	Hourly mean	7.5	0.038	1.21	16 %	1.25	17 %	-

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Tables 9 to 12 show that the process contribution is greater than 0.5 % of the long-term AQAL and greater than 10 % of the short-term AQAL at the point of maximum impact for the following pollutants for each scenario and, therefore, the magnitude of change cannot be screened out as negligible, irrespective of baseline concentrations:

- **Scenario A:**
  - Annual mean nitrogen dioxide;
  - Annual mean VOCs as Benzene;
  - Annual mean VOCs as 1,3-butadiene;
  - Annual mean cadmium;
  - Annual mean arsenic;
  - Annual mean chromium (VI);
  - Annual mean manganese; and
  - Annual mean nickel.

- **Scenario B:**
  - Annual mean nitrogen dioxide.

- **Scenario C:**
  - Annual mean nitrogen dioxide;
  - Annual mean VOCs as Benzene;
  - Annual mean VOCs as 1,3-butadiene;
  - Annual mean cadmium;
  - Annual mean arsenic;
  - Annual mean chromium (VI);
  - Annual mean manganese; and
  - Annual mean nickel.

- **Scenario D:**
  - Annual mean nitrogen dioxide;
  - Hourly mean nitrogen dioxide;
  - Annual mean sulphur dioxide;
  - 15-minute mean, hourly mean and daily mean sulphur dioxide;
  - Annual mean mercury; and
  - Hourly mean mercury.

For all other pollutants and averaging periods, the magnitude of change at the maximum impact point can be screened out as ‘negligible’ for annual mean AQALs and ‘insignificant’ for short-term AQALs irrespective of baseline concentrations. The predicted ground level concentrations at the local receptors will be below the levels stated in Tables 9 to 12 and, therefore, will also be negligible or insignificant at these receptors. The pollutants and averaging periods that can be classed as negligible or insignificant at the maximum impact point have not been considered further in this assessment.

It is worth noting that the predicted environmental concentration for PAHs as benzo[a]pyrene is above the AQAL for all scenarios modelled. This is due to the background concentration used in the assessment being significantly above the AQAL. The process contribution from all four scenarios modelled is less than 0.5 % and can, therefore, be classed as negligible regardless of background concentration. Therefore, PAHs have not been considered further.

The next stage of assessment within the EPUK & IAQM guidance for annual mean concentrations is to assess the change in the concentration relative to the AQAL and the overall

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predicted concentration (i.e. the future baseline plus the process contribution) (EPUK & IAQM, 2017). Table 2 shows the relevant matrix table taken from the EPUK & IAQM guidance. This shows that for pollutants where the long-term average concentration at the receptor is less than 75 % of the AQAL, then a change of 5 % or less can be classed as a negligible impact. Therefore, the impact of annual mean nitrogen dioxide, sulphur dioxide, VOCs as Benzene, VOCs as 1,3-butadiene, cadmium, manganese, mercury and nickel can be classed as negligible under the four scenarios as the long-term average concentration at the maximum impact point is less than 75 % and the change in concentration relative to the AQAL is less than 5 %. Therefore, the annual mean concentrations of these pollutants have not been considered further.

The following sections discuss the pollutants that cannot be screened as negligible or insignificant within the first two stages of assessment within the EPUK & IAQM guidance which are:

- **Scenario A:**
  - Annual mean arsenic; and
  - Annual mean chromium (VI).

- **Scenario C:**
  - Annual mean arsenic; and
  -
  - Annual mean chromium (VI).

- **Scenario D:**
  - Hourly mean nitrogen dioxide;
  - 15-minute mean, hourly mean and daily mean sulphur dioxide; and
  - Hourly mean mercury.

Annual mean nitrogen dioxide concentrations have also been considered further at the local air quality management area locations for completeness.

6.1 Nitrogen Dioxide Concentrations

6.1.1 Annual Mean Nitrogen Dioxide Concentrations

Table 13 shows the predicted annual mean nitrogen dioxide concentrations at the receptor points for the four AQMAs for all four scenarios. The impact at all the AQMAs can be classed as negligible for all scenarios. Figures 2 to 5 show the annual mean nitrogen dioxide process contributions for the four modelled Scenarios A to D respectively.

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Table 13: Annual mean nitrogen dioxide concentrations at local AQMAs

Receptor	AQS objective (µg/m³)	Back-ground (µg/m³)	PC (µg/m³)	PC/ EAL (%)	PEC (µg/m³)	PEC/ EAL (%)	Descriptor
SCENARIO A							
Kegworth AQMA1	40	24.6	0.05	0.13 %	24.65	62 %	Negligible
Kegworth AQMA2	40	24.6	0.04	0.11 %	24.64	62 %	Negligible
Kegworth AQMA3	40	24.6	0.04	0.10 %	24.64	62 %	Negligible
M1 AQMA1	40	24.6	0.05	0.12 %	24.65	62 %	Negligible
M1 AQMA2	40	24.6	0.04	0.10 %	24.64	62 %	Negligible
Long Eaton AQMA1	40	24.6	0.03	< 0.1 %	24.63	62 %	Negligible
Long Eaton AQMA2	40	24.6	0.03	< 0.1 %	24.63	62 %	Negligible
Nottingham AQMA1	40	24.6	0.08	0.21 %	24.68	62 %	Negligible
SCENARIO B							
Kegworth AQMA1	40	24.6	0.08	0.21 %	24.68	62 %	Negligible
Kegworth AQMA2	40	24.6	0.07	0.16 %	24.67	62 %	Negligible
Kegworth AQMA3	40	24.6	0.06	0.14 %	24.66	62 %	Negligible
M1 AQMA1	40	24.6	0.08	0.21 %	24.68	62 %	Negligible
M1 AQMA2	40	24.6	0.07	0.18 %	24.67	62 %	Negligible
Long Eaton AQMA1	40	24.6	0.05	0.12 %	24.65	62 %	Negligible
Long Eaton AQMA2	40	24.6	0.04	0.11 %	24.64	62 %	Negligible
Nottingham AQMA1	40	24.6	0.14	0.36 %	24.74	62 %	Negligible
SCENARIO C							
Kegworth AQMA1	40	24.6	0.09	0.22 %	24.69	62 %	Negligible
Kegworth AQMA2	40	24.6	0.07	0.17 %	24.67	62 %	Negligible
Kegworth AQMA3	40	24.6	0.06	0.14 %	24.66	62 %	Negligible
M1 AQMA1	40	24.6	0.09	0.22 %	24.69	62 %	Negligible
M1 AQMA2	40	24.6	0.07	0.18 %	24.67	62 %	Negligible
Long Eaton AQMA1	40	24.6	0.05	0.12 %	24.65	62 %	Negligible
Long Eaton AQMA2	40	24.6	0.04	0.11 %	24.64	62 %	Negligible
Nottingham AQMA1	40	24.6	0.18	0.45 %	24.78	62 %	Negligible
SCENARIO D							
Kegworth AQMA1	40	24.6	0.15	0.38 %	24.75	62 %	Negligible
Kegworth AQMA2	40	24.6	0.11	0.28 %	24.71	62 %	Negligible
Kegworth AQMA3	40	24.6	0.10	0.25 %	24.70	62 %	Negligible
M1 AQMA1	40	24.6	0.19	0.47 %	24.79	62 %	Negligible
M1 AQMA2	40	24.6	0.17	0.43 %	24.77	62 %	Negligible
Long Eaton AQMA1	40	24.6	0.10	0.25 %	24.70	62 %	Negligible
Long Eaton AQMA2	40	24.6	0.09	0.23 %	24.69	62 %	Negligible
Nottingham AQMA1	40	24.6	0.38	0.94 %	24.98	62 %	Negligible

6.1.2 99.79th Percentile Hourly Mean Nitrogen Dioxide Concentrations

Tables 9 to 12 show that the predicted 99.79th percentile hourly mean nitrogen dioxide concentrations at the maximum impact location can be classed as insignificant for Scenarios A, B and C. The predicted 99.79th percentile hourly mean concentration for Scenario D is predicted to be 16 % of the AQAL of 200 µg/m³. This is above the insignificance threshold of 10 %.

The PEC is predicted to be a maximum of 41 % of the AQAL. This shows that there is still a significant margin between the PEC and the 99.79th percentile hourly mean NO_2 AQS objective. Additionally, the modelling assessment assumes that the Proposed Development, the OCGTs and the coal-fired power station are all operating at full load during the hours of the year that cause the highest ground level concentrations. This is extremely unlikely to occur. The

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modelling shows that even if this does occur, the AQAL for hourly mean NO_2 concentrations will still be easily met at the point of maximum impact.

There is also some double accounting for impacts from the OCGTs and the coal-fired power station as baseline concentrations will include a contribution from these two sources as they are already operating. Even with all these worst-case assumptions, the hourly mean NO_2 AQAL is easily met.

Table 14 shows the predicted 99.79th percentile concentrations at the local receptor points for Scenario D which shows that the predicted short-term NO_2 concentrations are all below 10 % of the AQAL and can be classed as insignificant except for Gotham Primary School. The predicted 99.79th percentile of hourly mean NO_2 concentrations at Gotham Primary School is 10.42 % of the AQAL which is only just above the threshold for insignificance of 10 %. The PEC at Gotham Primary School is only 35 % of the AQAL which shows that the AQAL is met by a significant margin.

Table 14: Predicted 99.79th percentile hourly mean NO_2 process contribution (PC) and predicted environmental concentrations (PEC) for Scenario D at the local human receptors

Receptor	AQS objective (µg/m^3)	Back-ground (µg/m^3)	PC (µg/m^3)	PC/ EAL (%)	PEC (µg/m^3)	PEC/ EAL (%)	Descriptor
Church Lane	200	49.2	16.1	8.05 %	65.3	33 %	Insignificant
Wood Farm	200	49.2	14.9	7.44 %	64.1	32 %	Insignificant
Hillside Cottage	200	49.2	17.3	8.66 %	66.5	33 %	Insignificant
Stonepit Farm	200	49.2	19.3	9.66 %	68.5	34 %	Insignificant
Winking Hill Farm	200	49.2	10.5	5.27 %	59.7	30 %	Insignificant
Gotham PS	200	49.2	20.8	10.42 %	70.0	35 %	-
Main St	200	49.2	9.5	4.77 %	58.7	29 %	Insignificant
Lock Lane	200	49.2	9.3	4.67 %	58.5	29 %	Insignificant
Redhill Marina	200	49.2	9.4	4.72 %	58.6	29 %	Insignificant
Kingston Hall	200	49.2	7.8	3.92 %	57.0	29 %	Insignificant
Middlegate Farm	200	49.2	11.0	5.51 %	60.2	30 %	Insignificant
Little Lunnon	200	49.2	14.1	7.05 %	63.3	32 %	Insignificant
Kegworth Rd	200	49.2	8.8	4.39 %	58.0	29 %	Insignificant
Cranfleet Farm	200	49.2	8.5	4.24 %	57.7	29 %	Insignificant
Trent Lock	200	49.2	8.1	4.05 %	57.3	29 %	Insignificant
Ludford Close	200	49.2	8.2	4.09 %	57.4	29 %	Insignificant

The M1 AQMA which has been declared by North West Leicestershire District Council (North West Leicestershire District Council, 2019) is the only AQMA in the local area which has been declared for both annual mean and hourly mean concentrations of nitrogen dioxide. Therefore, Table 15 shows the 99.79th percentile hourly mean concentrations of nitrogen dioxide predicted at the M1 AQMA. Table 15 shows that hourly mean process contributions from the assessment can be classed as insignificant at the M1 AQMA for all scenarios.

Figures 6 to 9 show the 99.79th percentile of hourly mean nitrogen concentrations across the modelling domain for Scenarios A to D respectively.

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Table 15: 99.79th percentile nitrogen dioxide concentrations at the M1 AQMA

Receptor	AQS objective ($\mu g/m^3$)	Back-ground ($\mu g/m^3$)	PC ($\mu g/m^3$)	PC/ EAL (%)	PEC ($\mu g/m^3$)	PEC/ EAL (%)	Descriptor
SCENARIO A							
M1 AQMA1	200	49.2	3.47	1.74 %	52.67	26 %	Insignificant
M1 AQMA2	200	49.2	3.07	1.53 %	52.27	26 %	Insignificant
SCENARIO B							
M1 AQMA1	200	49.2	3.95	1.97 %	53.15	27 %	Insignificant
M1 AQMA2	200	49.2	3.68	1.84 %	52.88	26 %	Insignificant
SCENARIO C							
M1 AQMA1	200	49.2	3.89	1.94 %	53.09	27 %	Insignificant
M1 AQMA2	200	49.2	3.84	1.92 %	53.04	27 %	Insignificant
SCENARIO D							
M1 AQMA1	200	49.2	14.7	7.35 %	63.9	32 %	Insignificant
M1 AQMA2	200	49.2	14.0	6.98 %	63.2	32 %	Insignificant

6.2 Sulphur Dioxide Concentrations

6.2.1 Short-term Sulphur Dioxide Concentrations

Tables 9 to 12 show that the predicted short-term sulphur dioxide concentrations at the maximum impact location can be classed as insignificant for Scenarios A, B and C. The predicted 99.9th percentile of 15-minute mean SO_2 concentrations for Scenario D is predicted to be 40 % of the AQAL of 266 $\mu g/m^3$. The predicted environmental concentration to the 99.9th percentile of 15-minute mean SO_2 concentrations is predicted to be a maximum of 42 % of the AQAL. The predicted 99.73rd percentile of hourly mean SO_2 concentrations for Scenario D is predicted to be 20 % of the AQAL of 350 $\mu g/m^3$. The predicted environmental concentration to the 99.73rd percentile of hourly mean SO_2 concentrations is predicted to be a maximum of 22 % of the AQAL. The predicted 99.18th percentile of daily mean SO_2 concentrations for Scenario D is predicted to be 19 % of the AQAL of 125 $\mu g/m^3$. The predicted environmental concentration to the 99.18th percentile of daily mean SO_2 concentrations is predicted to be a maximum of 23 % of the AQAL. The process contributions for all three short-term statistics at the maximum impact point are predicted to be above the insignificance threshold of 10 %.

The PECs for each short-term statistic show that there is still a significant margin between the PEC and the AQAL for each statistic and, therefore, it is very unlikely that the Proposed Development will cause any of the SO_2 short-term AQALs to be breached.

Additionally, the modelling assessment assumes that the Proposed Development, the OCGTs and the coal-fired power station are all operating at full load during the hours of the year that cause the highest ground level concentrations. This is extremely unlikely to occur in practice. The modelling shows that even if this does occur, the short-term SO_2 AQALs will still be easily met. The modelling also shows that most of the sulphur dioxide concentrations at the maximum impact point are due to the coal-fired power station. Therefore, once the coal-fired power station stops operating, the sulphur dioxide concentrations will significantly decrease to the levels shown in the other three scenarios (< 10 % of the AQALs). Even with all these worst-case assumptions, the SO_2 short term AQALs are easily met.

Tables 16 to 18 show the predicted short-term SO_2 concentrations at the local human health receptors for each statistic. Table 16 shows that the impact on the 99.9th percentile of 15-minute mean SO_2 concentrations at 9 of the 16 local human receptors can be classed as insignificant.

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The maximum PEC at any of the human health receptors is 28 % of the AQAL which shows that the 99.9th percentile of 15-minute mean SO_2 concentrations will be easily met at all the local human receptor points.

Table 17 shows that the impact on the 99.73rd percentile of hourly mean SO_2 concentrations at 14 of the 16 local human receptors can be classed as insignificant. The maximum PEC at any of the human health receptors is 16 % of the AQAL which shows that the 99.73rd percentile of hourly mean SO_2 concentrations will be easily met at all the local human receptor points.

Table 18 shows that the impact on the 99.18th percentile of daily mean SO_2 concentrations at all but one of the local human receptors can be classed as insignificant. The maximum PEC at any of the human health receptors is 14 % of the AQAL which shows that the 99.18th percentile of daily mean SO_2 concentrations will be easily met at all the local human receptor points.

Figures 10 to 12 show the short-term SO_2 concentrations for Scenario D for 99.9th percentile of 15-minute mean, 99.73rd percentile of hourly mean and 99.18th percentile of daily mean SO_2 concentrations respectively.

Table 16: Predicted 99.9th percentile 15-minute mean SO_2 process contribution (PC) and predicted environmental concentrations (PEC) for Scenario D at the local human receptors

Receptor	AQS objective (µg/m³)	Back-ground (µg/m³)	PC (µg/m³)	PC/ EAL (%)	PEC (µg/m³)	PEC/ EAL (%)	Descriptor
Church Lane	266	4.8	27.5	10 %	32.3	12 %	-
Wood Farm	266	4.8	32.1	12 %	36.9	14 %	-
Hillside Cottage	266	4.8	44.3	17 %	49.1	18 %	-
Stonepit Farm	266	4.8	56.5	21 %	61.3	23 %	-
Winking Hill Farm	266	4.8	20.1	8 %	24.9	9 %	Insignificant
Gotham PS	266	4.8	69.3	26 %	74.1	28 %	-
Main St	266	4.8	17.4	7 %	22.2	8 %	Insignificant
Lock Lane	266	4.8	20.8	8 %	25.6	10 %	Insignificant
Redhill Marina	266	4.8	16.9	6 %	21.7	8 %	Insignificant
Kingston Hall	266	4.8	20.9	8 %	25.7	10 %	Insignificant
Middlegate Farm	266	4.8	19.3	7 %	24.1	9 %	Insignificant
Little Lunnon	266	4.8	40.3	15 %	45.1	17 %	-
Kegworth Rd	266	4.8	31.4	12 %	36.2	14 %	-
Cranfleet Farm	266	4.8	14.7	6 %	19.5	7 %	Insignificant
Trent Lock	266	4.8	19.1	7 %	23.9	9 %	Insignificant
Ludford Close	266	4.8	21.6	8 %	26.4	10 %	Insignificant

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Table 17: Predicted 99.73rd percentile hourly mean SO_2 process contribution (PC) and predicted environmental concentrations (PEC) for Scenario D at the local human receptors

Receptor	AQS objective (µg/m³)	Back-ground (µg/m³)	PC (µg/m³)	PC/ EAL (%)	PEC (µg/m³)	PEC/ EAL (%)	Descriptor
Church Lane	350	4.8	20.2	6 %	25.0	7 %	Insignificant
Wood Farm	350	4.8	24.3	7 %	29.1	8 %	Insignificant
Hillside Cottage	350	4.8	34.5	10 %	39.3	11 %	Insignificant
Stonepit Farm	350	4.8	44.5	13 %	49.3	14 %	-
Winking Hill Farm	350	4.8	14.5	4 %	19.3	6 %	Insignificant
Gotham PS	350	4.8	51.9	15 %	56.7	16 %	-
Main St	350	4.8	13.3	4 %	18.1	5 %	Insignificant
Lock Lane	350	4.8	13.2	4 %	18.0	5 %	Insignificant
Redhill Marina	350	4.8	13.0	4 %	17.8	5 %	Insignificant
Kingston Hall	350	4.8	11.8	3 %	16.6	5 %	Insignificant
Middlegate Farm	350	4.8	15.4	4 %	20.2	6 %	Insignificant
Little Lunnon	350	4.8	27.7	8 %	32.5	9 %	Insignificant
Kegworth Rd	350	4.8	17.7	5 %	22.5	6 %	Insignificant
Cranfleet Farm	350	4.8	11.9	3 %	16.7	5 %	Insignificant
Trent Lock	350	4.8	12.5	4 %	17.3	5 %	Insignificant
Ludford Close	350	4.8	13.4	4 %	18.2	5 %	Insignificant

Table 18: Predicted 99.18th percentile daily mean SO_2 process contribution (PC) and predicted environmental concentrations (PEC) for Scenario D at the local human receptors

Receptor	AQS objective (µg/m³)	Back-ground (µg/m³)	PC (µg/m³)	PC/ EAL (%)	PEC (µg/m³)	PEC/ EAL (%)	Descriptor
Church Lane	125	4.8	6.2	5 %	11.0	9 %	Insignificant
Wood Farm	125	4.8	6.9	5 %	11.7	9 %	Insignificant
Hillside Cottage	125	4.8	9.4	8 %	14.2	11 %	Insignificant
Stonepit Farm	125	4.8	12.0	10 %	16.8	13 %	Insignificant
Winking Hill Farm	125	4.8	5.2	4 %	10.0	8 %	Insignificant
Gotham PS	125	4.8	13.0	10 %	17.8	14 %	-
Main St	125	4.8	4.7	4 %	9.5	8 %	Insignificant
Lock Lane	125	4.8	6.3	5 %	11.1	9 %	Insignificant
Redhill Marina	125	4.8	4.6	4 %	9.4	8 %	Insignificant
Kingston Hall	125	4.8	4.0	3 %	8.8	7 %	Insignificant
Middlegate Farm	125	4.8	5.8	5 %	10.6	9 %	Insignificant
Little Lunnon	125	4.8	7.1	6 %	11.9	10 %	Insignificant
Kegworth Rd	125	4.8	4.9	4 %	9.7	8 %	Insignificant
Cranfleet Farm	125	4.8	4.8	4 %	9.6	8 %	Insignificant
Trent Lock	125	4.8	5.3	4 %	10.1	8 %	Insignificant
Ludford Close	125	4.8	5.2	4 %	10.0	8 %	Insignificant

6.3 Mercury Concentrations

6.3.1 Hourly Mean Mercury Concentrations

Tables 9 to 12 show that the predicted hourly mean mercury concentrations at the maximum impact location can be classed as insignificant for Scenarios A and C (mercury has not been included in Scenario B as the open cycle GTs do not release mercury at levels required for

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assessment). The predicted hourly mean concentrations for Scenario D are predicted to be 16 % of the AQAL of 7.5 µg/m^3. This is above the insignificance threshold of 10 %. The predicted environmental concentration is predicted to be a maximum of 17 % of the AQAL.

The results show that there is still a significant margin between the PEC and the AQAL for hourly mean mercury concentrations and, therefore, it is very unlikely that the Proposed Development will cause the short-term mercury AQAL to be breached.

The coal-fired power station is the main contributor to ground level concentrations in Scenario D as the modelled release concentration from the power station is 50 times more than for the Proposed Development. Therefore, when the coal-fired power station ceases operation, the mercury concentrations are predicted to reduce to below 10 % of the AQAL as shown in the modelling results for Scenarios A and C.

Even with the coal-fired power station and the Proposed Development both operating continuously all year, the AQAL for hourly mean mercury concentrations is easily met by a significant margin at the maximum impact point.

Table 19 shows the predicted maximum hourly mean mercury concentrations at the human receptor points for Scenario D. Table 19 shows that the impact at all the human receptors is below 10 % of the AQAL for hourly mean mercury concentrations and can, therefore, be classed as insignificant.

Figure 13 shows the maximum predicted mercury concentrations for Scenario D.

Table 19: Predicted maximum hourly mean mercury process contribution (PC) and predicted environmental concentrations (PEC) for Scenario D at the local human receptors

Receptor	AQS objective (µg/m^3)	Back-ground (µg/m^3)	PC (µg/m^3)	PC/ EAL (%)	PEC (µg/m^3)	PEC/ EAL (%)	Descriptor
Church Lane	7.5	0.038	0.231	3.09 %	0.269	4 %	Insignificant
Wood Farm	7.5	0.038	0.298	3.97 %	0.336	4 %	Insignificant
Hillside Cottage	7.5	0.038	0.713	9.51 %	0.751	10 %	Insignificant
Stonepit Farm	7.5	0.038	0.647	8.63 %	0.685	9 %	Insignificant
Winking Hill Farm	7.5	0.038	0.256	3.41 %	0.294	4 %	Insignificant
Gotham PS	7.5	0.038	0.748	9.98 %	0.786	10 %	Insignificant
Main St	7.5	0.038	0.154	2.05 %	0.192	3 %	Insignificant
Lock Lane	7.5	0.038	0.209	2.79 %	0.247	3 %	Insignificant
Redhill Marina	7.5	0.038	0.199	2.66 %	0.237	3 %	Insignificant
Kingston Hall	7.5	0.038	0.572	7.62 %	0.610	8 %	Insignificant
Middlegate Farm	7.5	0.038	0.150	2.00 %	0.188	3 %	Insignificant
Little Lunnon	7.5	0.038	0.452	6.02 %	0.490	7 %	Insignificant
Kegworth Rd	7.5	0.038	0.527	7.02 %	0.565	8 %	Insignificant
Cranfleet Farm	7.5	0.038	0.232	3.09 %	0.270	4 %	Insignificant
Trent Lock	7.5	0.038	0.192	2.56 %	0.230	3 %	Insignificant
Ludford Close	7.5	0.038	0.293	3.90 %	0.331	4 %	Insignificant

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6.4 Heavy Metal Concentrations

6.4.1 Annual Mean Arsenic Concentrations

The predicted annual mean arsenic process contribution from Scenarios A and C are 29 % of the AQAL. The predicted environmental concentration is 62 % of the AQAL. Following the Environment Agency released guidance on the assessment of Group 3 metals (Environment Agency, 2016b), in light of the revised lower environmental standards for arsenic, chromium (VI) and nickel, the annual mean arsenic concentrations can be classed as insignificant as the PEC is less than 100 % of the AQAL (see Section 3.3.3).

Table 20 shows the predicted annual mean arsenic concentrations at the local human receptors for Scenarios A and C. The predicted annual mean arsenic concentrations for the local human receptors are the same for Scenarios A and C as the only difference between these two scenarios for arsenic ground level concentrations is the inclusion of the Ratcliffe site buildings in Scenario C. The buildings only have an impact on ground level concentrations at locations near to the Ratcliffe site buildings. Therefore, at the distances for the human receptor locations, the inclusion of the Ratcliffe site buildings does not influence the predicted ground level concentrations. Table 20 shows that the annual mean arsenic concentrations cannot be classed as negligible at the human receptor points, but that the highest PEC at any of the human receptors is 56 % of the AQAL and, therefore, the AQAL is easily met at all the human receptors. It is worth noting that this is assuming that arsenic is released at the ELV for all nine Group 3 metals. Actual releases of arsenic are likely to be much lower than this; hence, the assessment shows a worst-case impact.

Figures 14 and 15 show the annual mean arsenic concentrations for Scenario A and Scenario C respectively.

Table 20: Predicted annual mean arsenic process contributions (PC) and predicted environmental concentrations (PEC) for Scenario A and Scenario C at the local human receptors

Receptor	AQS objective (µg/m^3)	Back-ground (µg/m^3)	PC (µg/m^3)	PC/ EAL (%)	PEC (µg/m^3)	PEC/ EAL (%)	Descriptor
Church Lane	0.003	0.00098	0.0007	24 %	0.0017	56 %	-
Wood Farm	0.003	0.00098	0.0006	19 %	0.0015	52 %	-
Hillside Cottage	0.003	0.00098	0.0007	24 %	0.0017	56 %	-
Stonepit Farm	0.003	0.00098	0.0005	15 %	0.0014	48 %	-
Winking Hill Farm	0.003	0.00098	0.0002	7 %	0.0012	39 %	-
Gotham PS	0.003	0.00098	0.0005	17 %	0.0015	50 %	-
Main St	0.003	0.00098	0.0003	11 %	0.0013	44 %	-
Lock Lane	0.003	0.00098	0.0002	6 %	0.0012	39 %	-
Redhill Marina	0.003	0.00098	0.0003	12 %	0.0013	44 %	-
Kingston Hall	0.003	0.00098	0.0001	5 %	0.0011	37 %	-
Middlegate Farm	0.003	0.00098	0.0006	20 %	0.0016	52 %	-
Little Lunnon	0.003	0.00098	0.0006	19 %	0.0016	52 %	-
Kegworth Rd	0.003	0.00098	0.0002	5 %	0.0011	38 %	-
Cranfleet Farm	0.003	0.00098	0.0002	7 %	0.0012	40 %	-
Trent Lock	0.003	0.00098	0.0002	6 %	0.0012	39 %	-
Ludford Close	0.003	0.00098	0.0002	7 %	0.0012	40 %	-

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6.4.2 Annual Mean Chromium (VI) Concentrations

The predicted annual mean chromium (VI) process contributions from the Proposed Development under Scenarios A and C are 438 % of the AQAL of 0.0002 µg/m^3. The predicted environmental concentration is 1938 % of the AQAL for chromium (VI). As the PEC is above the Environmental Standard when modelled on a worst-case basis (i.e. assuming that chromium (VI) is released at the ELV for all nine Group 3 metals), the second step of the EA guidance has been followed (Environment Agency, 2016b). This step revises the predicted impacts using emissions data which has been measured by the EA at municipal waste incinerators. Table 21 shows the revised annual mean process contributions and predicted environmental concentrations for chromium (VI) using the maximum, mean and minimum emission concentrations from the EA guidance (Environment Agency, 2016b).The results show that the process contribution when using the maximum, mean and minimum emission concentrations from the EA guidance are all below 0.5 % of the AQAL and, therefore, can be classed as negligible. The PEC for chromium VI is above the AQAL due to the background concentration being 15 times the annual mean AQAL.

Table 21: Revised annual mean process contributions and predicted environmental concentrations for chromium (VI)

Pollutant		AQAL (µg/m^3)	Back-ground conc (µg/m^3)	PC (µg/m^3)	PC/ AQAL (%)	PEC (µg/m^3)	PEC/ AQAL (%)
Cr (VI)	Max emissions	0.0002	0.003	3.5×10^{-7}	0.18 %	0.003	1500 %
	Mean emissions	0.0002	0.003	9.6×10^{-8}	< 0.1 %	0.003	1500 %
	Min emissions	0.0002	0.003	6.4×10^{-9}	< 0.1 %	0.003	1500 %

7 HABITATS IMPACT ASSESSMENT

The impacts of emissions to air on all relevant designated and non-designated ecological sites in the locality of the Proposed Development have been assessed in line with the distance criterion specified in the Environment Agency guidance (Environment Agency, 2016a), namely 10 km for Special Areas of Conservation (SACs), Special Protection Areas (SPAs) or RAMSAR sites and 2 km for Sites of Special Scientific Interest (SSSIs), National Nature Reserves (NNRs), Local Nature Reserves (LNRs), Ancient Woodlands and Local Wildlife Sites (LWSs).

Potential impacts on sensitive receptors at the local sites include direct effects resulting from concentrations of NO_x, SO_2, NH_3 and HF together with effects related to the deposition of acidity and nutrient nitrogen.

7.1 Local Ecologically Sensitive Sites

There are no SACs, SPAs or RAMSAR sites within 10 km of the Proposed Development. There are no ancient woodlands or NNRs within 2 km of the Proposed Development.

There is one Site of Special Scientific Interest (SSSI), namely Lockington Marshes SSSI, within 2 km of the Proposed Development.

There is one Local Nature Reserve (LNR), namely Forbes Hole LNR, within 2 km of the Proposed Development.

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Figure 16 shows the location of the SSSI and LNR.

The area within 2 km of the power station site straddles three counties, namely Nottinghamshire, Derbyshire and Leicestershire. Information obtained from the biological records centres for the three areas, together with pre-application advice from the Environment Agency in relation to the Environmental Permit, suggested the presence of 40 LWSs (or candidate LWSs) within 2 km of the Proposed Development. These were:

- Attenborough West Gravel Pits
- Copse Kingston-on-Soar
- Cranfleet Farm Floodbanks
- Cranfleet Ponds (West Pond)
- Erewash Canal
- Gotham Hill Woods
- Gotham Wood
- Lockington Ash
- Lockington Ash 2
- Lockington Confluence Backwater
- Lockington Confluence Hedges
- Lockington Fen
- Lockington Grounds, pond and marsh near Trent
- Lockington Trentside Pools
- Lockington swamp by SSSI
- Lower Soar Floodplain Wetland
- Meadow Lane Carr
- Narrow Bridge Fish Pond
- Pond in hedgeline between two improved grasslands
- Poplars Fish Pond
- Rare Plant Register Mousetail Pasture
- Ratcliffe Lane Pasture and Stream
- Ratcliffe-on-Soar Flyash Grassland
- Ratcliffe-on-Soar Flyash Track Grassland
- Ratcliffe-on-Soar Pond
- Red Hill Ratcliffe on Soar
- Redhill Marina Backwater
- River Soar Loughborough Meadows to Trent
- River Soar West Bank south of A453
- River Trent North Bank
- Shooting Ground Marsh Grassland, Lockington
- Sheetstores Junction Pond
- Soar Meadow near Ratcliffe Lock
- South Junction Pond
- Thrumpton Bank
- Thrumpton Park
- Trent Floodplain Wetland - Lock M07
- Trent Floodplain Wetland Lock M13
- Trent Lock Marsh
- River Trent

The approximate locations are shown in Figure 17.

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7.2 Assessment Criteria – Critical Levels and Critical Loads

Potential impacts on sensitive receptors at the local sites include direct effects resulting from concentrations of NO_x, SO_2, NH_3 and HF together with effects related to the deposition of acidity (associated with NO_x, NH_3, SO_2, HCl and HF) and nutrient nitrogen (associated with NO_x and NH_3).

Table 22 shows the critical levels against which air concentrations should be assessed at local ecological sites as set out in the Environment Agency guidance (Environment Agency, 2016). As a precautionary approach, the more stringent critical levels for ammonia and SO_2 have been used in this assessment.

Table 22: Critical levels for the assessment of air quality impacts on local ecological sites

Emission	Critical Level (µg/m^3)	Averaging Period
NH_3	1 where lichens or bryophytes are present 3 where they are not present	Annual
SO_2	10 where lichens or bryophytes are present 20 where they are not present	Annual
NO_x	30	Annual
NO_x	75	Daily
HF	0.5	Weekly
HF	5	Daily

Acid and nutrient nitrogen deposition at local ecological sites has been assessed against appropriate critical loads extracted from the Air Pollution Information System (APIS) database (www.apis.co.uk). APIS is a support tool for staff in the UK conservation and regulatory agencies, industry and local authorities, for assessing the potential effects of substances released to air on habitats and species.

Site relevant acid and nutrient nitrogen critical loads were available from APIS for the Lockington marshes SSSI for the sensitive habitat features present. The fen, marsh and swap features were identified as not sensitive to acid or nitrogen deposition. The broad-leaved, mixed and yew woodland features were identified as sensitive to nitrogen deposition (critical load 10–20 kg N/ha/yr) and acid deposition (critical load 1.764 to 11.013 keq/ha/yr). The invertebrates assemblage feature was identified as sensitive to nitrogen and acid deposition; however, no critical loads were available for this feature in APIS. As a precautionary measure, the lower (i.e. most stringent) end of the nitrogen and acid critical load range for the broad-leaved, mixed and yew woodland feature was used for the assessment. It was also assumed that these applied at the point of maximum impact, although critical loads may vary geographically across each site in practice. This approach should be sufficiently conservative to provide assurance that the woodland feature assessment would also encompass any potential impacts on the invertebrates assemblage feature, in the absence of any specific assessment criteria for the latter.

Site-specific critical loads are not available from APIS for LNRs or LWSs; however, location-specific critical loads are available for a selection of habitat types.

The following approach was taken for assigning habitats to each LWS and the LNR.

For woodland features:

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- A nitrogen critical load of 10 kg N/ha/yr was assigned representative of the lower (more stringent) end of the broad-leaved, mixed and yew woodland nitrogen critical load range. The exception was Thrumpton Park where the project ecologists recommended a critical load of 15 kg N/ha/yr based on the presence of Meso and eutrophic Quercus woodland (critical load range 15–20 kg N/ha/yr).

- A location specific acidity critical load for broad-leaved, mixed and yew woodland was extracted from APIS and the lower end of the critical load range applied.

For non-woodland features:

- Location-specific acid and nitrogen critical loads for calcareous grassland were assigned to Red Hill Ratcliffe-on Soar LWS (on ecologists advice) and to the Ratcliffe on Soar flyash grassland and Ratcliffe on Soar flyash track grassland (on the basis of the stored ash calcium content)

- Ratcliffe Lane Pasture and Stream, River Trent North Bank, Shooting Ground Marsh Grassland Lockington, Soar Meadow near Ratcliffe Lock and Thrumpton were assigned nitrogen critical loads of either 15 or 20 keq/ha/yr for low and medium altitude hay meadows based on advice from the project ecologists.

- The project ecologists assigned the rich fens habitats to a number of the local LWSs. The majority of other LWSs appeared to have surface water or marsh related habitats present. Therefore, the remaining LWSs were assigned a nitrogen critical load of 15 keq/ha/yr based on the rich fens habitat (critical load range 15–30 kg N/ha/yr).

- As the fen, marsh and swamp habitats and low and medium altitude hay meadows habitats are deemed non-sensitive to acid deposition by APIS, all LWS with the exception of those assigned for calcareous grassland were assigned acid critical loads associated with the bogs habitats, as a precautionary approach. These were extracted from APIS using the ‘Search by location’ tool at the point of maximum impact for each site.

The above assignments represent a highly precautionary approach for acidity critical loads as it is likely that, in practice, a number of sites will not exhibit sensitivity to acid deposition.

It should be noted that the high priority coastal and floodplain grazing marshes habitat identified in the Thrumpton Park area in the Environment Agency pre-application advice is encompassed within the critical loads assigned to this site (for low and medium altitude hay meadows).

The Environment Agency has set out an approach for assessing deposition against acid critical loads [Environment Agency, 2012]. This states that

- If $PEC_{\text{nitrogen deposition}}$ < CLminN, sulphur deposition is compared against CLmaxS.

- If $PEC_{\text{nitrogen deposition}}$ > CLminN, the sum of the nitrogen and sulphur deposition is compared against CLmaxN.

As CLminN was exceeded by background deposition at all local sensitive sites for both woodland and non-woodland critical loads, the latter approach comparing total acid deposition against CLmaxN has been applied in all cases.

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7.3 Significance Criteria for Ecological Impacts

The EPUK & IAQM Guidance 2017 does not provide impact descriptors for the assessment of ecological impacts; therefore, the Environment Agency guidance (Environment Agency, 2016) has been used. This states the following significance criteria, applicable to both critical loads and critical levels:

For SACs, SPAs, Ramsar sites and SSSIs, impacts may be considered insignificant where:

- the short-term PC is less than 10 % of the short-term environmental standard
- the long-term PC is less than 1 % of the long-term environmental standard.

For local nature sites (ancient woods, local wildlife sites and national and local nature reserves) impacts may be considered insignificant where:

- the short-term PC is less than 100 % of the short-term environmental standard
- the long-term PC is less than 100 % of the long-term environmental standard.

Where impacts as not classed as insignificant, the combined PC and estimated background deposition (available from APIS) should be compared to the environmental standard.

In June 2019, the IAQM issued guidance (IAQM, 2019) relating to the assessment of air quality impacts on designated nature conservation sites. The guidance suggests that for ecological impact assessments of projects and plans, LNRs and LWSs should be treated in the same manner as SSSIs and European sites (i.e. using 1 % and 10 % thresholds for screening of long-term and short-term effects, respectively), but notes that the determination of significance of an effect may be different.

As the Environment Agency criteria have historically been applied as a numerical indicator of significance for impacts on ecological sites in planning applications, these criteria have been applied as a preliminary determination of significance for LWSs in this report. However, a detailed evaluation by an ecologist taking into account the IAQM, 2019 guidance is presented in Appendix 6-3 of the ES.

7.4 Modelling Methodology

Concentrations and deposition have been predicted on a 10 km by 10 km grid centred on the Proposed Development with a grid spacing of 100 m for NO_x, SO_2, NH_3 and HF. Five years of meteorology were used, as described in Section 4.4, to ensure that worst-case meteorological conditions were captured.

Both concentrations and deposition have been assessed based on the long-term emission rates set out in Table 3 and Table 4. In the case of the Proposed Development, the long-term emission rates are based on the maximum daily average BAT AEL in the WI BREF. As acid and nitrogen critical loads are based on annual deposition and critical levels are based on averaging periods ranging from daily to annual, the use of these maximum daily emission rates remains suitably precautionary. In terms of the coal plant emissions, the long-term emission rates are based on annual average BAT AELs. The permitted daily mean emission rates for SO_2 and NO_x will be based on a 10 % uplift of the annual emission in practice (i.e. 220 mg/Nm^3 in both cases); however, the assumption in the modelling that the station will operate for the entire year at full load is sufficiently precautionary to encompass this increase, being equivalent to a 91 % annual load factor at 220 mg/Nm^3.

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Results presented are the maximum predicted for any year of meteorological data at any modelled point over each local ecological site. As a precautionary approach, these runs assumed no plume depletion due to deposition.

Dry deposition to both non-woodland and woodland features has been assessed by multiplying the modelled concentrations by the deposition velocities shown in Table 23 based on the AQTAG06 Environment Agency Guidance (Environment Agency, 2014) followed by appropriate unit conversion for comparison to acid and nutrient nitrogen critical loads. These runs did not incorporate NO_x chemistry and effectively assign the same deposition velocity to NO and NO_2. This represents a precautionary approach for nitrogen deposition as this is primarily associated with NO_2 with the NO deposition velocity being negligible in comparison. AQTAG06 does not include deposition velocities for HF; therefore, the deposition velocity for HCl has been used for this species given their shared chemical properties as hydrogen halides.

Wet deposition of SO_2, NO_x and NH_3 is negligible in comparison with dry deposition over near-field distances (Environment Agency, 2014) and has therefore been omitted. Given the high solubility of HCl and to an extent HF, there is potential for wet deposition to be significant over short distances. As a precautionary approach, the modelled dry deposition total has been doubled to account for wet deposition. This is consistent with the approach applied in other energy from waste plant deposition assessments for these species.

Table 23: Deposition parameter values used in ADMS modelling

Species	Dry deposition velocity (m/s) Non-woodland habitats	Dry deposition velocity (m/s) Woodland habitats	Wet deposition
NO_x	0.0015	0.003	-
SO_2	0.012	0.024	-
NH_3	0.02	0.03	-
HCl	0.025	0.060	Assumed equal to dry deposition
HF	0.025	0.060	Assumed equal to dry deposition

7.5 Results

7.5.1 Assessment Against NH_3 Annual Mean Critical Level

Table 24 compares the modelled annual mean NH_3 concentrations to the annual mean NH_3 critical level for Scenarios A, C and D. As it is assumed there are negligible emissions of NH_3 from the OCGTs, the results for Scenario B will be the same as Scenario A and are not considered separately.

It can be seen that the PC is below 100 % of the critical level at the LNR and at all of the LWSs for all three scenarios and hence the impacts can be considered as insignificant at these sites in relation to the EA significance criterion for long-term impacts. It should be noted that the project ecologist recommended that the less stringent ammonia critical level of 3 $\mu g/m^3$ should be applied at the LNR and LWSs (see Appendix 6-3 of the ES) which would reduce the impact to less than 1 % of the critical level at all sites except the Gotham Hill Woods LWS.

The PC at Lockington Marshes SSSI is fractionally above the 1 % long-term significance threshold for SSSIs for the three scenarios. Table 25 shows the PECs using the background NH_3 concentration extracted from APIS for the location of the maximum impact point. It can be

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seen that the background ammonia concentration already exceeds the annual mean NH_3 critical level by more than a factor of two. The PC comprises 0.6 %, 0.6 % and 0.8 % of the background ammonia concentration for Scenarios A, C and D respectively.

The area around the Ratcliffe-on-Soar power station site is predominantly rural and as such the background ammonia concentrations will derive primarily from farming activities as opposed to industrial or commercial sources; hence, it is evident that sources other than the Proposed Development and the existing coal-fired power station dominate ammonia concentrations at the Lockington Marshes SSSI.

The assessment has been based on the highest impact at any point on the site over the five meteorological years modelled. The average ammonia concentration over the five years is below the 1 % threshold over the entire SSSI (the highest average value being 0.009 µg/m^3 at any point in the site) for Scenarios A and C and is below the 1 % threshold over 90 % of the entire SSSI area for Scenario D.

The site-specific critical level information on APIS for the Lockington Marshes SSSI suggests that site-specific advice should be sought in relation to the habitat sensitivity of the fen, marsh and swamp features and the broad-leaved mixed and yew woodland features in relation to ammonia. A critical level of 3 µg/m^3 is recommended for the invertebrate assemblage feature. A review by the project ecologist (see Appendix 6-3 of the ES) concluded that the higher ammonia critical load of 3 µg/m^3 should be applied at the SSSI. Applying the higher critical load would result in PCs comprising 0.5 % and 0.6 % of the critical level for Scenario A and Scenario D respectively, which would be below the 1 % significance threshold.

The assessment has a number of conservative assumptions built in, notably:

- The Proposed Development and existing coal-fired power station are assumed to operate with a 100 % annual load factor;
- The assessment is based on the worst-case meteorological year;
- The assessment is based on the highest impact point over the entire site; and
- The more precautionary 1 µg/m^3 critical level has been used.

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Table 24: Predicted process contributions (PC) assessed against the annual mean NH_3 critical level (Clv) – Scenarios A, C and D

Site		Scenario A		Scenario C		Scenario D	
	Clv µg/m³	PC µg/m³	PC/Clv %	PC µg/m³	PC/Clv %	PC µg/m³	PC/Clv %
Lockington Marshes SSSI	1	0.014	1.4 %	0.014	1.4 %	0.018	1.8 %
Forbes Hole LNR	1	0.007	0.7 %	0.007	0.7 %	0.009	0.9 %
Attenborough West Gravel Pits	1	0.012	1.2 %	0.012	1.2 %	0.014	1.4 %
Copse Kingston-on-Soar	1	0.006	0.6 %	0.006	0.6 %	0.008	0.8 %
Cranfleet Farm Floodbanks	1	0.009	0.9 %	0.009	0.9 %	0.009	0.9 %
Cranfleet Ponds (West Pond)	1	0.007	0.7 %	0.007	0.7 %	0.008	0.8 %
Erewash Canal	1	0.006	0.6 %	0.006	0.6 %	0.007	0.7 %
Gotham Hill Woods	1	0.027	2.7 %	0.027	2.7 %	0.035	3.5 %
Gotham Wood	1	0.013	1.3 %	0.008	0.8 %	0.021	2.1 %
Lockington Ash	1	0.006	0.6 %	0.006	0.6 %	0.006	0.6 %
Lockington Ash 2	1	0.006	0.6 %	0.006	0.6 %	0.006	0.6 %
Lockington Confluence Backwater	1	0.007	0.7 %	0.007	0.7 %	0.007	0.7 %
Lockington Confluence Hedges	1	0.006	0.6 %	0.006	0.6 %	0.007	0.7 %
Lockington Fen	1	0.010	1.0 %	0.012	1.2 %	0.017	1.7 %
Lockington Grounds, pond and marsh near Trent	1	0.005	0.5 %	0.005	0.5 %	0.006	0.6 %
Lockington Trentside Pools	1	0.006	0.6 %	0.006	0.6 %	0.007	0.7 %
Lockington swamp by SSSI	1	0.005	0.5 %	0.005	0.5 %	0.006	0.6 %
Lower Soar Floodplain Wetland	1	0.016	1.6 %	0.016	1.6 %	0.019	1.9 %
Meadow Lane Carr	1	0.008	0.8 %	0.008	0.8 %	0.009	0.9 %
Narrow Bridge Fish Pond	1	0.006	0.6 %	0.006	0.6 %	0.007	0.7 %
Pond in hedgeline between two improved grasslands	1	0.014	1.4 %	0.014	1.4 %	0.016	1.6 %
Poplars Fish Pond	1	0.007	0.7 %	0.007	0.7 %	0.007	0.7 %
Rare Plant Register Mousetail Pasture	1	0.017	1.7 %	0.017	1.7 %	0.019	1.9 %
Ratcliffe Lane Pasture and Stream	1	0.016	1.6 %	0.016	1.6 %	0.018	1.8 %
Ratcliffe-on-Soar Flyash Grassland	1	0.007	0.7 %	0.007	0.7 %	0.008	0.8 %
Ratcliffe-on-Soar Flyash Track Grassland	1	0.007	0.7 %	0.007	0.7 %	0.007	0.7 %
Ratcliffe-on-Soar Pond	1	0.004	0.4 %	0.004	0.4 %	0.004	0.4 %
Red Hill Ratcliffe on Soar	1	0.007	0.7 %	0.007	0.7 %	0.007	0.7 %
Redhill Marina Backwater	1	0.008	0.8 %	0.008	0.8 %	0.008	0.8 %

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Table 24 (cont): Predicted process contributions (PC) assessed against the annual mean NH_3 critical level (Clv) – Scenarios A, C and D

Site		Scenario A		Scenario C		Scenario D	
	Clv µg/m³	PC µg/m³	PC/Clv %	PC µg/m³	PC/Clv %	PC µg/m³	PC/Clv %
River Soar Loughborough Meadows to Trent	1	0.017	1.7 %	0.014	1.4 %	0.019	1.9 %
River Soar West Bank south of A453	1	0.010	1.0 %	0.012	1.2 %	0.013	1.3 %
River Trent North Bank	1	0.027	2.7 %	0.027	2.7 %	0.029	2.9 %
Shooting Ground Marsh Grassland, Lockington	1	0.014	1.4 %	0.017	1.7 %	0.017	1.7 %
Sheetstores Junction Pond	1	0.006	0.6 %	0.006	0.6 %	0.007	0.7 %
Soar Meadow near Ratcliffe Lock	1	0.016	1.6 %	0.016	1.6 %	0.018	1.8 %
South Junction Pond	1	0.006	0.6 %	0.006	0.6 %	0.007	0.7 %
Thrumpton Bank	1	0.026	2.6 %	0.026	2.6 %	0.028	2.8 %
Thrumpton Park	1	0.026	2.6 %	0.026	2.6 %	0.027	2.7 %
Trent Floodplain Wetland - Lock M07	1	0.006	0.6 %	0.006	0.6 %	0.007	0.7 %
Trent Floodplain Wetland Lock M13	1	0.005	0.5 %	0.005	0.5 %	0.006	0.6 %
Trent Lock Marsh	1	0.006	0.6 %	0.006	0.6 %	0.006	0.6 %
River Trent (Erewash)	1	0.007	0.7 %	0.007	0.7 %	0.007	0.7 %

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Table 25: Predicted process contributions (PC) and predicted environmental concentrations (PEC) at Lockington Marshes SSSI assessed against the annual mean NH_3 critical level – Scenarios A and D

	Critical Level ($\mu g/m^3$)	PC ($\mu g/m^3$)	PC/CLv (%)	Background ($\mu g/m^3$)	PEC ($\mu g/m^3$)	PEC/ CLv (%)
Scenario A	1	0.014	1.4 %	2.17	2.19	219 %
Scenario C	1	0.014	1.4 %	2.17	2.19	219 %
Scenario D	1	0.018	1.8 %	2.17	2.18	218 %

Given the precautionary approach adopted, the low levels of impact relative to both the critical level and the background, and the domination of ammonia levels at the SSSI by sources other than the Proposed Development, it can reasonably be concluded that annual emissions of ammonia from the Proposed Development would not be at levels which could lead to significant adverse effects on the ecological features at the Lockington Marshes SSSI under all of the scenarios considered.

As ammonia impacts are below are below the EA significance threshold at the LNR and all local LWSs, it can confidently be concluded that that annual emissions of ammonia from the Proposed Development would not be at levels which could lead to significant adverse effects on the ecological features at these sites under all of the scenarios considered.

7.5.2 Assessment Against SO_2 Annual Mean Critical Level

Table 26 compares the modelled annual mean SO_2 concentrations to the annual mean SO_2 critical level for Scenarios A to D.

Table 26 shows that the PC is below 100 % of the critical level at the LNR and at all of the LWSs for all four scenarios and hence the impacts can be considered as insignificant at these sites in relation to the EA significance criterion for long-term impacts.

The PC at Lockington Marshes SSSI is only above the 1 % long-term significance threshold for SSSIs for Scenario D. Table 27 shows the PEC for Scenario D using the background SO_2 concentration extracted from APIS for the location of the maximum impact point. It can be seen that the PEC is well below the critical level.

The site-specific critical level information on APIS for the Lockington Marshes SSSI suggests that site-specific advice should be sought in relation to the habitat sensitivity of the fen, marsh and swamp features and the broad-leaved mixed and yew woodland features in relation to sulphur dioxide. A critical level of 20 $\mu g/m^3$ is recommended for the invertebrate assemblage feature. Applying the higher critical load would result in a PC of 1.2 % of the critical level for Scenario D.

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Table 26: Predicted process contributions (PC) assessed against the annual mean SO_2 critical level – Scenarios A to D

Site		Scenario A		Scenario B		Scenario C		Scenario D	
	Clv µg/m^3	PC µg/m^3	PC/Clv %	PC µg/m^3	PC/Clv %	PC µg/m^3	PC/Clv %	PC µg/m^3	PC/Clv %
Lockington Marshes SSSI	10	0.040	0.4 %	0.065	0.6 %	0.074	0.7 %	0.236	2.4 %
Forbes Hole LNR	10	0.022	0.2 %	0.032	0.3 %	0.032	0.3 %	0.089	0.9 %
Attenborough West Gravel Pits	10	0.035	0.4 %	0.049	0.5 %	0.057	0.6 %	0.143	1.4 %
Copse Kingston-on-Soar	10	0.019	0.2 %	0.030	0.3 %	0.031	0.3 %	0.082	0.8 %
Cranfleet Farm Floodbanks	10	0.026	0.3 %	0.035	0.4 %	0.035	0.4 %	0.050	0.5 %
Cranfleet Ponds (West Pond)	10	0.022	0.2 %	0.030	0.3 %	0.030	0.3 %	0.040	0.4 %
Erewash Canal	10	0.018	0.2 %	0.023	0.2 %	0.023	0.2 %	0.046	0.5 %
Gotham Hill Woods	10	0.078	0.8 %	0.120	1.2 %	0.139	1.4 %	0.543	5.4 %
Gotham Wood	10	0.037	0.4 %	0.069	0.7 %	0.042	0.4 %	0.406	4.1 %
Lockington Ash	10	0.016	0.2 %	0.022	0.2 %	0.022	0.2 %	0.044	0.4 %
Lockington Ash 2	10	0.016	0.2 %	0.022	0.2 %	0.022	0.2 %	0.044	0.4 %
Lockington Confluence Backwater	10	0.019	0.2 %	0.024	0.2 %	0.024	0.2 %	0.054	0.5 %
Lockington Confluence Hedges	10	0.019	0.2 %	0.024	0.2 %	0.024	0.2 %	0.047	0.5 %
Lockington Fen	10	0.031	0.3 %	0.057	0.6 %	0.064	0.6 %	0.245	2.4 %
Lockington Grounds, pond and marsh near Trent	10	0.014	0.1 %	0.019	0.2 %	0.020	0.2 %	0.055	0.6 %
Lockington Trentside Pools	10	0.019	0.2 %	0.024	0.2 %	0.024	0.2 %	0.041	0.4 %
Lockington swamp by SSSI	10	0.016	0.2 %	0.022	0.2 %	0.022	0.2 %	0.048	0.5 %
Lower Soar Floodplain Wetland	10	0.048	0.5 %	0.076	0.8 %	0.090	0.9 %	0.176	1.8 %
Meadow Lane Carr	10	0.023	0.2 %	0.033	0.3 %	0.033	0.3 %	0.092	0.9 %
Narrow Bridge Fish Pond	10	0.018	0.2 %	0.023	0.2 %	0.023	0.2 %	0.039	0.4 %
Pond in hedgeline between two improved grasslands	10	0.042	0.4 %	0.063	0.6 %	0.068	0.7 %	0.123	1.2 %
Poplars Fish Pond	10	0.020	0.2 %	0.026	0.3 %	0.025	0.3 %	0.051	0.5 %
Rare Plant Register Mousetail Pasture	10	0.051	0.5 %	0.079	0.8 %	0.094	0.9 %	0.162	1.6 %
Ratcliffe Lane Pasture and Stream	10	0.047	0.5 %	0.076	0.8 %	0.089	0.9 %	0.245	2.4 %
Ratcliffe-on-Soar Flyash Grassland	10	0.020	0.2 %	0.031	0.3 %	0.032	0.3 %	0.078	0.8 %
Ratcliffe-on-Soar Flyash Track Grassland	10	0.020	0.2 %	0.025	0.3 %	0.025	0.3 %	0.047	0.5 %
Ratcliffe-on-Soar Pond	10	0.011	0.1 %	0.013	0.1 %	0.014	0.1 %	0.020	0.2 %
Red Hill Ratcliffe on Soar	10	0.020	0.2 %	0.025	0.3 %	0.025	0.3 %	0.041	0.4 %

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Table 26 (cont): Predicted process contributions (PC) assessed against the annual mean SO_2 critical level – Scenarios A to D

Site		Scenario A		Scenario B		Scenario C		Scenario D	
	Clv µg/m³	PC µg/m³	PC/Clv %	PC µg/m³	PC/Clv %	PC µg/m³	PC/Clv %	PC µg/m³	PC/Clv %
Redhill Marina Backwater	10	0.023	0.2 %	0.026	0.3 %	0.027	0.3 %	0.042	0.4 %
River Soar Loughborough Meadows to Trent	10	0.051	0.5 %	0.079	0.8 %	0.072	0.7 %	0.188	1.9 %
River Soar West Bank south of A453	10	0.028	0.3 %	0.052	0.5 %	0.054	0.5 %	0.096	1.0 %
River Trent North Bank	10	0.081	0.8 %	0.106	1.1 %	0.164	1.6 %	0.224	2.2 %
Shooting Ground Marsh Grassland, Lockington	10	0.040	0.4 %	0.063	0.6 %	0.094	0.9 %	0.201	2.0 %
Sheetstores Junction Pond	10	0.018	0.2 %	0.023	0.2 %	0.023	0.2 %	0.044	0.4 %
Soar Meadow near Ratcliffe Lock	10	0.048	0.5 %	0.075	0.7 %	0.086	0.9 %	0.161	1.6 %
South Junction Pond	10	0.019	0.2 %	0.024	0.2 %	0.024	0.2 %	0.053	0.5 %
Thrumpton Bank	10	0.076	0.8 %	0.101	1.0 %	0.147	1.5 %	0.225	2.3 %
Thrumpton Park	10	0.077	0.8 %	0.100	1.0 %	0.186	1.9 %	0.212	2.1 %
Trent Floodplain Wetland - Lock M07	10	0.019	0.2 %	0.024	0.2 %	0.024	0.2 %	0.038	0.4 %
Trent Floodplain Wetland Lock M13	10	0.014	0.1 %	0.019	0.2 %	0.020	0.2 %	0.052	0.5 %
Trent Lock Marsh	10	0.017	0.2 %	0.022	0.2 %	0.022	0.2 %	0.045	0.4 %
River Trent (Erewash)	10	0.020	0.2 %	0.025	0.2 %	0.025	0.2 %	0.057	0.6 %

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Table 27: Predicted process contribution (PC) and predicted environmental concentration (PEC) at Lockington Marshes SSSI assessed against the annual mean SO_2 critical level – Scenario D

	Critical Level ($\mu g/m^3$)	PC ($\mu g/m^3$)	PC/CLv (%)	Background ($\mu g/m^3$)	PEC ($\mu g/m^3$)	PEC/CLv (%)
Scenario D	10	0.236	2.4 %	1.56	1.80	18.0 %

The assessment has a number of conservative assumptions built in, notably:

- The Proposed Development, OCGTs (which are restricted to 500 hours of operation per year) and the existing coal-fired power station are assumed to operate with a 100 % annual load factor;
- The assessment is based on the worst-case meteorological year;
- The assessment is based on the highest impact point over the entire site; and
- The more precautionary 10 $\mu g/m^3$ critical level has been used.

Given that the PEC is well below the annual mean SO_2 critical level, it can confidently be concluded that annual emissions of SO_2 from the Proposed Development would not be at levels which could lead to significant adverse effects on the ecological features at the Lockington Marshes SSSI under all of the scenarios considered.

As SO_2 impacts are below the EA significance threshold at the LNR and all local LWSs, it can confidently be concluded that that annual emissions of SO_2 from the Proposed Development would not be at levels which could lead to significant adverse effects on the ecological features at these sites under all of the scenarios considered.

7.5.3 Assessment Against NO_x Annual Mean Critical Level

Table 28 compares the modelled annual mean NO_x concentrations to the annual mean NO_x critical level for Scenarios A to D. It can be seen that the PC is below 100 % of the critical level at the LNR and at all of the LWSs for all four scenarios and hence the impacts can be considered as insignificant at these sites in relation to the EA significance criterion for long-term impacts.

The PC at Lockington Marshes SSSI is fractionally above the 1 % long-term significance threshold for SSSIs for Scenario C and Scenario D.

Table 29 shows the PECs for Scenario C and Scenario D using the background NO_x concentration extracted from APIS for the location of the maximum impact point. It can be seen that the PEC is more than 20 % below the critical level for both scenarios.

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Table 28: Predicted process contributions (PC) assessed against the annual mean NO_x critical level – Scenarios A to D

Site		Scenario A		Scenario B		Scenario C		Scenario D	
	Clv µg/m³	PC µg/m³	PC/Clv %	PC µg/m³	PC/Clv %	PC µg/m³	PC/Clv %	PC µg/m³	PC/Clv %
Lockington Marshes SSSI	30	0.164	0.5 %	0.264	0.9 %	0.302	1.0 %	0.464	1.5 %
Forbes Hole LNR	30	0.090	0.3 %	0.129	0.4 %	0.129	0.4 %	0.186	0.6 %
Attenborough West Gravel Pits	30	0.144	0.5 %	0.201	0.7 %	0.234	0.8 %	0.319	1.1 %
Copse Kingston-on-Soar	30	0.077	0.3 %	0.122	0.4 %	0.127	0.4 %	0.177	0.6 %
Cranfleet Farm Floodbanks	30	0.105	0.4 %	0.143	0.5 %	0.143	0.5 %	0.158	0.5 %
Cranfleet Ponds (West Pond)	30	0.088	0.3 %	0.121	0.4 %	0.121	0.4 %	0.131	0.4 %
Erewash Canal	30	0.073	0.2 %	0.095	0.3 %	0.095	0.3 %	0.113	0.4 %
Gotham Hill Woods	30	0.319	1.1 %	0.496	1.7 %	0.572	1.9 %	0.943	3.1 %
Gotham Wood	30	0.150	0.5 %	0.281	0.9 %	0.173	0.6 %	0.638	2.1 %
Lockington Ash	30	0.066	0.2 %	0.088	0.3 %	0.089	0.3 %	0.111	0.4 %
Lockington Ash 2	30	0.066	0.2 %	0.088	0.3 %	0.089	0.3 %	0.111	0.4 %
Lockington Confluence Backwater	30	0.079	0.3 %	0.099	0.3 %	0.099	0.3 %	0.118	0.4 %
Lockington Confluence Hedges	30	0.078	0.3 %	0.100	0.3 %	0.100	0.3 %	0.117	0.4 %
Lockington Fen	30	0.125	0.4 %	0.233	0.8 %	0.261	0.9 %	0.442	1.5 %
Lockington Grounds, pond and marsh near Trent	30	0.057	0.2 %	0.079	0.3 %	0.080	0.3 %	0.115	0.4 %
Lockington Trentside Pools	30	0.078	0.3 %	0.098	0.3 %	0.098	0.3 %	0.115	0.4 %
Lockington swamp by SSSI	30	0.066	0.2 %	0.088	0.3 %	0.089	0.3 %	0.115	0.4 %
Lower Soar Floodplain Wetland	30	0.197	0.7 %	0.309	1.0 %	0.367	1.2 %	0.453	1.5 %
Meadow Lane Carr	30	0.095	0.3 %	0.135	0.5 %	0.135	0.5 %	0.194	0.6 %
Narrow Bridge Fish Pond	30	0.075	0.2 %	0.092	0.3 %	0.092	0.3 %	0.105	0.4 %
Pond in hedgeline between two improved grasslands	30	0.171	0.6 %	0.256	0.9 %	0.279	0.9 %	0.334	1.1 %
Poplars Fish Pond	30	0.080	0.3 %	0.104	0.3 %	0.104	0.3 %	0.129	0.4 %
Rare Plant Register Mousetail Pasture	30	0.206	0.7 %	0.321	1.1 %	0.384	1.3 %	0.452	1.5 %
Ratcliffe Lane Pasture and Stream	30	0.193	0.6 %	0.309	1.0 %	0.364	1.2 %	0.502	1.7 %
Ratcliffe-on-Soar Flyash Grassland	30	0.081	0.3 %	0.126	0.4 %	0.132	0.4 %	0.178	0.6 %
Ratcliffe-on-Soar Flyash Track Grassland	30	0.081	0.3 %	0.102	0.3 %	0.102	0.3 %	0.122	0.4 %
Ratcliffe-on-Soar Pond	30	0.047	0.2 %	0.054	0.2 %	0.055	0.2 %	0.062	0.2 %
Red Hill Ratcliffe on Soar	30	0.080	0.3 %	0.103	0.3 %	0.103	0.3 %	0.116	0.4 %

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Table 28 (cont): Predicted process contributions (PC) assessed against the annual mean NO_x critical level – Scenarios A to D

Site		Scenario A		Scenario B		Scenario C		Scenario D	
	Clv µg/m³	PC µg/m³	PC/Clv %	PC µg/m³	PC/Clv %	PC µg/m³	PC/Clv %	PC µg/m³	PC/Clv %
Redhill Marina Backwater	30	0.095	0.3 %	0.108	0.4 %	0.110	0.4 %	0.121	0.4 %
River Soar Loughborough Meadows to Trent	30	0.210	0.7 %	0.321	1.1 %	0.295	1.0 %	0.473	1.6 %
River Soar West Bank south of A453	30	0.115	0.4 %	0.210	0.7 %	0.220	0.7 %	0.262	0.9 %
River Trent North Bank	30	0.329	1.1 %	0.433	1.4 %	0.669	2.2 %	0.716	2.4 %
Shooting Ground Marsh Grassland, Lockington	30	0.164	0.5 %	0.257	0.9 %	0.384	1.3 %	0.423	1.4 %
Sheetstores Junction Pond	30	0.075	0.2 %	0.092	0.3 %	0.092	0.3 %	0.111	0.4 %
Soar Meadow near Ratcliffe Lock	30	0.195	0.6 %	0.304	1.0 %	0.350	1.2 %	0.426	1.4 %
South Junction Pond	30	0.077	0.3 %	0.100	0.3 %	0.100	0.3 %	0.129	0.4 %
Thrumpton Bank	30	0.308	1.0 %	0.412	1.4 %	0.598	2.0 %	0.677	2.3 %
Thrumpton Park	30	0.315	1.1 %	0.408	1.4 %	0.774	2.6 %	0.799	2.7 %
Trent Floodplain Wetland - Lock M07	30	0.078	0.3 %	0.100	0.3 %	0.100	0.3 %	0.113	0.4 %
Trent Floodplain Wetland Lock M13	30	0.057	0.2 %	0.079	0.3 %	0.080	0.3 %	0.112	0.4 %
Trent Lock Marsh	30	0.068	0.2 %	0.090	0.3 %	0.090	0.3 %	0.112	0.4 %
River Trent (Erewash)	30	0.081	0.3 %	0.100	0.3 %	0.100	0.3 %	0.119	0.4 %

NCC received 16.07.2020

Table 29: Predicted process contributions (PC) and predicted environmental concentrations (PEC) at Lockington Marshes SSSI assessed against the annual mean NO_x critical level – Scenarios C and D

	Critical Level ($\mu g/m^3$)	PC ($\mu g/m^3$)	PC/CLv (%)	Background ($\mu g/m^3$)	PEC ($\mu g/m^3$)	PEC/CLv (%)
Scenario C	30	0.302	1.0 %	23.41	23.71	79.0 %
Scenario D	30	0.464	1.5 %	23.41	23.87	79.6 %

The assessment has a number of conservative assumptions built in, notably:

- The Proposed Development, OCGTs (which are restricted to 500 hours of operation per year) and the existing coal-fired power station are assumed to operate with a 100 % annual load factor;
- The assessment is based on the worst-case meteorological year; and
- The assessment is based on the highest impact point over the entire site.

Given that the PEC is significantly below the annual mean NO_x critical level, it can confidently be concluded that annual emissions of NO_x from the Proposed Development would not be at levels which could lead to significant adverse effects on the ecological features at the Lockington Marshes SSSI under all of the scenarios considered.

As NO_x impacts are below the EA significance threshold at the LNR and all local LWSs, it can confidently be concluded that that annual emissions of NO_x from the Proposed Development would not be at levels which could lead to significant adverse effects on the ecological features at these sites under all of the scenarios considered.

7.5.4 Assessment Against NO_x Maximum Daily Mean Critical Level

Table 30 compares the modelled maximum daily mean NO_x concentrations to the maximum daily mean NO_x critical level for Scenarios A to D. It can be seen that the PC is below 100 % of the critical level at the LNR and at all of the LWSs for all four scenarios and hence the impacts can be considered as insignificant at these sites in relation to the EA significance criterion for short-term impacts.

The PC at Lockington Marshes SSSI is below the 10 % short-term significance threshold for Scenario A, fractionally above the threshold for Scenario B and 14.3 % and 27.9 % of the critical level for Scenario C and Scenario D, respectively.

Table 31 shows the PECs for Scenario B, Scenario C and Scenario D using the background NO_x concentration extracted from APIS for the location of the maximum impact point. The Environment Agency guidance suggests using twice the annual mean background concentration when determining the PEC for short-term effects.

It can be seen that the PEC is more than 20 % below the critical level for Scenario B and Scenario C, and around 90 % of the critical level for Scenario D. It should be noted that Scenario D considers operation of the existing power station and, hence, this scenario would occur for no more than nine months in total based on the assumed dates for commencing operation of the Proposed Development and for closure of the existing power station.

NCC received 16.07.2020

Table 30: Predicted process contributions (PC) assessed against the daily mean NO_x critical level – Scenarios A to D

Site		Scenario A		Scenario B		Scenario C		Scenario D	
	Clv µg/m³	PC µg/m³	PC/Clv %	PC µg/m³	PC/Clv %	PC µg/m³	PC/Clv %	PC µg/m³	PC/Clv %
Lockington Marshes SSSI	75	3.44	4.6 %	7.68	10.2 %	10.76	14.3 %	20.92	27.9 %
Forbes Hole LNR	75	2.87	3.8 %	4.52	6.0 %	4.52	6.0 %	7.59	10.1 %
Attenborough West Gravel Pits	75	3.19	4.3 %	4.39	5.9 %	4.47	6.0 %	8.58	11.4 %
Copse Kingston-on-Soar	75	2.08	2.8 %	3.96	5.3 %	4.10	5.5 %	7.11	9.5 %
Cranfleet Farm Floodbanks	75	3.52	4.7 %	4.58	6.1 %	4.58	6.1 %	4.85	6.5 %
Cranfleet Ponds (West Pond)	75	2.92	3.9 %	3.83	5.1 %	3.82	5.1 %	4.44	5.9 %
Erewash Canal	75	2.66	3.5 %	3.18	4.2 %	3.18	4.2 %	5.07	6.8 %
Gotham Hill Woods	75	3.25	4.3 %	7.00	9.3 %	8.24	11.0 %	23.21	30.9 %
Gotham Wood	75	2.89	3.8 %	4.69	6.3 %	4.77	6.4 %	14.45	19.3 %
Lockington Ash	75	3.04	4.1 %	3.52	4.7 %	3.56	4.7 %	5.48	7.3 %
Lockington Ash 2	75	3.04	4.1 %	3.52	4.7 %	3.56	4.7 %	5.48	7.3 %
Lockington Confluence Backwater	75	3.14	4.2 %	3.90	5.2 %	3.90	5.2 %	5.63	7.5 %
Lockington Confluence Hedges	75	3.40	4.5 %	4.36	5.8 %	4.36	5.8 %	5.54	7.4 %
Lockington Fen	75	2.46	3.3 %	6.84	9.1 %	8.59	11.4 %	23.03	30.7 %
Lockington Grounds, pond and marsh near Trent	75	2.34	3.1 %	3.08	4.1 %	3.08	4.1 %	5.52	7.4 %
Lockington Trentside Pools	75	2.96	4.0 %	3.52	4.7 %	3.52	4.7 %	4.56	6.1 %
Lockington swamp by SSSI	75	2.71	3.6 %	3.56	4.7 %	3.55	4.7 %	5.63	7.5 %
Lower Soar Floodplain Wetland	75	3.54	4.7 %	7.11	9.5 %	11.50	15.3 %	16.23	21.6 %
Meadow Lane Carr	75	3.04	4.1 %	4.50	6.0 %	4.50	6.0 %	7.52	10.0 %
Narrow Bridge Fish Pond	75	2.68	3.6 %	3.43	4.6 %	3.45	4.6 %	4.81	6.4 %
Pond in hedgeline between two improved grasslands	75	3.37	4.5 %	6.28	8.4 %	8.34	11.1 %	10.18	13.6 %
Poplars Fish Pond	75	2.36	3.2 %	3.22	4.3 %	3.21	4.3 %	4.94	6.6 %
Rare Plant Register Mousetail Pasture	75	3.64	4.9 %	7.42	9.9 %	13.19	17.6 %	16.81	22.4 %
Ratcliffe Lane Pasture and Stream	75	3.37	4.5 %	7.22	9.6 %	10.87	14.5 %	19.06	25.4 %
Ratcliffe-on-Soar Flyash Grassland	75	3.06	4.1 %	3.31	4.4 %	3.31	4.4 %	6.23	8.3 %
Ratcliffe-on-Soar Flyash Track Grassland	75	3.83	5.1 %	5.14	6.9 %	5.13	6.8 %	7.91	10.5 %
Ratcliffe-on-Soar Pond	75	2.25	3.0 %	2.31	3.1 %	2.32	3.1 %	2.69	3.6 %
Red Hill Ratcliffe on Soar	75	3.69	4.9 %	4.87	6.5 %	4.86	6.5 %	5.51	7.3 %

NCC received 16.07.2020

Table 30 (cont): Predicted process contributions (PC) assessed against the daily mean NO_x critical level – Scenarios A to D

Site		Scenario A		Scenario B		Scenario C		Scenario D	
	Clv µg/m³	PC µg/m³	PC/Clv %	PC µg/m³	PC/Clv %	PC µg/m³	PC/Clv %	PC µg/m³	PC/Clv %
Redhill Marina Backwater	75	3.17	4.2 %	3.62	4.8 %	3.61	4.8 %	5.50	7.3 %
River Soar Loughborough Meadows to Trent	75	4.16	5.6 %	7.91	10.6 %	10.98	14.6 %	16.11	21.5 %
River Soar West Bank south of A453	75	2.72	3.6 %	5.28	7.0 %	5.54	7.4 %	7.18	9.6 %
River Trent North Bank	75	5.81	7.8 %	9.55	12.7 %	15.56	20.7 %	17.20	22.9 %
Shooting Ground Marsh Grassland, Lockington	75	3.12	4.2 %	7.68	10.2 %	13.88	18.5 %	20.58	27.4 %
Sheetstores Junction Pond	75	2.58	3.4 %	3.27	4.4 %	3.29	4.4 %	5.27	7.0 %
Soar Meadow near Ratcliffe Lock	75	3.20	4.3 %	6.05	8.1 %	9.85	13.1 %	11.92	15.9 %
South Junction Pond	75	2.22	3.0 %	3.06	4.1 %	3.05	4.1 %	5.07	6.8 %
Thrumpton Bank	75	4.42	5.9 %	8.06	10.8 %	11.31	15.1 %	14.74	19.7 %
Thrumpton Park	75	6.13	8.2 %	9.34	12.5 %	25.28	33.7 %	25.36	33.8 %
Trent Floodplain Wetland - Lock M07	75	3.40	4.5 %	4.36	5.8 %	4.36	5.8 %	4.96	6.6 %
Trent Floodplain Wetland Lock M13	75	2.37	3.2 %	2.99	4.0 %	3.05	4.1 %	5.21	6.9 %
Trent Lock Marsh	75	2.36	3.2 %	2.92	3.9 %	2.92	3.9 %	4.89	6.5 %
River Trent (Erewash)	75	3.32	4.4 %	3.86	5.1 %	3.86	5.1 %	6.35	8.5 %

NCC received 16.07.2020

Table 31: Predicted process contributions (PC) and predicted environmental concentrations (PEC) at Lockington Marshes SSSI assessed against the maximum daily mean NO_x critical level – Scenarios B, C and D

	Critical Level (µg/m³)	PC (µg/m³)	PC/CLv (%)	Background (µg/m³)*	PEC (µg/m³)	PEC/CLv (%)
Scenario B	75	7.7	10.2 %	46.82	54.5	72.7 %
Scenario C	75	10.8	14.3 %	46.82	57.6	76.8 %
Scenario D	75	20.9	27.9 %	46.82	67.7	90.3 %

*Based on twice the annual mean background of 23.41 µg/m³

The assessment has a number of conservative assumptions built in, notably:

- The Proposed Development, OCGTs (which are restricted to 500 hours of operation per year) and the existing coal-fired power station are assumed to operate with a 100 % annual load factor;
- The assessment is based on the worst-case meteorological year; and
- The assessment is based on the highest impact point over the entire site.

Given that the PEC is significantly below the maximum daily mean NO_x critical level, it can confidently be concluded that daily emissions of NO_x from the Proposed Development would not be at levels which could lead to significant adverse effects on the ecological features at the Lockington Marshes SSSI under all of the scenarios considered.

As NO_x impacts are below the EA significance threshold at the LNR and all local LWSs, it can confidently be concluded that that daily emissions of NO_x from the Proposed Development would not be at levels which could lead to significant adverse effects on the ecological features at these sites under all of the scenarios considered.

7.5.5 Assessment Against HF Maximum Daily Mean Critical Level

Table 32 compares the modelled maximum daily mean HF concentrations to the maximum daily mean HF critical level for Scenarios A, C and D. As it is assumed there are negligible emissions of HF from the OCGTs, the results for Scenario B will be the same as Scenario A and are not considered separately. It can be seen that the PC is below 100 % of the critical level at the LNR and at all of the LWSs for all three scenarios and hence the impacts can be considered as insignificant at these sites in relation to the EA significance criterion for short-term impacts. The PC is also below the 10 % short-term significance threshold at the Lockington Marshes SSSI and hence the impacts can be considered as insignificant at this site.

As HF impacts are below significance at the SSSI, LNR and all local LWSs, it can confidently be concluded that that daily emissions of HF from the Proposed Development would not be at levels which could lead to significant adverse effects on the ecological features at these sites under all of the scenarios considered.

7.5.6 Assessment Against HF Maximum Weekly Mean Critical Level

Table 33 compares the modelled maximum weekly mean HF concentrations to the maximum weekly mean HF critical level for Scenarios A, C and D. As it is assumed there are negligible emissions of HF from the OCGTs, the results for Scenario B will be the same as Scenario A and are not considered separately. It can be seen that the PC is below 100 % of the critical level at the LNR and at all of the LWSs for all three scenarios and hence the impacts can be considered as insignificant at these sites in relation to the EA significance criterion for short-term impacts.

NCC received 16.07.2020

The PC is also below the 10 % short-term significance threshold at the Lockington Marshes SSSI for Scenarios A and C and hence the impacts can be considered as insignificant at this site for the Proposed Development operating after the existing power station has closed.

The air quality assessment section of this report used a highly precautionary background HF concentration of 2.35 μg/m^3 (see Table 8). As this is well above the HF maximum weekly mean critical level, it is important to use a more appropriate background concentration for determining the PEC. The 2.4 μg/m^3 figure was taken from an EPAQS report published in 2006 (EPAQS, 2006) based on measurements in the vicinity of three industrial plants. HF is primarily associated with coal burning and hence UK emissions have decreased dramatically reducing from 3.8 kt in 2006 to 0.43 kt in 2017 (based on the UK National Emissions Inventory (NEAI), https://naei.beis.gov.uk/).

Given the predominantly rural location of the Proposed Development site, and the low load factors associated with UK coal-fired power stations over recent years, there are unlikely to be any significant local sources of HF other that the Ratcliffe-on-Soar coal-fired power station. The maximum modelled annual mean HF concentration over the entire modelling grid for the existing power station (based on a 100 % annual load factor) was 0.017 μg/m^3.

Given the association with coal burning the concentration of HF could be approximated by multiplying measured SO_2 concentrations by the ratio of HF to SO_2 emissions from coal-fired power stations. This ratio was around 0.01 in 2017 based on the NAEI. Applying this to the local SO_2 background concentration of 2.4 μg/m^3 (see Table 8) would give a HF background concentration of 0.024 μg/m^3, similar in magnitude to the maximum modelled annual mean HF. This value has therefore been applied as the local background for evaluation of the PEC.

Table 34 shows the PEC for Scenario D using twice the annual mean background concentration when determining the PEC for short-term effects. It can be seen that the PEC is well below the critical level.

Given that the PEC is well below the maximum weekly mean HF critical level, it can confidently be concluded that weekly emissions of HF from the Proposed Development would not be at levels which could lead to significant adverse effects on the ecological features at the Lockington Marshes SSSI under all of the scenarios considered.

As HF impacts are below the EA significance threshold at the LNR and all local LWSs, it can confidently be concluded that that weekly emissions of HF from the Proposed Development would not be at levels which could lead to significant adverse effects on the ecological features at these sites under all of the scenarios considered.

NCC received 16.07.2020

Table 32: Predicted process contributions (PC) assessed against the daily HF critical level – Scenarios A, C and D

Site		Scenario A		Scenario C		Scenario D	
	Clv µg/m³	PC µg/m³	PC/Clv %	PC µg/m³	PC/Clv %	PC µg/m³	PC/Clv %
Lockington Marshes SSSI	5	0.027	0.5 %	0.027	0.5 %	0.419	8.4 %
Forbes Hole LNR	5	0.023	0.5 %	0.027	0.5 %	0.168	3.4 %
Attenborough West Gravel Pits	5	0.025	0.5 %	0.024	0.5 %	0.185	3.7 %
Copse Kingston-on-Soar	5	0.016	0.3 %	0.016	0.3 %	0.136	2.7 %
Cranfleet Farm Floodbanks	5	0.028	0.6 %	0.028	0.6 %	0.059	1.2 %
Cranfleet Ponds (West Pond)	5	0.023	0.5 %	0.023	0.5 %	0.055	1.1 %
Erewash Canal	5	0.021	0.4 %	0.021	0.4 %	0.116	2.3 %
Gotham Hill Woods	5	0.026	0.5 %	0.026	0.5 %	0.545	10.9 %
Gotham Wood	5	0.023	0.5 %	0.023	0.5 %	0.390	7.8 %
Lockington Ash	5	0.024	0.5 %	0.024	0.5 %	0.094	1.9 %
Lockington Ash 2	5	0.024	0.5 %	0.024	0.5 %	0.094	1.9 %
Lockington Confluence Backwater	5	0.025	0.5 %	0.025	0.5 %	0.109	2.2 %
Lockington Confluence Hedges	5	0.027	0.5 %	0.027	0.5 %	0.078	1.6 %
Lockington Fen	5	0.019	0.4 %	0.019	0.4 %	0.524	10.5 %
Lockington Grounds, pond and marsh near Trent	5	0.018	0.4 %	0.018	0.4 %	0.116	2.3 %
Lockington Trentside Pools	5	0.023	0.5 %	0.023	0.5 %	0.071	1.4 %
Lockington swamp by SSSI	5	0.021	0.4 %	0.021	0.4 %	0.106	2.1 %
Lower Soar Floodplain Wetland	5	0.028	0.6 %	0.028	0.6 %	0.182	3.6 %
Meadow Lane Carr	5	0.024	0.5 %	0.024	0.5 %	0.163	3.3 %
Narrow Bridge Fish Pond	5	0.021	0.4 %	0.021	0.4 %	0.084	1.7 %
Pond in hedgeline between two improved grasslands	5	0.027	0.5 %	0.027	0.5 %	0.091	1.8 %
Poplars Fish Pond	5	0.019	0.4 %	0.019	0.4 %	0.098	2.0 %
Rare Plant Register Mousetail Pasture	5	0.029	0.6 %	0.029	0.6 %	0.147	2.9 %
Ratcliffe Lane Pasture and Stream	5	0.027	0.5 %	0.027	0.5 %	0.346	6.9 %
Ratcliffe-on-Soar Flyash Grassland	5	0.024	0.5 %	0.024	0.5 %	0.112	2.2 %
Ratcliffe-on-Soar Flyash Track Grassland	5	0.030	0.6 %	0.030	0.6 %	0.125	2.5 %
Ratcliffe-on-Soar Pond	5	0.018	0.4 %	0.018	0.4 %	0.049	1.0 %
Red Hill Ratcliffe on Soar	5	0.029	0.6 %	0.029	0.6 %	0.083	1.7 %
Redhill Marina Backwater	5	0.025	0.5 %	0.025	0.5 %	0.095	1.9 %

NCC received 16.07.2020

Table 32 (cont) . Predicted process contributions (PC) assessed against the daily HF critical level – Scenarios A, C and D

Site		Scenario A		Scenario C		Scenario D	
	Clv µg/m³	PC µg/m³	PC/Clv %	PC µg/m³	PC/Clv %	PC µg/m³	PC/Clv %
River Soar Loughborough Meadows to Trent	5	0.033	0.7 %	0.025	0.5 %	0.169	3.4 %
River Soar West Bank south of A453	5	0.021	0.4 %	0.021	0.4 %	0.140	2.8 %
River Trent North Bank	5	0.046	0.9 %	0.046	0.9 %	0.144	2.9 %
Shooting Ground Marsh Grassland, Lockington	5	0.025	0.5 %	0.033	0.7 %	0.377	7.5 %
Sheetstores Junction Pond	5	0.020	0.4 %	0.020	0.4 %	0.095	1.9 %
Soar Meadow near Ratcliffe Lock	5	0.025	0.5 %	0.025	0.5 %	0.116	2.3 %
South Junction Pond	5	0.018	0.4 %	0.018	0.4 %	0.104	2.1 %
Thrumpton Bank	5	0.035	0.7 %	0.035	0.7 %	0.164	3.3 %
Thrumpton Park	5	0.048	1.0 %	0.048	1.0 %	0.096	1.9 %
Trent Floodplain Wetland - Lock M07	5	0.027	0.5 %	0.027	0.5 %	0.068	1.4 %
Trent Floodplain Wetland Lock M13	5	0.019	0.4 %	0.019	0.4 %	0.100	2.0 %
Trent Lock Marsh	5	0.019	0.4 %	0.019	0.4 %	0.088	1.8 %
River Trent (Erewash)	5	0.026	0.5 %	0.026	0.5 %	0.136	2.7 %

NCC received 16.07.2020

Table 33: Predicted process contributions (PC) assessed against the weekly HF critical level (Clv) – Scenarios A, C and D

Site		Scenario A		Scenario C		Scenario D	
	Clv µg/m³	PC µg/m³	PC/Clv %	PC µg/m³	PC/Clv %	PC µg/m³	PC/Clv %
Lockington Marshes SSSI	0.5	0.013	2.5 %	0.013	2.5 %	0.098	19.5 %
Forbes Hole LNR	0.5	0.006	1.3 %	0.006	1.3 %	0.029	5.7 %
Attenborough West Gravel Pits	0.5	0.008	1.7 %	0.008	1.7 %	0.038	7.7 %
Copse Kingston-on-Soar	0.5	0.005	1.1 %	0.005	1.1 %	0.033	6.7 %
Cranfleet Farm Floodbanks	0.5	0.007	1.4 %	0.007	1.4 %	0.010	2.0 %
Cranfleet Ponds (West Pond)	0.5	0.007	1.3 %	0.007	1.3 %	0.008	1.6 %
Erewash Canal	0.5	0.005	1.0 %	0.005	1.0 %	0.019	3.8 %
Gotham Hill Woods	0.5	0.012	2.4 %	0.012	2.3 %	0.147	29.3 %
Gotham Wood	0.5	0.006	1.3 %	0.005	1.0 %	0.119	23.8 %
Lockington Ash	0.5	0.006	1.1 %	0.006	1.1 %	0.023	4.6 %
Lockington Ash 2	0.5	0.006	1.1 %	0.006	1.1 %	0.023	4.6 %
Lockington Confluence Backwater	0.5	0.005	1.1 %	0.005	1.1 %	0.026	5.1 %
Lockington Confluence Hedges	0.5	0.006	1.2 %	0.006	1.2 %	0.017	3.4 %
Lockington Fen	0.5	0.010	2.1 %	0.010	2.1 %	0.122	24.4 %
Lockington Grounds, pond and marsh near Trent	0.5	0.005	0.9 %	0.005	0.9 %	0.027	5.5 %
Lockington Trentside Pools	0.5	0.005	1.0 %	0.005	1.0 %	0.014	2.8 %
Lockington swamp by SSSI	0.5	0.006	1.2 %	0.006	1.2 %	0.025	5.1 %
Lower Soar Floodplain Wetland	0.5	0.014	2.8 %	0.014	2.8 %	0.045	9.0 %
Meadow Lane Carr	0.5	0.006	1.3 %	0.006	1.3 %	0.028	5.7 %
Narrow Bridge Fish Pond	0.5	0.004	0.9 %	0.004	0.9 %	0.015	2.9 %
Pond in hedgeline between two improved grasslands	0.5	0.011	2.3 %	0.011	2.3 %	0.041	8.1 %
Poplars Fish Pond	0.5	0.006	1.2 %	0.006	1.2 %	0.013	2.7 %
Rare Plant Register Mousetail Pasture	0.5	0.015	3.0 %	0.015	3.0 %	0.040	8.1 %
Ratcliffe Lane Pasture and Stream	0.5	0.013	2.6 %	0.013	2.6 %	0.081	16.2 %
Ratcliffe-on-Soar Flyash Grassland	0.5	0.007	1.4 %	0.007	1.4 %	0.030	6.1 %
Ratcliffe-on-Soar Flyash Track Grassland	0.5	0.012	2.5 %	0.012	2.4 %	0.019	3.8 %
Ratcliffe-on-Soar Pond	0.5	0.005	1.0 %	0.005	1.0 %	0.009	1.9 %
Red Hill Ratcliffe on Soar	0.5	0.007	1.5 %	0.007	1.5 %	0.020	4.0 %
Redhill Marina Backwater	0.5	0.008	1.5 %	0.008	1.5 %	0.020	4.1 %

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Table 33 (cont): Predicted process contributions (PC) assessed against the weekly HF critical level (Clv) – Scenarios A, C and D

Site		Scenario A		Scenario C		Scenario D	
	Clv µg/m³	PC µg/m³	PC/Clv %	PC µg/m³	PC/Clv %	PC µg/m³	PC/Clv %
River Soar Loughborough Meadows to Trent	0.5	0.015	3.1 %	0.012	2.4 %	0.054	10.8 %
River Soar West Bank south of A453	0.5	0.009	1.9 %	0.009	1.9 %	0.033	6.7 %
River Trent North Bank	0.5	0.015	2.9 %	0.015	2.9 %	0.030	6.0 %
Shooting Ground Marsh Grassland, Lockington	0.5	0.012	2.4 %	0.015	3.1 %	0.087	17.5 %
Sheetstores Junction Pond	0.5	0.004	0.8 %	0.004	0.8 %	0.017	3.3 %
Soar Meadow near Ratcliffe Lock	0.5	0.013	2.6 %	0.013	2.6 %	0.044	8.8 %
South Junction Pond	0.5	0.006	1.1 %	0.006	1.1 %	0.016	3.2 %
Thrumpton Bank	0.5	0.012	2.4 %	0.012	2.4 %	0.033	6.7 %
Thrumpton Park	0.5	0.015	2.9 %	0.015	2.9 %	0.026	5.2 %
Trent Floodplain Wetland - Lock M07	0.5	0.005	1.1 %	0.005	1.1 %	0.014	2.9 %
Trent Floodplain Wetland Lock M13	0.5	0.005	0.9 %	0.005	0.9 %	0.027	5.4 %
Trent Lock Marsh	0.5	0.004	0.9 %	0.004	0.9 %	0.020	4.0 %
River Trent (Erewash)	0.5	0.005	1.1 %	0.005	1.1 %	0.030	5.9 %

NCC received 16.07.2020

Table 34: Predicted process contributions (PC) and predicted environmental concentrations (PEC) at Lockington Marshes SSSI assessed against the maximum weekly mean HF critical level – Scenario D

	Critical Level ($\mu g/m^3$)	PC ($\mu g/m^3$)	PC/LCv (%)	Background ($\mu g/m^3$)*	PEC ($\mu g/m^3$)	PEC/CLv (%)
Scenario D	0.5	0.098	19.5 %	0.048	0.15	29.1 %

*Based on twice the annual mean background of 0.024 $\mu g/m^3$

7.5.7 Assessment Against Nitrogen Critical Loads

Table 35 compares the modelled nitrogen deposition to the nutrient nitrogen critical loads (CL_{NutN}) for Scenarios A to D. It can be seen that the PC is below 100 % of the critical load at the LNR and at all of the LWSs for all four scenarios and hence the impacts can be considered as insignificant at these sites in relation to the EA significance criterion for long-term impacts.

The PC at Lockington Marshes SSSI ranges from 1.5 % of the critical load in Scenario A to 2.7 % of the critical load in Scenario D.

Table 36 shows the PECs for Scenarios A to D using the background nitrogen deposition extracted from APIS for the location of the maximum impact point. It can be seen that the background nitrogen deposition already exceeds the nitrogen critical load level by more than a factor of two. The PC comprises less than 1 % of the background nitrogen deposition across all four scenarios.

The area around the Ratcliffe-on-Soar power station site is predominantly rural and as such the background ammonia concentrations deriving from farming activities will make a significant contribution to local nitrogen deposition. There will also be significant NO_x emissions associated with traffic on the M1 and A453 contributing to local concentrations and deposition. Source attribution data on APIS suggests that around 27 % of the nitrogen deposition at the SSSI arises from livestock and fertiliser, around 28 % from transport and around 18 % is imported from Europe. Industrial combustion contributes less than 2 %. Given the maximum contribution under Scenario D comprises only 2.7 % of the critical load, it is evident that sources other than the Proposed Development and the existing coal-fired power station dominate nitrogen deposition at the Lockington Marshes SSSI.

Importantly, the project ecologist advised that the W6 - Alnus glutinosa - Urtica dioica woodland habitat present at the Lockington Marshes SSSI is not sensitive to nitrogen deposition and that the critical load assignment is due to an anomaly in the interpretation of plant communities by APIS (see Appendix 6-3 of the ES).

The assessment has a number of conservative assumptions built in, notably:

- The Proposed Development, OCGTs (which are restricted to 500 hours of operation per year) and the existing coal-fired power station are assumed to operate with a 100 % annual load factor;
- The assessment is based on the worst-case meteorological year;
- The assessment is based on the highest impact point over the entire site;
- The lowest end of the critical load range has been used; and
- The habitat is unlikely to be sensitive in reality.

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Table 35: Predicted process contributions (PC) assessed against the Nitrogen Critical Load (CL_{NutN}) – Scenarios A to D

Site	Woodland or Non-woodland	CL_{NutN} kgN/ha/yr	Scenario A PC kgN/ha/yr	Scenario A PC/ CL_{NutN} %	Scenario B PC kgN/ha/yr	Scenario B PC/ CL_{NutN} %	Scenario C PC kgN/ha/yr	Scenario C PC/ CL_{NutN} %	Scenario D PC kgN/ha/yr	Scenario D PC/ CL_{NutN} %
Lockington Marshes SSSI	NW	Covered by woodland feature assessment – see Subsection 7.2								
	W	10	0.154	1.5 %	0.182	1.8 %	0.193	1.9 %	0.271	2.7 %
Forbes Hole LNR	NW	15	0.052	0.3 %	0.058	0.4 %	0.058	0.4 %	0.073	0.5 %
	W	10	0.084	0.8 %	0.096	1.0 %	0.096	1.0 %	0.123	1.2 %
Attenborough West Gravel Pits	NW	15	0.083	0.6 %	0.091	0.6 %	0.096	0.6 %	0.120	0.8 %
Copse Kingston-on-Soar	W	10	0.073	0.7 %	0.084	0.8 %	0.086	0.9 %	0.110	1.1 %
Cranfleet Farm Floodbanks	NW	15	0.061	0.4 %	0.066	0.4 %	0.066	0.4 %	0.070	0.5 %
Cranfleet Ponds (West Pond)	NW	15	0.051	0.3 %	0.056	0.4 %	0.056	0.4 %	0.058	0.4 %
Erewash Canal	NW	15	0.042	0.3 %	0.045	0.3 %	0.045	0.3 %	0.050	0.3 %
Gotham Hill Woods	W	10	0.299	3.0 %	0.349	3.5 %	0.370	3.7 %	0.535	5.4 %
Gotham Wood	W	10	0.141	1.4 %	0.178	1.8 %	0.186	1.9 %	0.346	3.5 %
Lockington Ash	W	10	0.062	0.6 %	0.068	0.7 %	0.069	0.7 %	0.079	0.8 %
Lockington Ash 2	W	10	0.062	0.6 %	0.068	0.7 %	0.069	0.7 %	0.079	0.8 %
Lockington Confluence Backwater	NW	15	0.045	0.3 %	0.048	0.3 %	0.048	0.3 %	0.052	0.3 %
Lockington Confluence Hedges	NW	15	0.045	0.3 %	0.046	0.3 %	0.048	0.3 %	0.052	0.3 %
Lockington Fen	NW	15	0.083	0.6 %	0.096	0.6 %	0.100	0.7 %	0.150	1.0 %
Lockington Grounds, pond and marsh near Trent	NW	15	0.033	0.2 %	0.036	0.2 %	0.036	0.2 %	0.046	0.3 %
Lockington Trentside Pools	NW	15	0.045	0.3 %	0.048	0.3 %	0.048	0.3 %	0.052	0.3 %
Lockington swamp by SSSI	NW	15	0.038	0.3 %	0.041	0.3 %	0.041	0.3 %	0.048	0.3 %
Lower Soar Floodplain Wetland	NW	15	0.114	0.8 %	0.130	0.9 %	0.138	0.9 %	0.162	1.1 %
Meadow Lane Carr	NW	15	0.055	0.4 %	0.060	0.4 %	0.060	0.4 %	0.076	0.5 %
	W	10	0.089	0.9 %	0.100	1.0 %	0.100	1.0 %	0.129	1.3 %
Narrow Bridge Fish Pond	NW	15	0.043	0.3 %	0.046	0.3 %	0.046	0.3 %	0.049	0.3 %
Pond in hedgeline between two improved grasslands	NW	15	0.099	0.7 %	0.111	0.7 %	0.114	0.8 %	0.129	0.9 %
Poplars Fish Pond	NW	15	0.046	0.3 %	0.049	0.3 %	0.049	0.3 %	0.053	0.4 %

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Table 35 (cont): Predicted process contributions (PC) assessed against the Nitrogen Critical Load (CL_{NutN}) – Scenarios A to D

Site			Scenario A		Scenario B		Scenario C		Scenario D	
	Woodland or Non-woodland	CL_{NutN} kgN/ha/yr	PC kgN/ha/yr	PC/ CL_{NutN} %	PC kgN/ha/yr	PC/ CL_{NutN} %	PC kgN/ha/yr	PC/ CL_{NutN} %	PC kgN/ha/yr	PC/ CL_{NutN} %
Rare Plant Register Mousetail Pasture	NW	20	0.119	0.6 %	0.136	0.7 %	0.123	0.6 %	0.163	0.8 %
Ratcliffe Lane Pasture and Stream	NW	20	0.111	0.6 %	0.128	0.6 %	0.136	0.7 %	0.171	0.9 %
Ratcliffe-on-Soar Flyash Grassland	NW	15	0.047	0.3 %	0.052	0.3 %	0.053	0.4 %	0.066	0.4 %
Ratcliffe-on-Soar Flyash Track Grassland	NW	15	0.046	0.3 %	0.050	0.3 %	0.049	0.3 %	0.054	0.4 %
Ratcliffe-on-Soar Pond	NW	15	0.027	0.2 %	0.028	0.2 %	0.028	0.2 %	0.030	0.2 %
Red Hill Ratcliffe on Soar	NW	15	0.046	0.3 %	0.049	0.3 %	0.049	0.3 %	0.052	0.3 %
Redhill Marina Backwater	NW	15	0.055	0.4 %	0.057	0.4 %	0.057	0.4 %	0.059	0.4 %
River Soar Loughborough Meadows to Trent	NW	15	0.121	0.8 %	0.136	0.9 %	0.113	0.8 %	0.167	1.1 %
River Soar West Bank south of A453	NW	15	0.083	0.6 %	0.092	0.6 %	0.094	0.6 %	0.105	0.7 %
River Trent North Bank	NW	20	0.190	0.9 %	0.205	1.0 %	0.238	1.2 %	0.253	1.3 %
Shooting Ground Marsh Grassland, Lockington	NW	15	0.095	0.6 %	0.108	0.7 %	0.145	1.0 %	0.149	1.0 %
Sheetstores Junction Pond	NW	15	0.043	0.3 %	0.046	0.3 %	0.046	0.3 %	0.049	0.3 %
Soar Meadow near Ratcliffe Lock	NW	20	0.112	0.6 %	0.128	0.6 %	0.135	0.7 %	0.155	0.8 %
South Junction Pond	NW	15	0.045	0.3 %	0.047	0.3 %	0.047	0.3 %	0.052	0.3 %
Thrumpton Bank	NW	15	0.178	1.2 %	0.193	1.3 %	0.219	1.5 %	0.241	1.6 %
Thrumpton Park	NW	20	0.182	0.9 %	0.195	1.0 %	0.233	1.2 %	0.244	1.2 %
	W	15	0.296	2.0 %	0.322	2.1 %	0.398	2.7 %	0.416	2.8 %
Trent Floodplain Wetland - Lock M07	NW	15	0.045	0.3 %	0.048	0.3 %	0.048	0.3 %	0.052	0.3 %
Trent Floodplain Wetland Lock M13	NW	15	0.033	0.2 %	0.036	0.2 %	0.036	0.2 %	0.045	0.3 %
Trent Lock Marsh	NW	15	0.039	0.3 %	0.043	0.3 %	0.043	0.3 %	0.049	0.3 %
	W	10	0.064	0.6 %	0.070	0.7 %	0.070	0.7 %	0.081	0.8 %
River Trent (Erewash)	NW	15	0.047	0.3 %	0.050	0.3 %	0.050	0.3 %	0.053	0.4 %

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Table 36: Predicted process contributions (PC) and predicted environmental concentrations (PEC) at Lockington Marshes SSSI assessed against the nutrient nitrogen critical load – Scenarios A to D

	CL_{NutN} kgN/ha/yr	PC kgN/ha/yr	PC/ CL_{NutN} %	Background kgN/ha/yr	PEC kgN/ha/yr	PEC/ CL_{NutN} %
Scenario A	10	0.154	1.5 %	33.88	34.03	340 %
Scenario B	10	0.182	1.8 %	33.88	34.06	341 %
Scenario C	10	0.193	1.9 %	33.88	34.07	341 %
Scenario D	10	0.271	2.7 %	33.88	34.15	342 %

Given the precautionary approach adopted, the low levels of impact relative to both the critical level and the background, and the domination of nitrogen deposition at the SSSI by sources other than the Proposed Development, it can reasonably be concluded that annual emissions of NO_x and NH_3 from the Proposed Development would not be at levels which could lead to significant adverse effects on the ecological features at the Lockington Marshes SSSI under all of the scenarios considered.

As nitrogen impacts are below the EA significance threshold at the LNR and all local LWSs, it can confidently be concluded that that annual emissions of NO_x and NH_3 from the Proposed Development would not be at levels which could lead to significant adverse effects on the ecological features at these sites under all of the scenarios considered.

7.5.8 Assessment Against Acid Critical Loads

Table 37 compares the modelled acid deposition to the acid critical loads (CL_{MaxtN}) for Scenarios A to D. It can be seen that the PC is below 100 % of the critical load at the LNR and at all of the LWSs for all four scenarios and hence the impacts can be considered as insignificant at these sites in relation to the EA significance criterion for long-term impacts.

The PC at Lockington Marshes SSSI ranges from 1.8 % of the critical load in Scenario A to 6.5 % of the critical load in Scenario D.

Table 38 shows the PECs for Scenarios A to D using the background acid deposition extracted from APIS for the location of the maximum impact point. It can be seen that the background acid deposition already exceeds the acid critical load. The PC comprises less than 2.0 % of the background acid deposition for Scenarios A to C and 5.2 % of the background for Scenario D.

Source attribution data on APIS suggests that around 20 % of the acid deposition at the SSSI arises from livestock and fertiliser, around 22 % from transport and around 16 % is imported from Europe. Around 4 % is directly attributed to the existing coal-fired power station; hence, the PEC in Table 38 is double counting the existing power station contribution. Given that the maximum contribution under Scenarios A to C comprises only 2.4 % of the critical load, it is evident that sources other than the Proposed Development dominate nitrogen deposition at the Lockington Marshes SSSI.

The assessment has a number of conservative assumptions built in, notably:

- The Proposed Development, OCGTs (which are restricted to 500 hours of operation per year) and the existing coal-fired power station are assumed to operate with a 100 % annual load factor;
- The assessment is based on the worst-case meteorological year;

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- The assessment is based on the highest impact point over the entire site; and
- The lowest end of the critical load range has been used.

Scenario B and Scenario C assume that the OCGTs are operating for 8760 hours per year, whereas in reality they are restricted to a maximum of 500 hours of operation. If the OCGT impacts are scaled to reflect this, the PCs would be reduced to less than 2 % of the acid critical loads.

Although the in-combination contribution with the existing power station could be close to 7 %, it is highly unlikely that the existing power station would run anywhere close to a 100 % annual load factor, given that generation has averaged 17 % over the past five years. In any case, operation of the Proposed Development and the power station is not anticipated to overlap for more than nine months given the requirement to close the existing station by October 2025.

Given the precautionary approach adopted, the low levels of impact relative to both the critical level and the background, and the domination of acid deposition at the SSSI by sources other than the Proposed Development, it can reasonably be concluded that annual emissions of NO_x, SO_2, NH_3, HF and HCl from the Proposed Development would not be at levels which could lead to significant adverse effects on the ecological features at the Lockington Marshes SSSI under all of the scenarios considered.

As acid deposition impacts are below the EA significance threshold at the LNR and all local LWSs, it can confidently be concluded that that annual emissions of NO_x, SO_2, NH_3, HF and HCl from the Proposed Development would not be at levels which could lead to significant adverse effects on the ecological features at these sites under all of the scenarios considered.

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Table 37: Predicted process contributions (PC) assessed against the Acid Critical Load (CL_{MaxN}) – Scenarios A to D

Site			Scenario A		Scenario B		Scenario C		Scenario D	
	Woodland or Non-woodland	CL_{MaxN} keq/ha/yr	PC keq/ha/yr	PC/ CL_{MaxN}	PC keq/ha/yr	PC/ CL_{MaxN}	PC keq/ha/yr	PC/ CL_{MaxN}	PC keq/ha/yr	PC/ CL_{MaxN}
Lockington Marshes SSSI	NW	Covered by woodland feature assessment – see Subsection 7.2								
	W	1.764	0.032	1.8 %	0.040	2.2 %	0.043	2.4 %	0.114	6.5 %
Forbes Hole LNR	NW	0.53	0.009	1.7 %	0.010	2.0 %	0.010	2.0 %	0.022	4.2 %
	W	1.762	0.017	1.0 %	0.021	1.2 %	0.021	1.2 %	0.046	2.6 %
Attenborough West Gravel Pits	NW	0.511	0.014	2.8 %	0.018	0.2 %	0.019	0.2 %	0.041	0.4 %
Copse Kingston-on-Soar	W	11.001	0.015	0.1 %	0.012	2.2 %	0.012	2.2 %	0.015	2.8 %
Cranfleet Farm Floodbanks	NW	0.53	0.010	2.0 %	0.010	1.9 %	0.010	1.9 %	0.012	2.3 %
Cranfleet Ponds (West Pond)	NW	0.53	0.009	1.7 %	0.008	1.5 %	0.008	1.5 %	0.012	2.3 %
Erewash Canal	NW	0.53	0.007	1.4 %	0.076	0.7 %	0.082	0.7 %	0.254	2.3 %
Gotham Hill Woods	W	10.973	0.062	0.6 %	0.039	0.4 %	0.041	0.4 %	0.187	1.7 %
Gotham Wood	W	11	0.029	0.3 %	0.015	0.1 %	0.015	0.1 %	0.024	0.2 %
Lockington Ash	W	11.013	0.013	0.1 %	0.015	0.1 %	0.015	0.1 %	0.024	0.2 %
Lockington Ash 2	W	11.013	0.013	0.1 %	0.009	1.6 %	0.009	1.6 %	0.014	2.6 %
Lockington Confluence Backwater	NW	0.531	0.008	1.5 %	0.008	1.6 %	0.009	1.6 %	0.013	2.4 %
Lockington Confluence Hedges	NW	0.531	0.008	1.5 %	0.018	3.3 %	0.019	3.5 %	0.057	10.6 %
Lockington Fen	NW	0.533	0.014	2.7 %	0.007	1.2 %	0.007	1.2 %	0.014	2.6 %
Lockington Grounds, pond and marsh near Trent	NW	0.532	0.006	1.1 %	0.009	1.6 %	0.009	1.6 %	0.012	2.2 %
Lockington Trentside Pools	NW	0.53	0.008	1.5 %	0.007	1.4 %	0.007	1.4 %	0.013	2.4 %
Lockington swamp by SSSI	NW	0.532	0.007	1.2 %	0.024	4.5 %	0.026	4.9 %	0.044	8.3 %
Lower Soar Floodplain Wetland	NW	0.533	0.020	3.7 %	0.011	2.1 %	0.011	2.1 %	0.023	4.4 %
Meadow Lane Carr	NW	0.53	0.009	1.8 %	0.022	1.2 %	0.022	1.2 %	0.047	2.7 %
	W	1.762	0.018	1.0 %	0.008	1.5 %	0.008	1.5 %	0.011	2.1 %
Narrow Bridge Fish Pond	NW	0.53	0.007	1.4 %	0.020	3.8 %	0.021	4.0 %	0.033	6.1 %
Pond in hedgeline between two improved grasslands	NW	0.533	0.017	3.2 %	0.009	1.6 %	0.009	1.6 %	0.014	2.6 %
Poplars Fish Pond	NW	0.53	0.008	1.5 %	0.040	2.2 %	0.043	2.4 %	0.114	6.5 %

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Table 37 (cont): Predicted process contributions (PC) assessed against the Acid Critical Load (CL_{MaxN}) – Scenarios A to D

Site			Scenario A		Scenario B		Scenario C		Scenario D	
	Woodland or Non-woodland	CL_{MaxN} keq/ha/yr	PC keq/ha/yr	PC/ CL_{MaxN}	PC keq/ha/yr	PC/ CL_{MaxN}	PC keq/ha/yr	PC/ CL_{MaxN}	PC keq/ha/yr	PC/ CL_{MaxN}
Rare Plant Register Mousetail Pasture	NW	0.533	0.020	3.8 %	0.025	4.7 %	0.027	5.2 %	0.042	7.8 %
Ratcliffe Lane Pasture and Stream	NW	0.533	0.019	3.6 %	0.024	4.4 %	0.026	4.8 %	0.058	10.8 %
Ratcliffe-on-Soar Flyash Grassland	NW	4.928	0.008	0.2 %	0.010	0.2 %	0.010	0.2 %	0.019	0.4 %
Ratcliffe-on-Soar Flyash Track Grassland	NW	5.071	0.008	0.2 %	0.009	0.2 %	0.009	0.2 %	0.013	0.3 %
Ratcliffe-on-Soar Pond	NW	0.521	0.005	0.9 %	0.005	0.9 %	0.005	1.0 %	0.006	1.2 %
Red Hill Ratcliffe on Soar	NW	4.928	0.008	0.2 %	0.009	0.2 %	0.009	0.2 %	0.012	0.2 %
Redhill Marina Backwater	NW	0.533	0.009	1.8 %	0.010	1.9 %	0.010	1.9 %	0.012	2.3 %
River Soar Loughborough Meadows to Trent	NW	0.533	0.021	3.9 %	0.025	4.7 %	0.021	4.0 %	0.047	8.8 %
River Soar West Bank south of A453	NW	0.535	0.014	2.7 %	0.017	3.2 %	0.017	3.2 %	0.026	4.8 %
River Trent North Bank	NW	0.51	0.033	6.4 %	0.037	7.2 %	0.046	9.0 %	0.058	11.4 %
Shooting Ground Marsh Grassland, Lockington	NW	0.533	0.016	3.1 %	0.020	3.7 %	0.027	5.2 %	0.048	9.0 %
Sheetstores Junction Pond	NW	0.53	0.007	1.4 %	0.008	1.5 %	0.008	1.5 %	0.012	2.2 %
Soar Meadow near Ratcliffe Lock	NW	0.533	0.019	3.6 %	0.024	4.4 %	0.025	4.8 %	0.041	7.7 %
South Junction Pond	NW	0.53	0.008	1.4 %	0.008	1.6 %	0.008	1.6 %	0.014	2.7 %
Thrumpton Bank	NW	0.51	0.031	6.0 %	0.035	6.8 %	0.042	8.2 %	0.058	11.4 %
Thrumpton Park	NW	0.51	0.031	6.1 %	0.035	6.9 %	0.041	8.0 %	0.053	10.4 %
	W	1.726	0.061	3.6 %	0.069	4.0 %	0.081	4.7 %	0.106	6.1 %
Trent Floodplain Wetland - Lock M07	NW	0.531	0.008	1.5 %	0.009	1.6 %	0.009	1.6 %	0.011	2.1 %
Trent Floodplain Wetland Lock M13	NW	0.532	0.006	1.1 %	0.007	1.2 %	0.007	1.2 %	0.013	2.5 %
Trent Lock Marsh	NW	0.531	0.007	1.3 %	0.008	1.4 %	0.008	1.4 %	0.012	2.3 %
	W	1.763	0.013	0.8 %	0.015	0.9 %	0.015	0.9 %	0.025	1.4 %
River Trent (Erewash)	NW	0.531	0.008	1.5 %	0.009	1.7 %	0.009	1.7 %	0.014	2.7 %

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Table 38: Predicted process contributions (PC) and predicted environmental concentrations (PEC) at Lockington Marshes SSSI assessed against the acid critical load – Scenarios A to D

	CL_{NutN} keqN/ha/yr	PC keq/ha/yr	PC/ CL_{NutN} %	Background keq/ha/yr	PEC keq/ha/yr	PEC/ CL_{MaxN} %
Scenario A	1.764	0.032	1.8 %	2.18	2.21	125 %
Scenario B	1.764	0.040	2.2 %	2.18	2.22	126 %
Scenario C	1.764	0.043	2.4 %	2.18	2.22	126 %
Scenario D	1.764	0.114	6.5 %	2.18	2.29	130 %

8 CONCLUSIONS

Uniper is proposing building an energy recovery facility on the Ratcliffe-on-Soar power station site. An air dispersion modelling study has been undertaken to evaluate the significance of any air quality affects that may arise from the Proposed Development. Where it was necessary to make assumptions and approximations, a worst-case approach has been adopted to ensure that the modelled concentrations are likely to be overestimates rather than underestimates.

8.1 Impacts on Human Health

The Proposed Development will release emissions to air of nitrogen oxides, sulphur dioxide, carbon monoxide, particulates, hydrogen chloride, hydrogen fluoride, ammonia, heavy metals, PAHs and PCBS. This assessment has modelled all these pollutants and compared the predicted ground level concentrations at the maximum impact point with the relevant air quality assessment levels. This study concludes that no human health based ambient air quality standards or guidelines are predicted to be exceeded due to emissions from the Proposed Development and hence there will be no significant adverse effects on human health. This assessment also concludes that cumulative impacts from the Proposed Development, the OCGTs and the coal-fired power station will not have a significant adverse effect on human health.

8.2 Impacts on Local Ecological Sites

The process contributions under all scenarios for all species were below the EA significance criteria in relation to the corresponding critical levels and acid and nitrogen critical loads at the Forbes Hole LNR and all local LWSs. It can therefore confidently be concluded that that emissions from the Proposed Development would not be at levels which could lead to significant adverse effects on the ecological features at these sites under all of the scenarios considered.

The maximum scenario process contributions to ground level concentrations of NH_3 at the Lockington Marshes SSSI were 1.5 % or less of the annual ammonia critical level and less than 1 % of current ammonia background concentrations under the four scenarios considered.

The maximum contributions to ground level concentrations of SO_2 at the Lockington Marshes SSSI were 0.4 % to 2.4 % of the annual SO_2 critical level and were less than the critical level in combination with background concentrations.

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The maximum scenario process contributions to ground level concentrations of NO_x at the Lockington Marshes SSSI were 0.5 % to 1.5 % of the annual NO_x critical level and were less than the critical level in combination with background concentrations.

The maximum scenario process contributions to ground level concentrations of NO_x at the Lockington Marshes SSSI were 4.6 % to 27.9 % of the maximum daily mean NO_x critical level and were less than the critical level in combination with background concentrations.

The maximum scenario process contributions to ground level concentrations of HF at the Lockington Marshes SSSI were below significance in relation to the maximum daily mean critical level.

The maximum scenario process contributions to ground level concentrations of HF at the Lockington Marshes SSSI were 2.5 % to 19.5 % of the maximum weekly mean HF critical level and were less than the critical level in combination with background concentrations.

The maximum scenario process contributions to nitrogen deposition at the Lockington Marshes SSSI were 1.5 % to 2.7 % of the most stringent applicable critical load.

The maximum process contributions to acid deposition at the Lockington Marshes SSSI were 1.8 % to 2.4 % of the most stringent applicable critical load for Scenarios A to C and 6.5 % for Scenario D, although the latter scenario will occur for no more than 9 months.

The assessment has a number of conservative assumptions built in, notably:

- The Proposed Development, OCGTs (which are restricted to 500 hours of operation per year) and the existing coal-fired power station are assumed to operate with a 100 % annual load factor;
- The assessment is based on the worst-case meteorological year;
- The assessment is based on the highest impact point over the entire site; and
- The lowest end of the critical load range has been used for nitrogen and acid deposition.

Given the precautionary approach adopted, the low levels of impact relative to the applicable critical levels and critical loads, and taking into account the level of background concentrations at the Lockington Marshes SSSI and the associated sources, it can reasonably be concluded that emissions from the Proposed Development would not be at levels which could lead to significant adverse effects on the ecological features at the Lockington Marshes SSSI under all of the scenarios considered.

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NCC received 16.07.2020

FIGURES

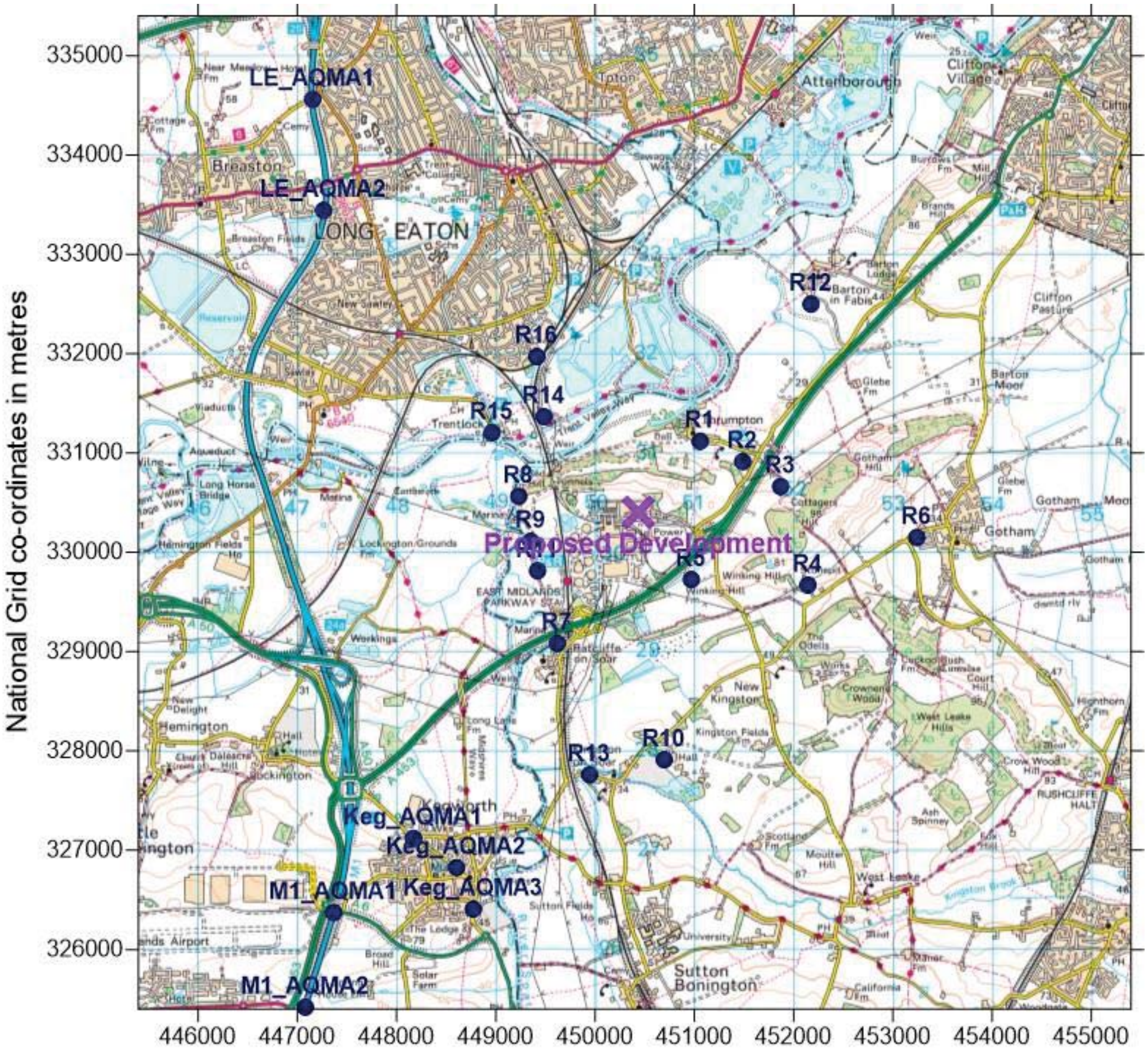

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Figure 1: Proposed Development and human receptor locations

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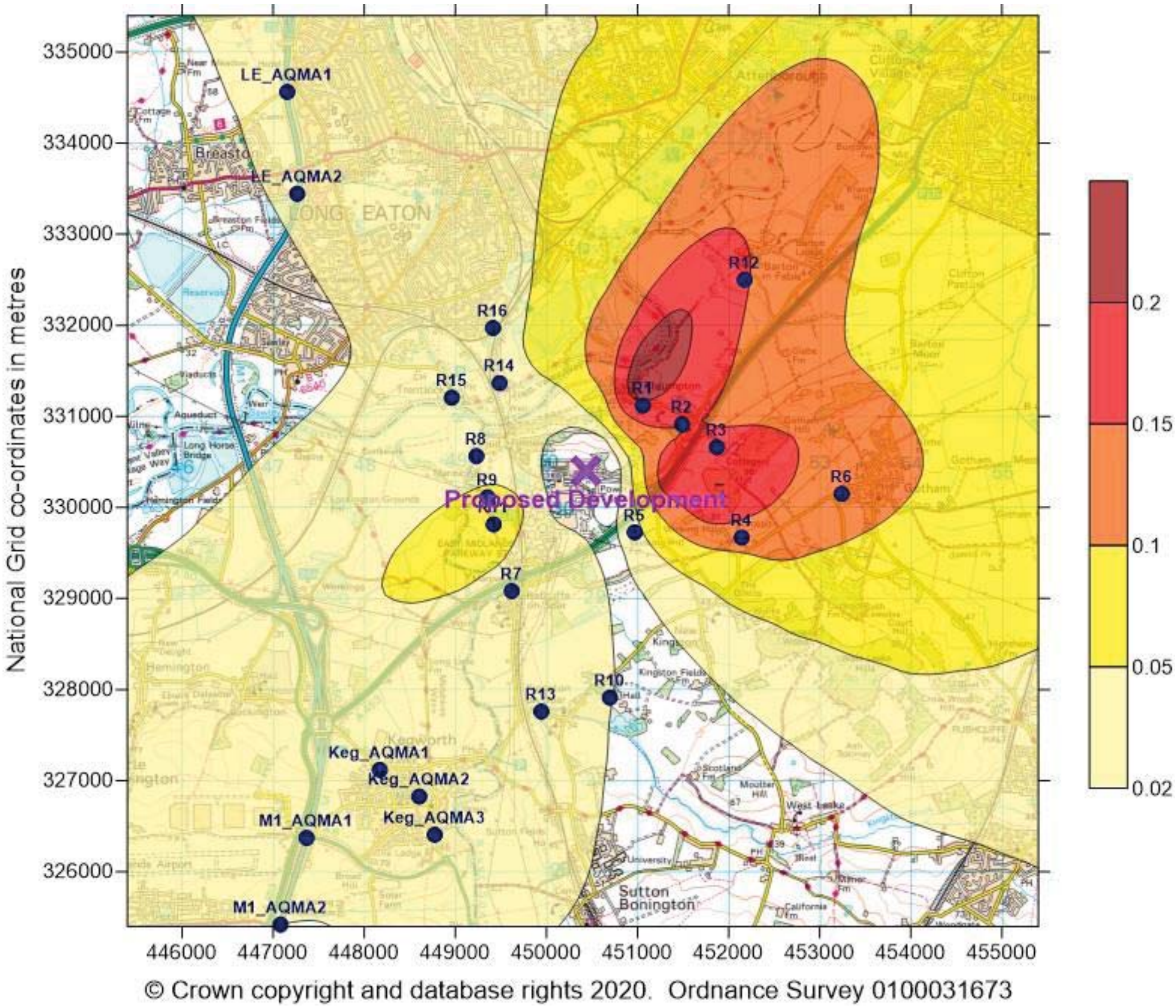

Figure 2: Predicted annual mean NO_2 concentrations (μg/m^3) resulting from the Proposed Development operating continuously (Scenario A) for 2015 meteorology

Contours plotted: 0.02 μg/m^3, 0.05 μg/m^3 to 0.2 μg/m^3 in steps of 0.05 μg/m^3

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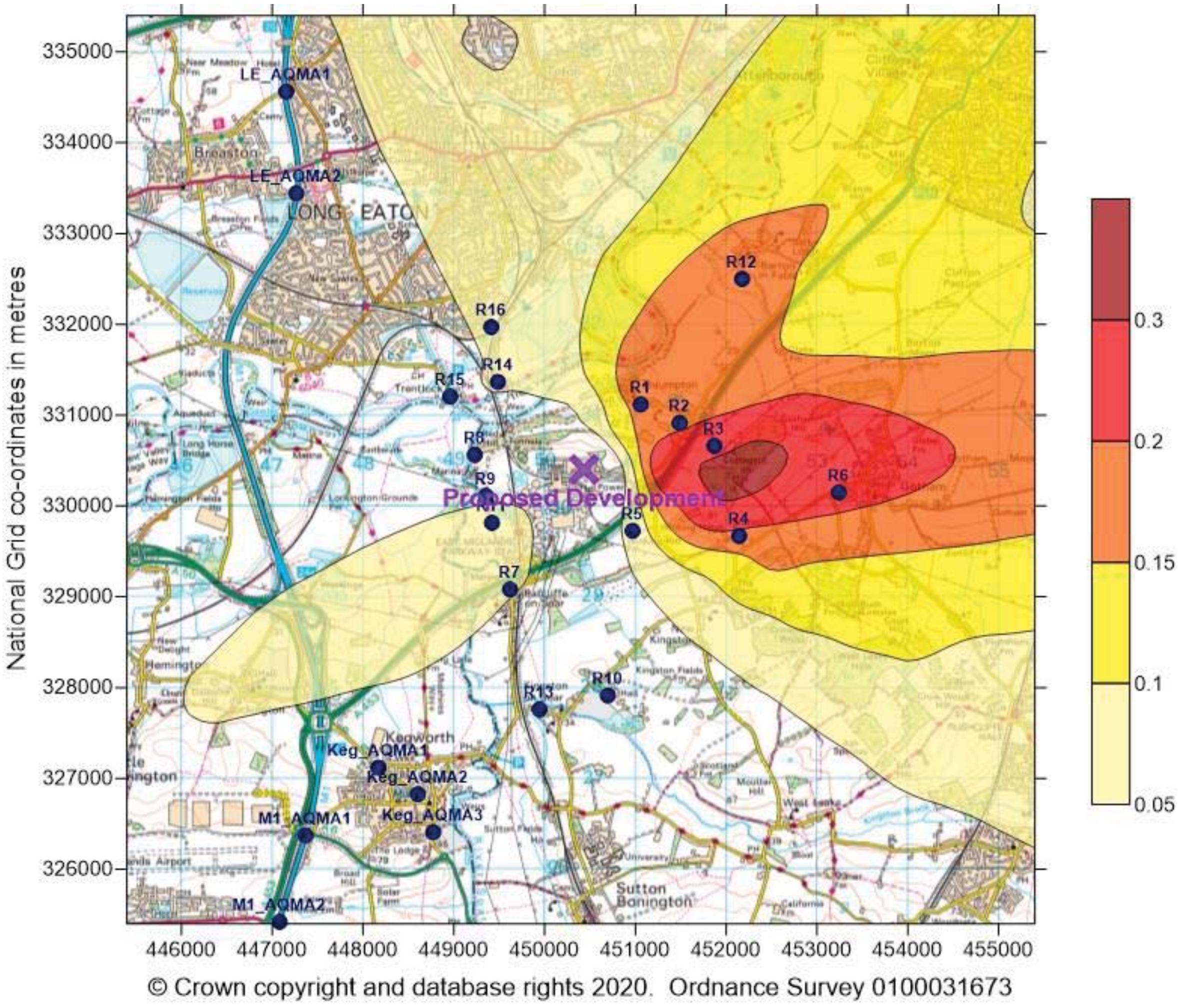

Figure 3: Predicted annual mean NO_2 concentrations (μg/m^3) resulting from the Proposed Development and the OCGTs operating continuously (Scenario B) for 2017 meteorology

Contours plotted: 0.05 μg/m^3 to 0.2 μg/m^3 in steps of 0.05 μg/m^3, 0.3 μg/m^3

NCC received 16.07.2020

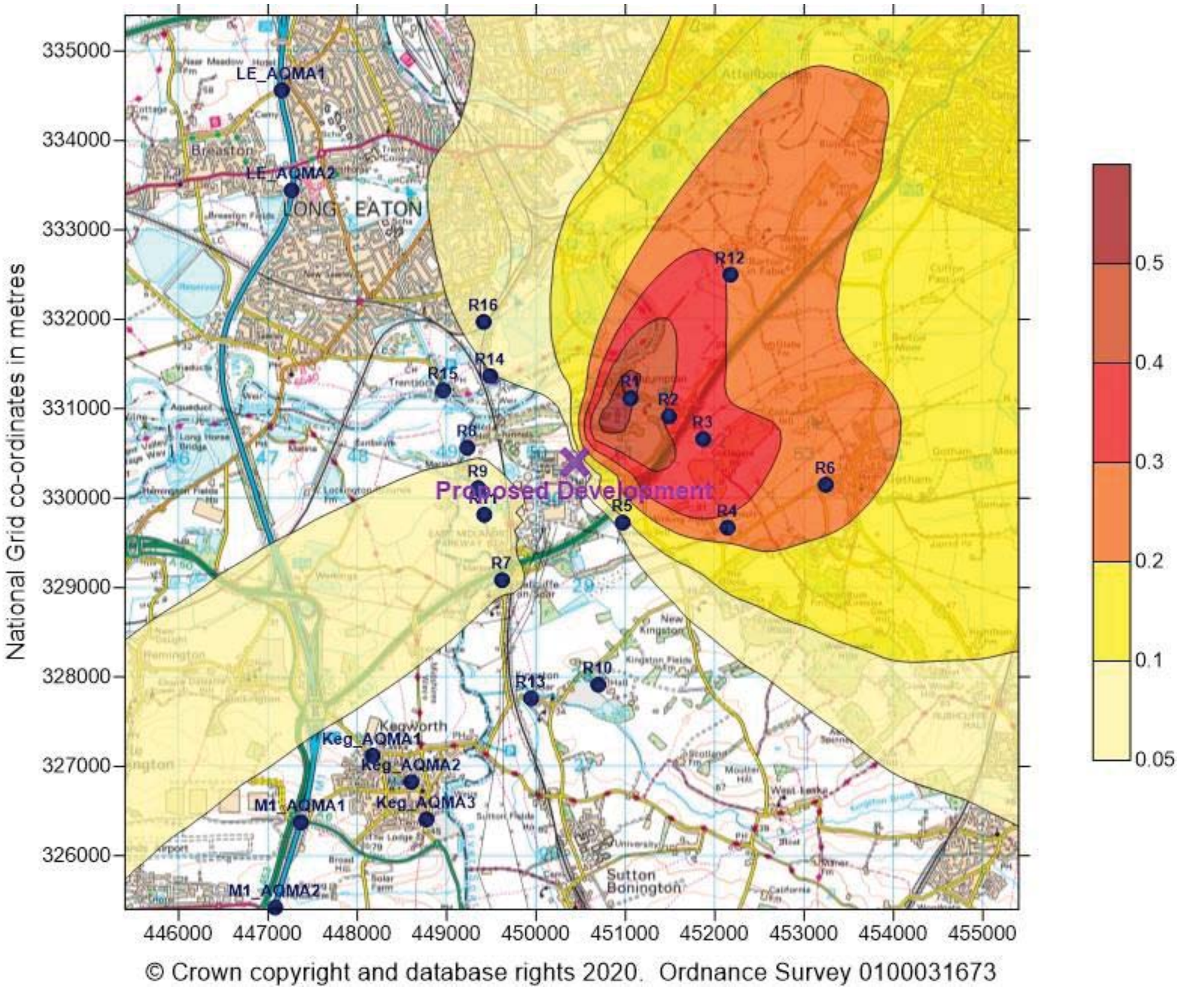

Figure 4: Predicted annual mean NO_2 concentrations ($\mu g/m^3$) resulting from the Proposed Development and the OCGTs operating continuously including the buildings on the Ratcliffe site above 30 m in height (Scenario C) for 2015 meteorology

Contours plotted: 0.05 $\mu g/m^3$, 0.1 $\mu g/m^3$ to 0.5 $\mu g/m^3$ in steps of 0.1 $\mu g/m^3$

NCC received 16.07.2020

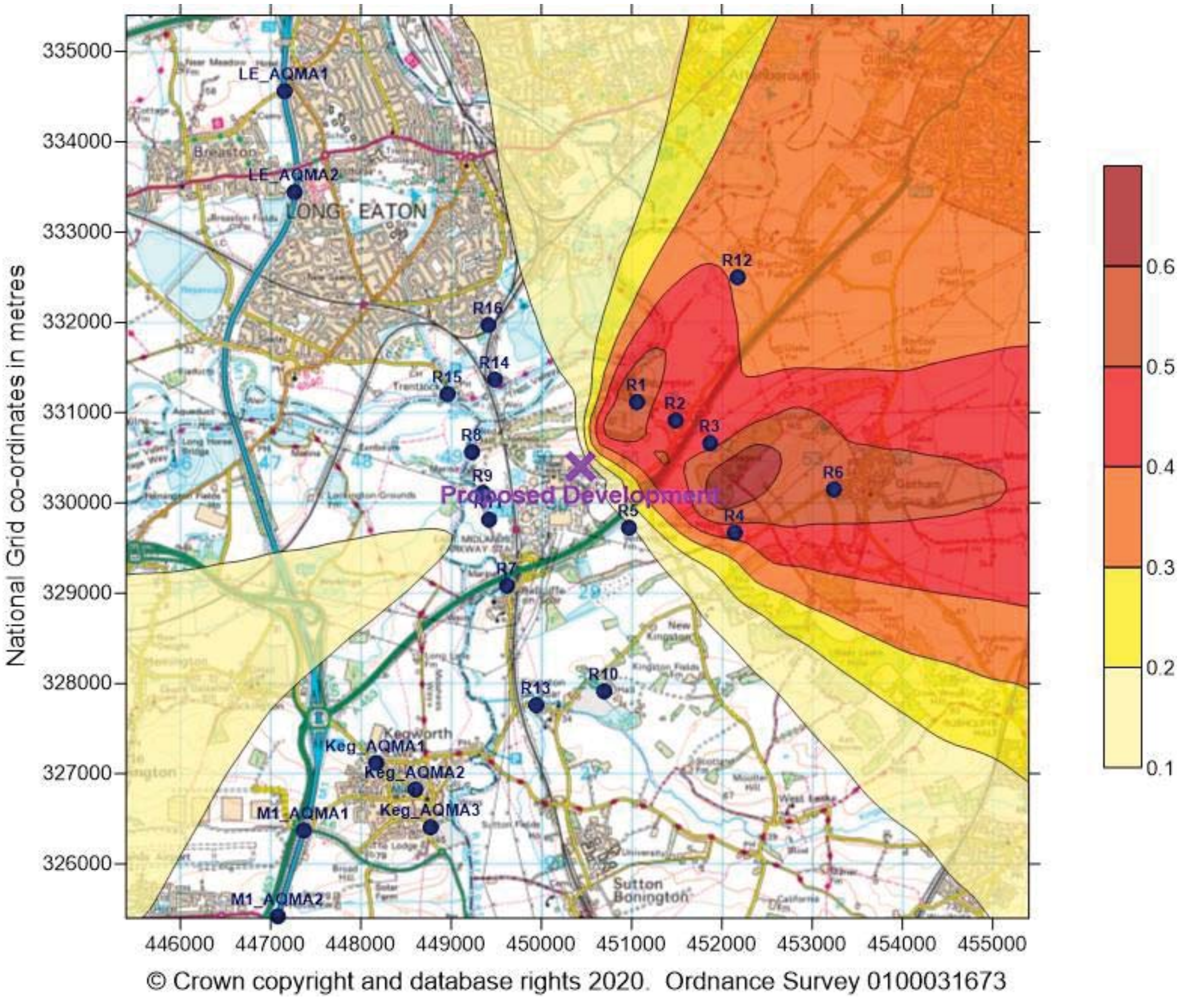

Figure 5: Predicted annual mean NO_2 concentrations (μg/m^3) resulting from the Proposed Development, the OCGTs and the coal-fired power station operating continuously including the buildings on the Ratcliffe site above 30 m in height (Scenario D) for 2015 meteorology

Contours plotted: 0.1 μg/m^3 to 0.6 μg/m^3 in steps of 0.1 μg/m^3

NCC received 16.07.2020

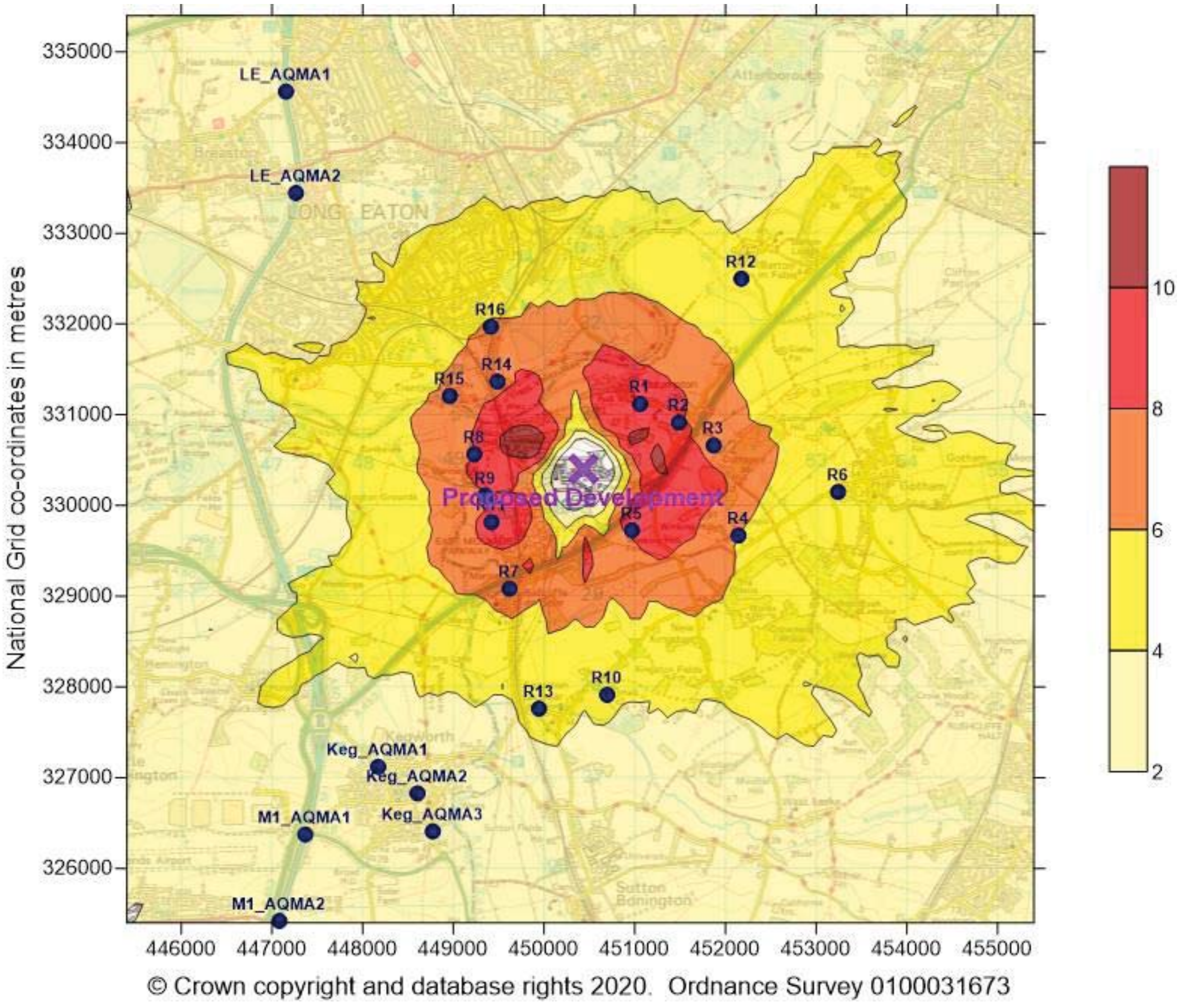

Figure 6: Predicted 99.79th percentile of hourly mean NO_2 concentrations resulting from the Proposed Development operating continuously (Scenario A) for 2019 meteorology

Contours plotted: 2 μg/m^3 to 10 μg/m^3 in steps of 2 μg/m^3

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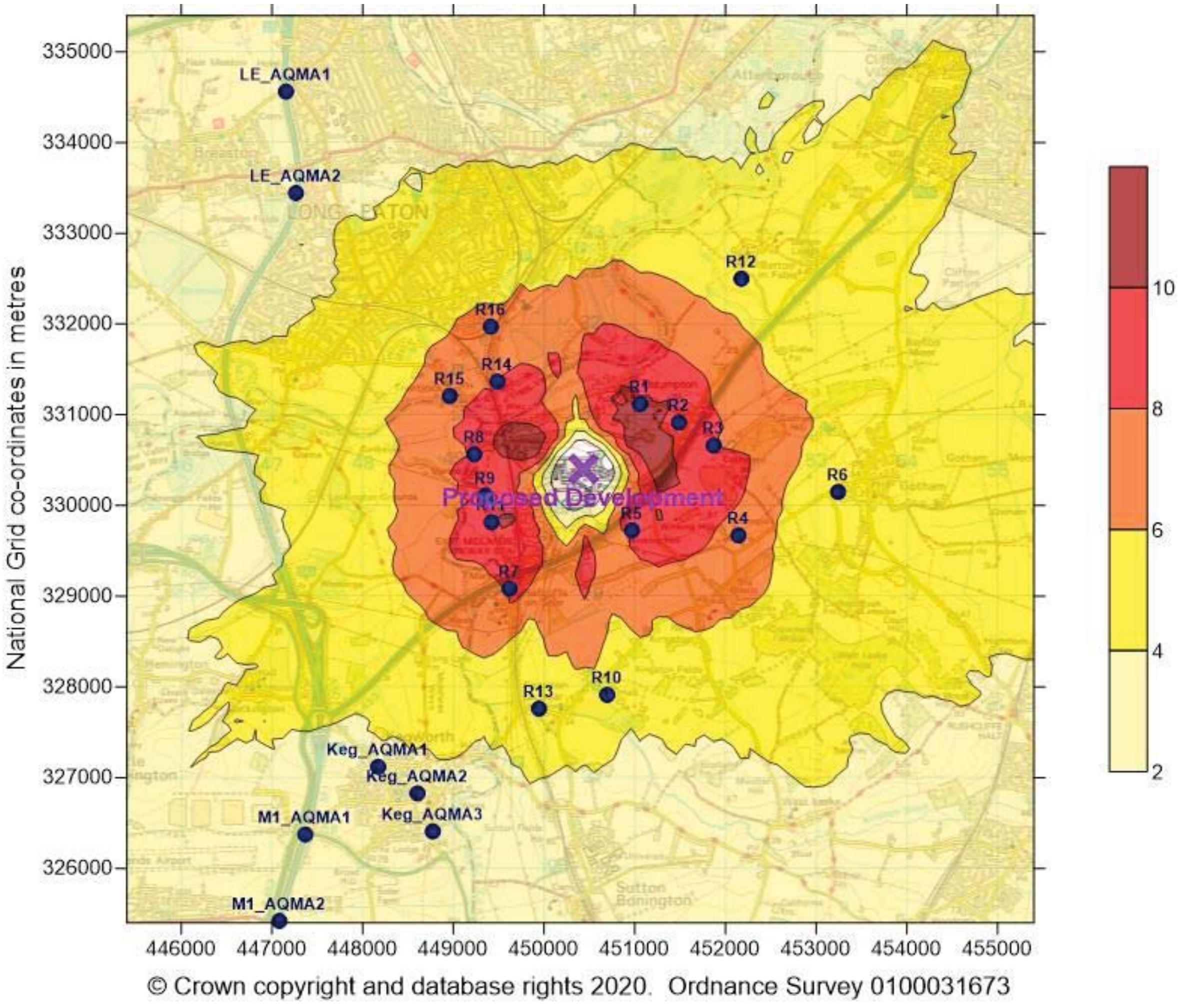

Figure 7: Predicted 99.79th percentile of hourly mean NO_2 concentrations resulting from the Proposed Development and the OCGTs operating continuously (Scenario B) for 2019 meteorology

Contours plotted: 2 µg/m³ to 10 µg/m³ in steps of 2 µg/m³

NCC received 16.07.2020

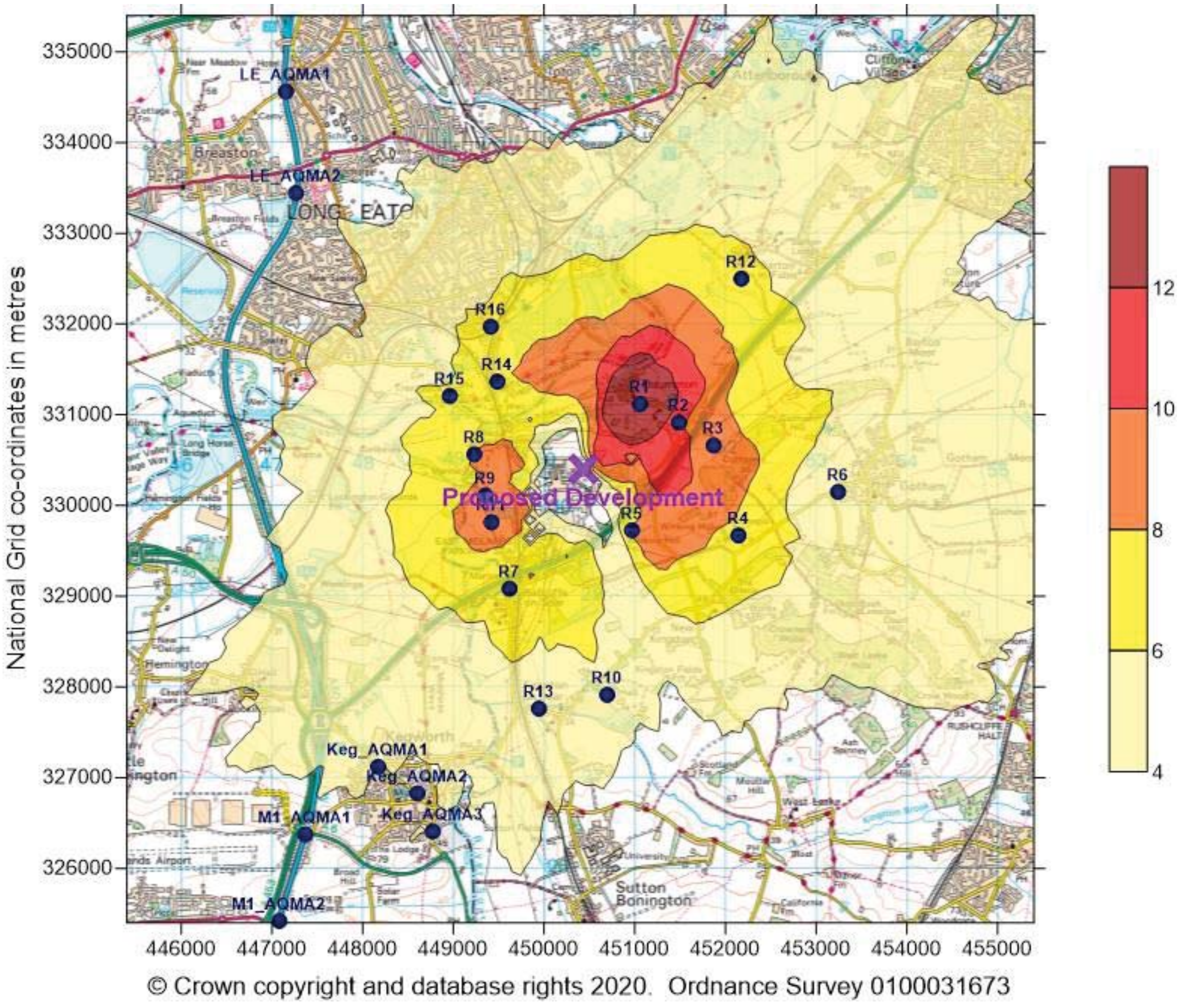

Figure 8: Predicted 99.79th percentile of hourly mean NO_2 concentrations (µg/m^3) resulting from the Proposed Development and the OCGTs operating continuously including the buildings on the Ratcliffe site above 30 m in height (Scenario C) for 2015 meteorology

Contours plotted: 4 µg/m^3 to 12 µg/m^3 in steps of 2 µg/m^3

NCC received 16.07.2020

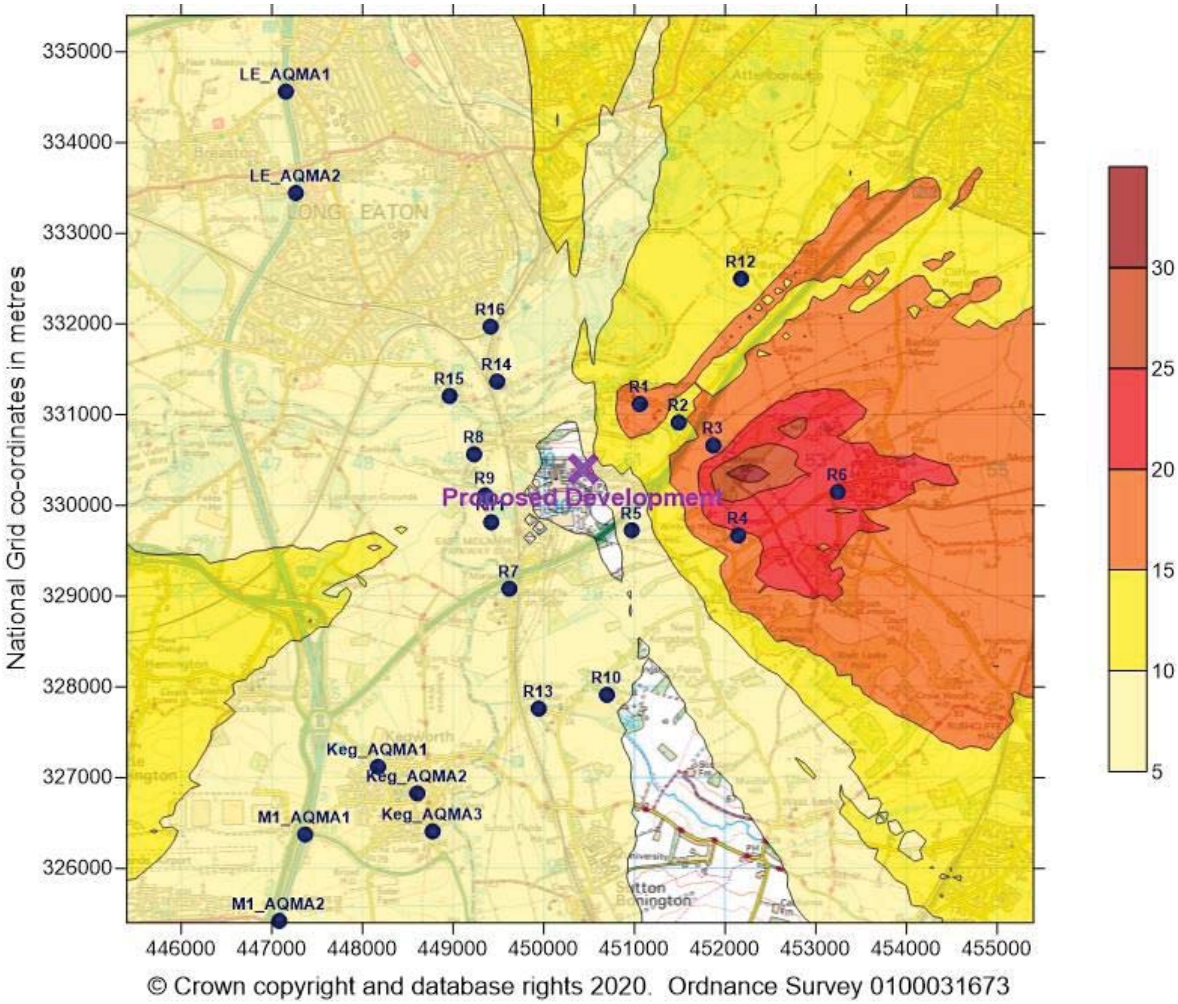

Figure 9: Predicted 99.79th percentile of hourly mean NO_2 concentrations (µg/m^3) resulting from the Proposed Development, the OCGTs and the coal-fired power station operating continuously including the buildings on the Ratcliffe site above 30 m in height (Scenario D) for 2015 meteorology

Contours plotted: 5 µg/m^3 to 30 µg/m^3 in steps of 5 µg/m^3

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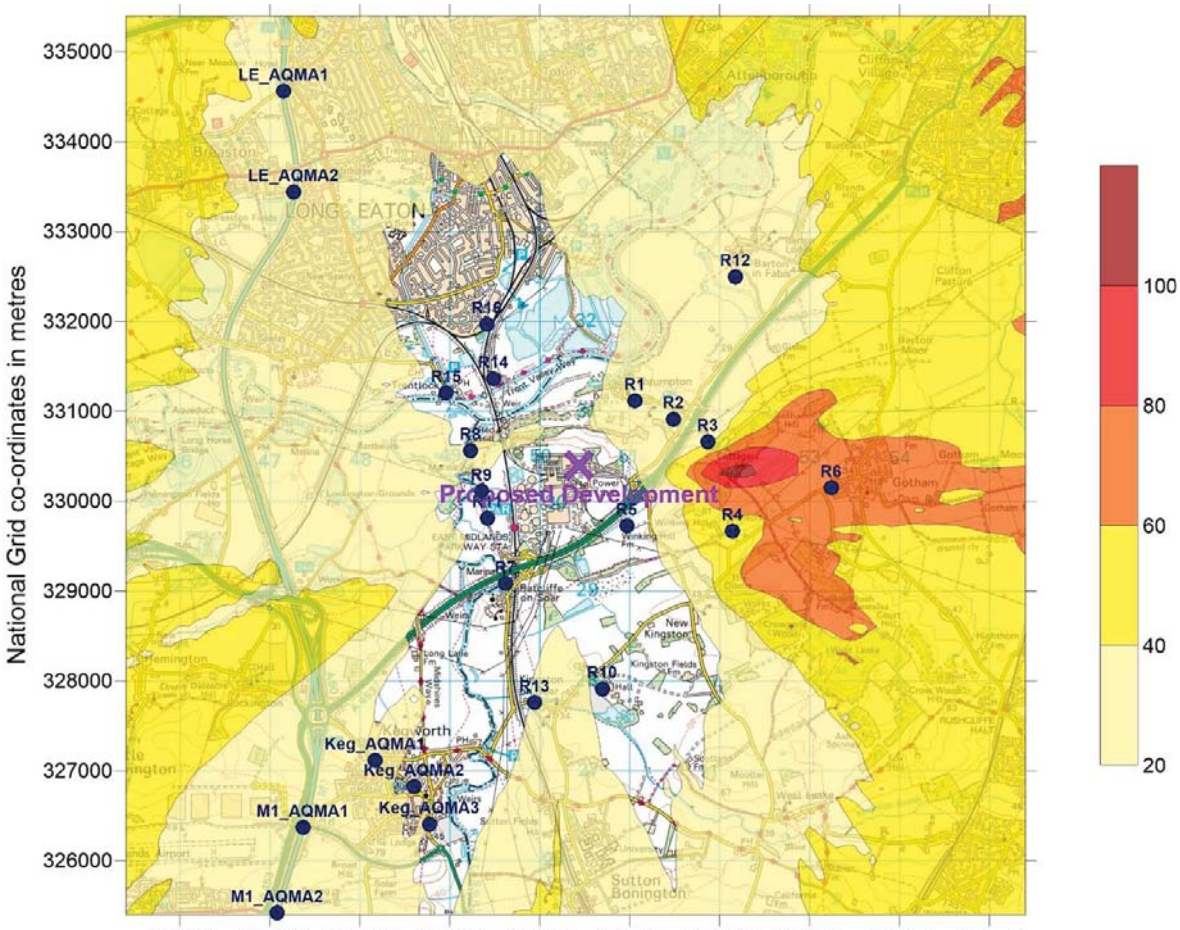

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Figure 10: Predicted 99.9th percentile of 15-minute mean SO_2 concentrations (µg/m^3) resulting from the Proposed Development, the OCGTs and the coal-fired power station operating continuously including the buildings on the Ratcliffe site above 30 m in height (Scenario D) for 2019 meteorology

Contours plotted: 20 µg/m^3 to 100 µg/m^3 in steps of 20 µg/m^3

NCC received 16.07.2020

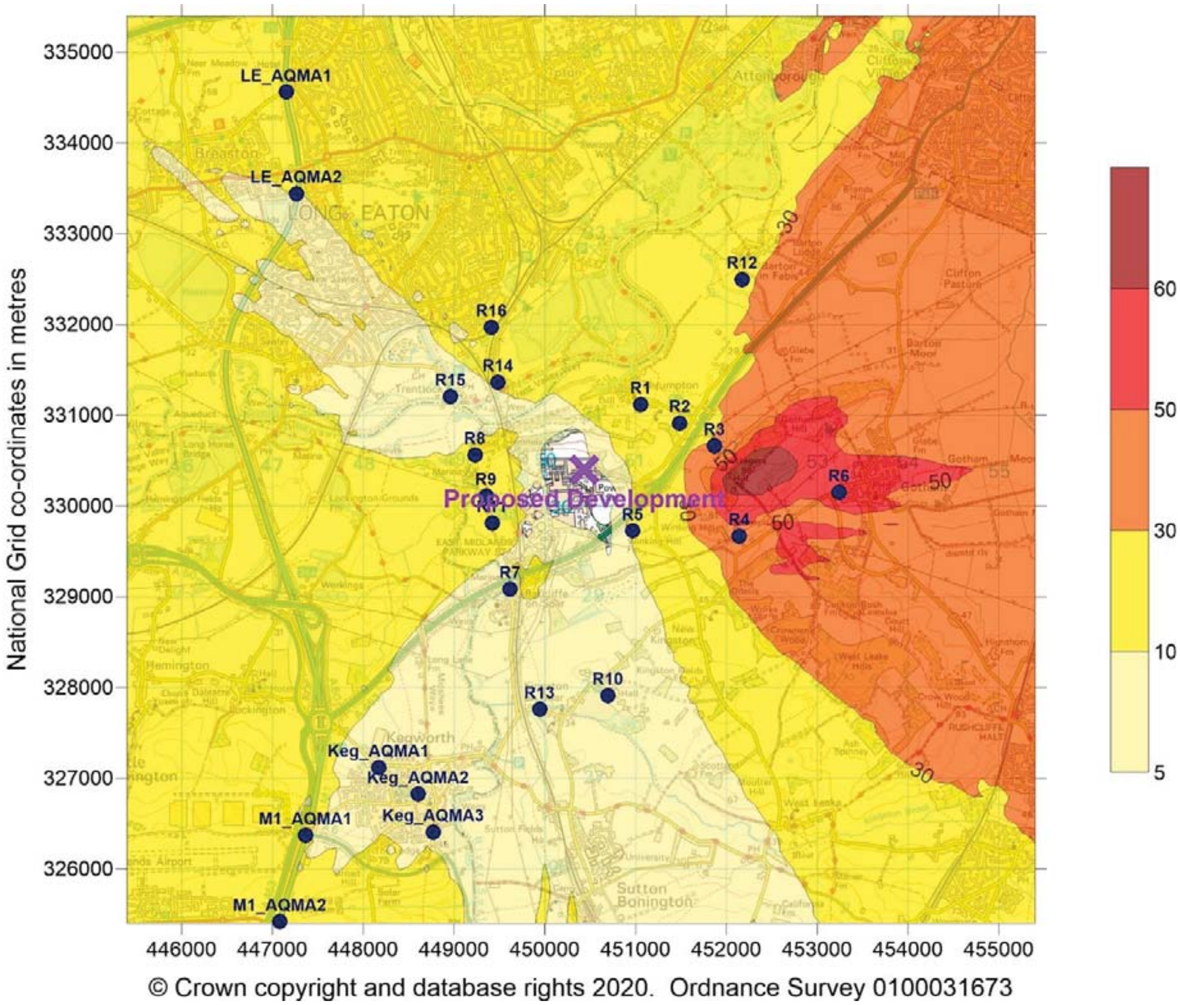

Figure 11: Predicted 99.73rd percentile of hourly mean SO_2 concentrations (µg/m^3) resulting from the Proposed Development, the OCGTs and the coal-fired power station operating continuously including the buildings on the Ratcliffe site above 30 m in height (Scenario D) for 2015 meteorology

Contours plotted: 5 µg/m^3, 10 µg/m^3 to 50 µg/m^3 in steps of 20 µg/m^3, 60 µg/m^3

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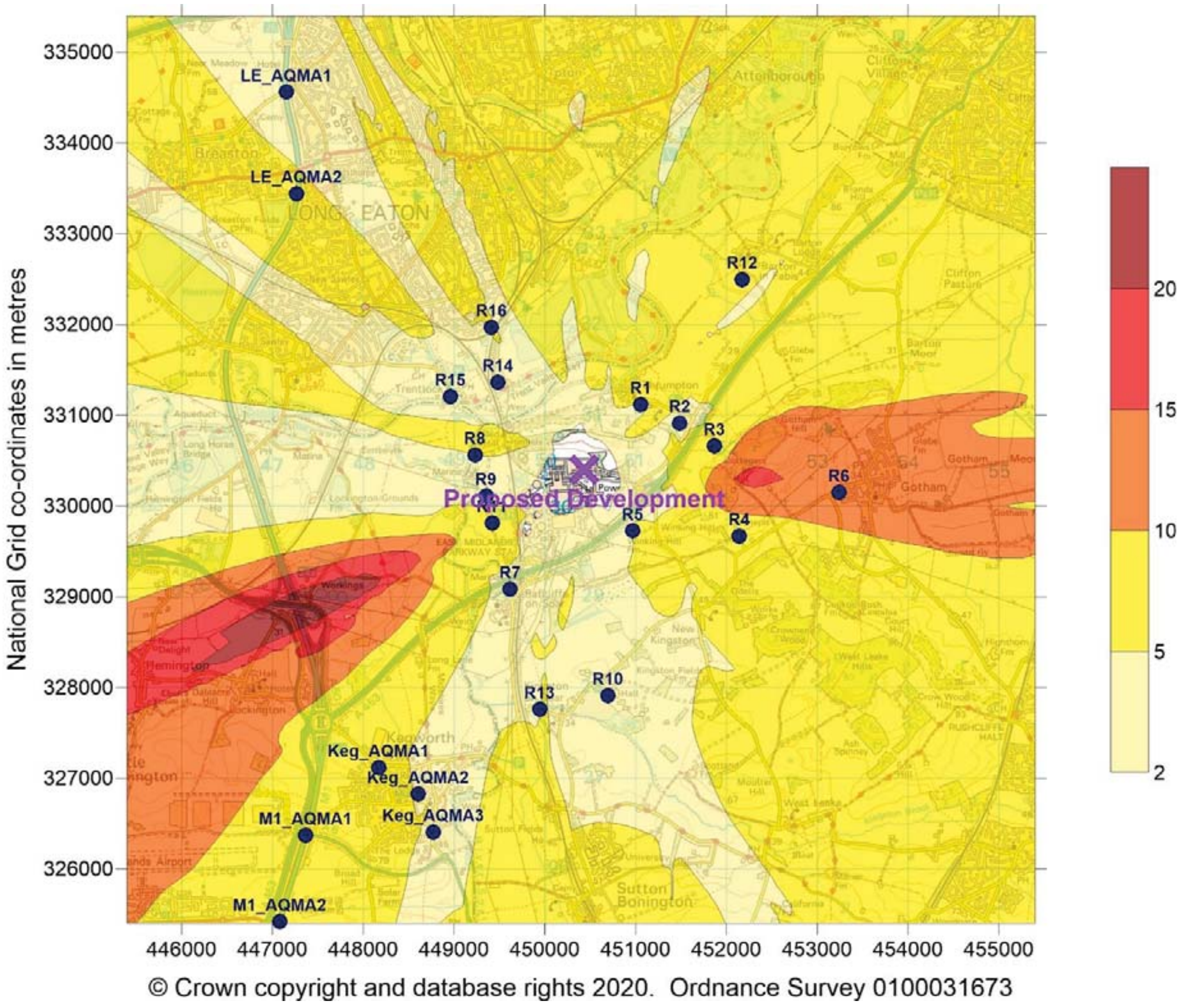

Figure 12: Predicted 99.18th percentile of daily mean SO_2 concentrations (μg/m^3) resulting from the Proposed Development, the OCGTs and the coal-fired power station operating continuously including the buildings on the Ratcliffe site above 30 m in height (Scenario D) for 2018 meteorology

Contours plotted: 2 μg/m^3, 5 μg/m^3 to 20 μg/m^3 in steps of 5 μg/m^3

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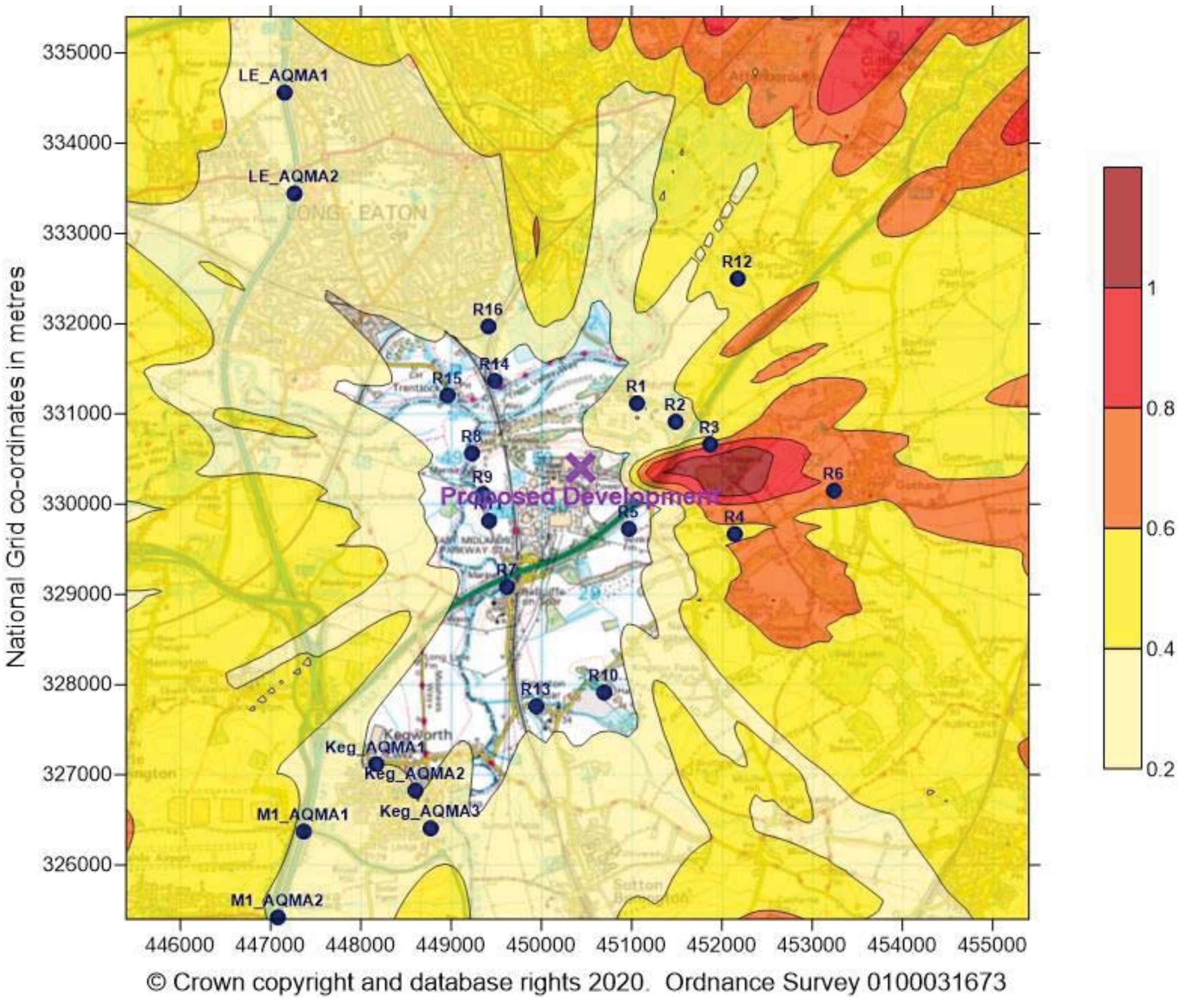

Figure 13: Predicted maximum hourly mean mercury concentrations (µg/m³) resulting from the Proposed Development, the OCGTs and the coal-fired power station operating continuously including the buildings on the Ratcliffe site above 30 m in height (Scenario D) for 2015 meteorology

Contours plotted: 0.2 µg/m³ to 1 µg/m³ in steps of 0.2 µg/m³

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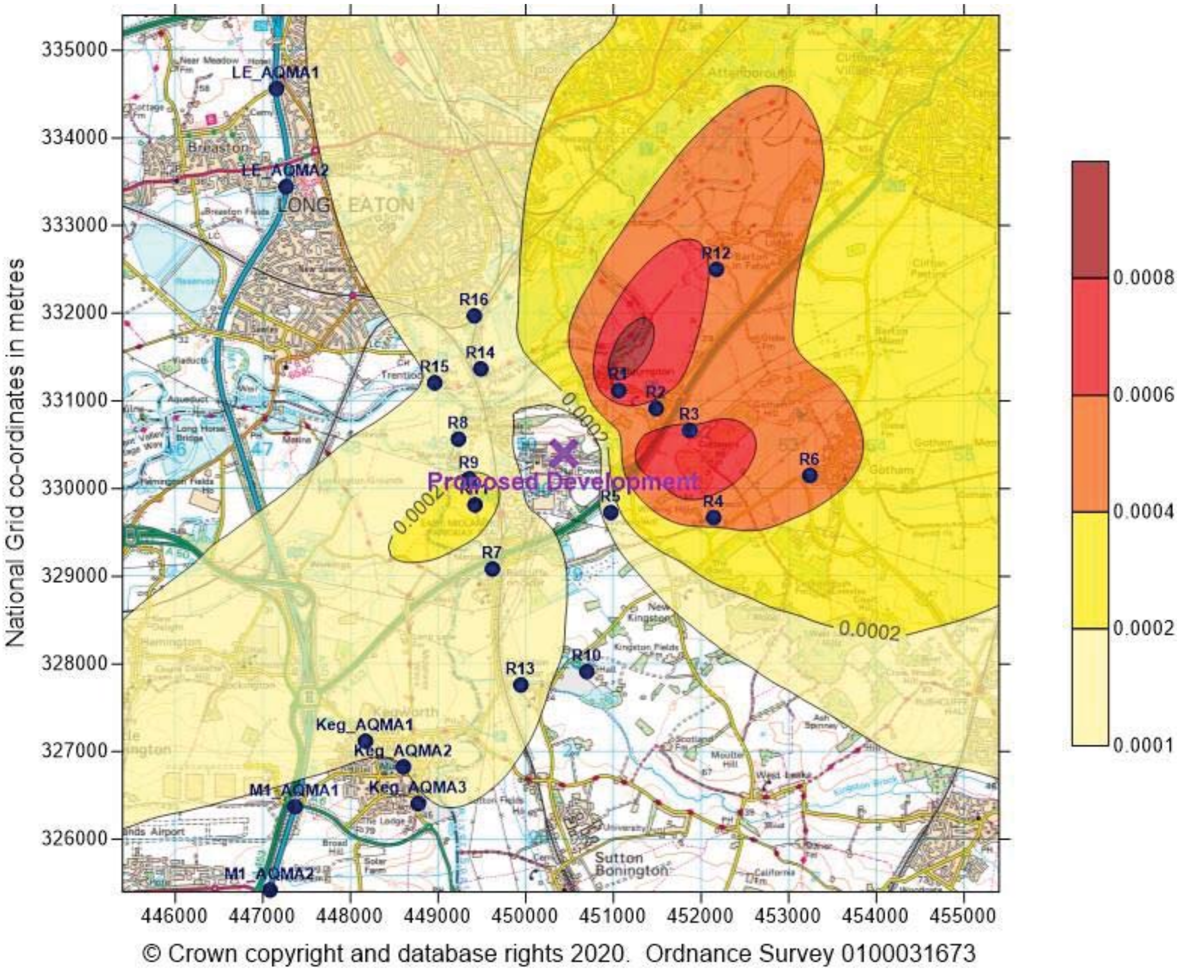

Figure 14: Predicted annual mean arsenic concentrations (µg/m³) resulting from the Proposed Development operating continuously (Scenario A) for 2015 meteorology

Contours plotted: 0.0001 µg/m³, 0.0002 µg/m³ to 0.0008 µg/m³ in steps of 0.0002 µg/m³

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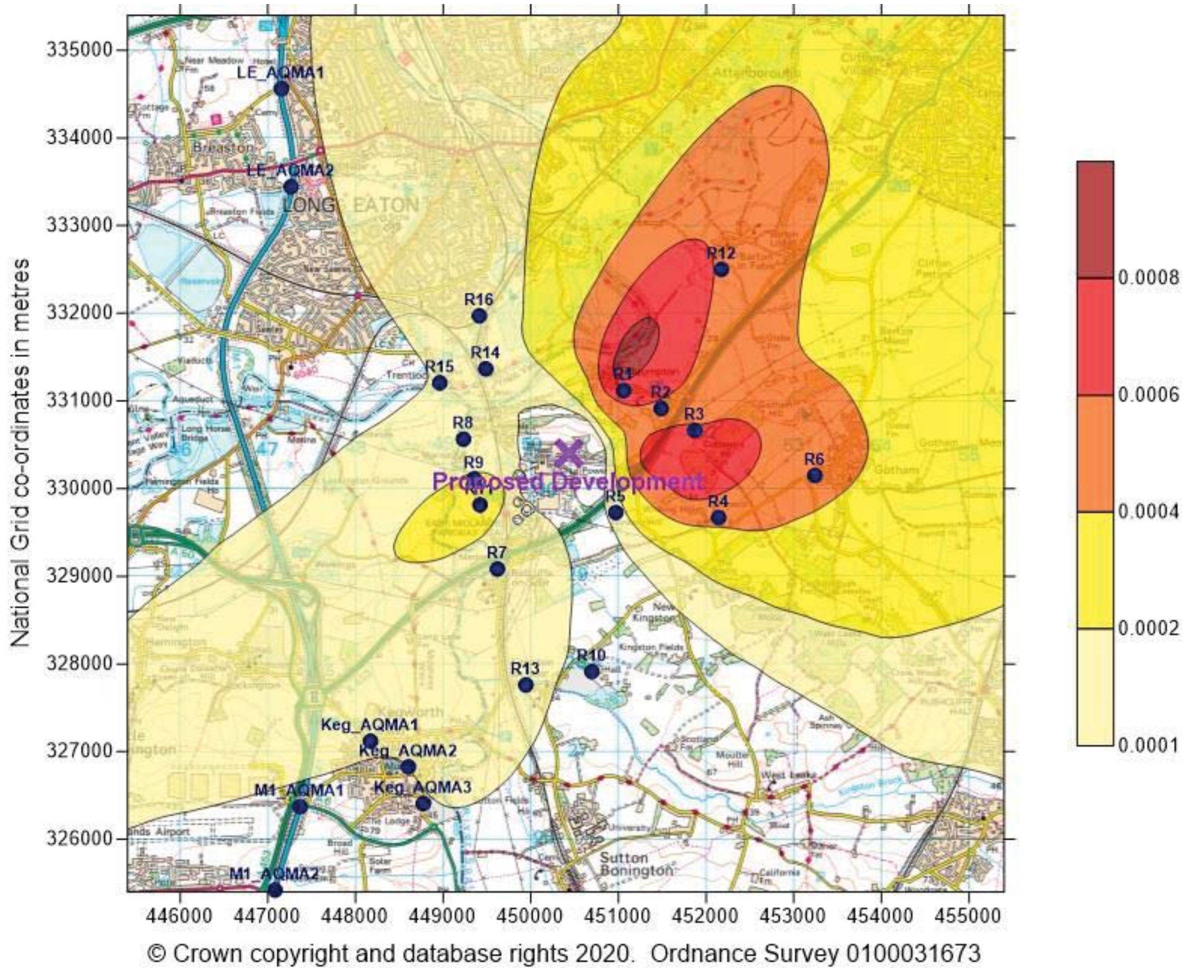

Figure 15: Predicted annual mean arsenic concentrations (µg/m³) resulting from the Proposed Development and the OCGTs operating continuously including the buildings on the Ratcliffe site above 30 m in height (Scenario C) for 2015 meteorology

Contours plotted: 0.0001 µg/m³, 0.0002 µg/m³ to 0.0008 µg/m³ in steps of 0.0002 µg/m³

NCC received 16.07.2020

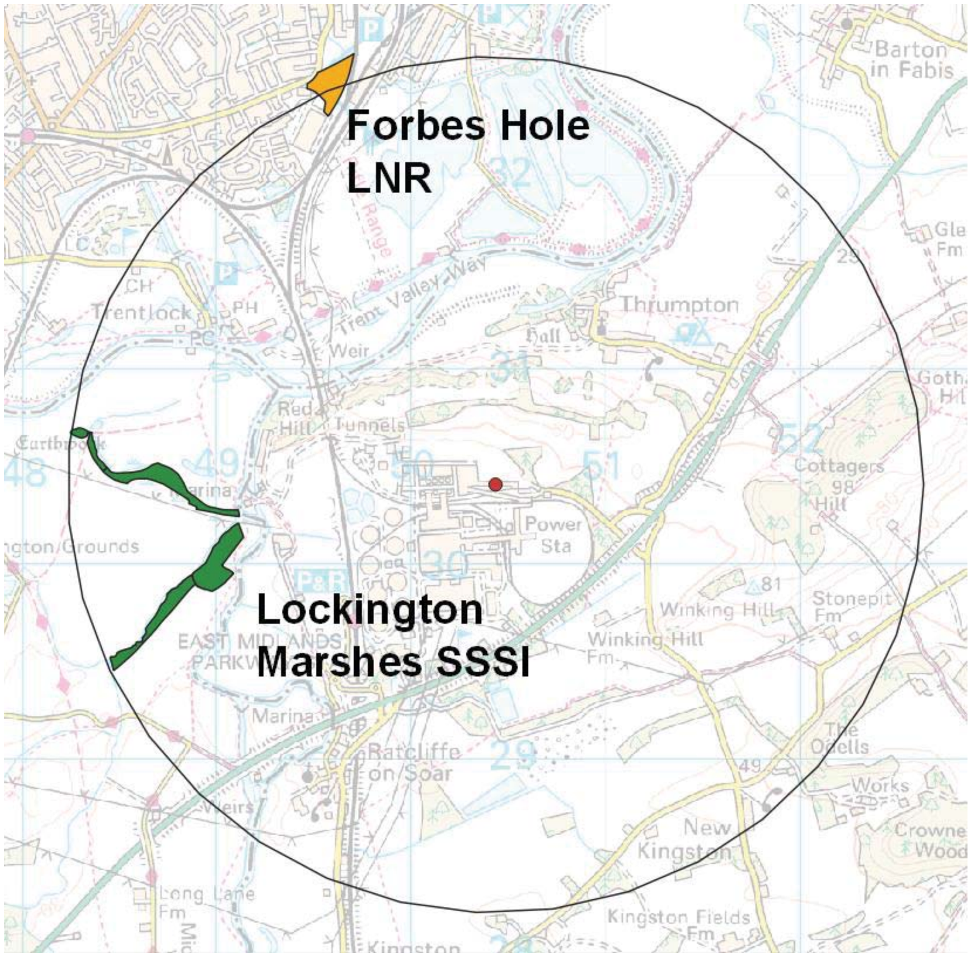

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Figure 16: Map showing Sites of Special Scientific interest (SSSI) and Local Nature Reserves (LNRs) within 2 km of the Proposed Development.
Note that the screened area is based on a 2.2 km radius to account for the site boundary

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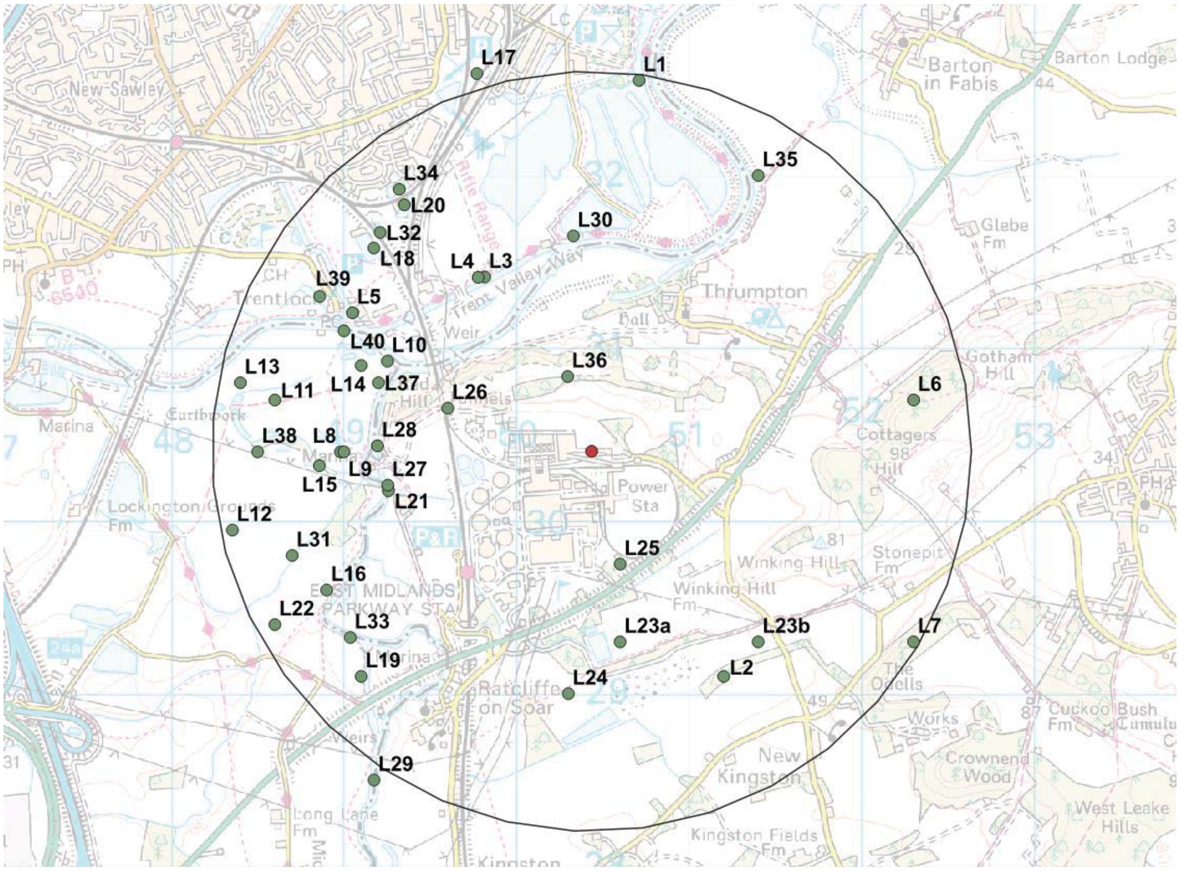

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Figure 17: Map showing Local Wildlife Sites within 2 km of the Proposed Development. Note that the screened area is based on a 2.2 km radius to account for the site boundary

L1	Attenborough West Gravel Pits	L22	Ratcliffe Lane Pasture and Stream
L2	Copse Kingston-on-Soar	L23a	Ratcliffe-on-Soar Flyash Grassland1
L3	Cranfleet Farm Floodbanks	L23b	Ratcliffe-on-Soar Flyash Grassland2
L4	Cranfleet Ponds (West Pond)	L24	Ratcliffe-on-Soar Flyash Track Grassland
L5	Erewash Canal	L25	Ratcliffe-on-Soar Pond
L6	Gotham Hill Woods	L26	Red Hill Ratcliffe on Soar
L7	Gotham Wood	L27	Redhill Marina Backwater
L8	Lockington Ash	L28	River Soar Loughborough Meadows to Trent
L9	Lockington Ash 2	L29	River Soar West Bank south of A453
L10	Lockington Confluence Backwater	L30	River Trent North Bank
L11	Lockington Confluence Hedges	L31	Shooting Ground Marsh Grassland, Lockington
L12	Lockington Fen	L32	Sheetstores Junction Pond
L13	Lockington Grounds, pond and marsh near Trent	L33	Soar Meadow near Ratcliffe Lock
L14	Lockington Trentside Pools	L34	South Junction Pond
L15	Lockington swamp by SSSI	L35	Thrumpton Bank
L16	Lower Soar Floodplain Wetland	L36	Thrumpton Park
L17	Meadow Lane Carr	L37	Trent Floodplain Wetland - Lock M07
L18	Narrow Bridge Fish Pond	L38	Trent Floodplain Wetland Lock M13
L19	Pond in hedgeline between two improved grasslands	L39	Trent Lock Marsh
L20	Poplars Fish Pond	L40	River Trent
L21	Rare Plant Register Mousetail Pasture		

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APPENDIX A:

STACK HEIGHT EVALUATION

An evaluation of the stack height for the Proposed Development has been undertaken using ADMS v5.2. The selection of an appropriate stack release height requires a number of factors to be taken into account, the most important of which is the need to balance a release height sufficient to achieve adequate dispersion of pollutants against other constraints such as visual impact.

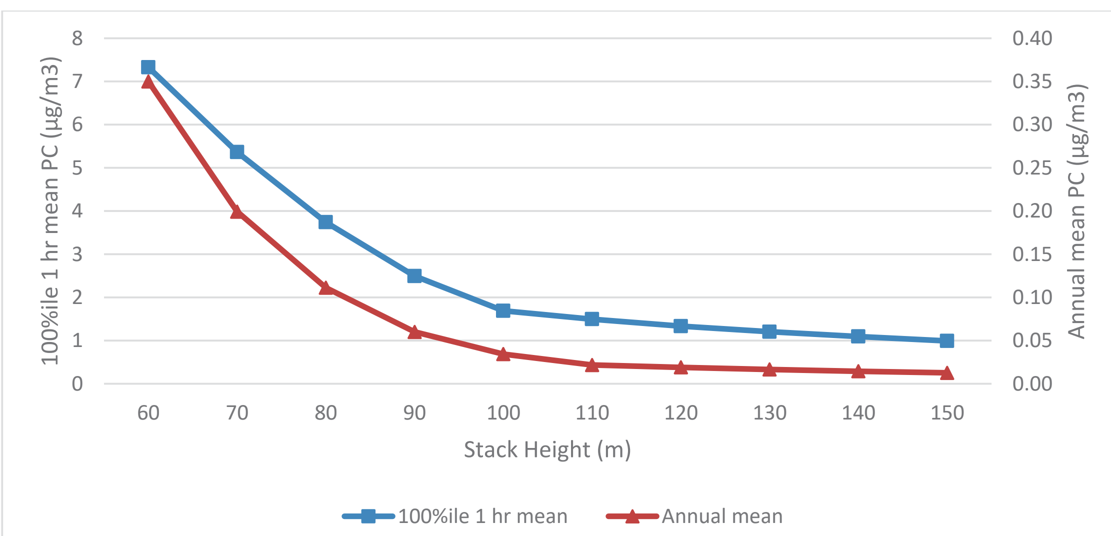
Stack heights between 60 m and 150 m in increments of 10 m have been investigated. A graph showing the highest process contribution (PC) to annual mean and maximum 1-hour mean pollutant concentrations for a modelled unit emission rate (1 g/s) is presented in Figure A1. The purpose of the graph is to evaluate the optimum release height in terms of the dispersion of pollutants which would occur, against the visual constraints of further increases in release height.

Analysis of the annual mean curve shows that the benefit of incremental increases in release height up to 90 m is relatively pronounced. At heights above 100 m, the air quality benefit of increasing release height further is reduced. From 110 m height onwards the decrease in annual mean concentrations from the 10 m stack height increase is minimal.

The relative benefit of increasing the release height on maximum 1-hour mean concentrations follows a similar pattern to the annual mean curve with a flattening of the curve seen at heights greater than 100 m, above which a reduced improvement in ground level concentrations is predicted with increasing release height.

The graph shows that the use of a stack of height 110 m above ground level would be capable of mitigating both the short-term and long-term impacts of the modelled emissions of emitted pollutants. Therefore, a stack height of 110 m is considered to be appropriate when balancing the visual impacts versus air quality benefits.

Figure A1: Predicted process contribution to annual mean ground level pollutant concentrations at stack release heights between 60 m and 150 m based on 1 g/s release rate.



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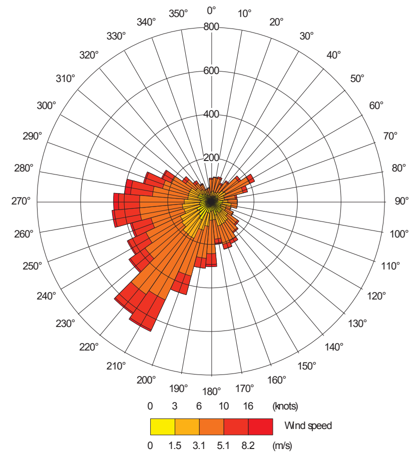
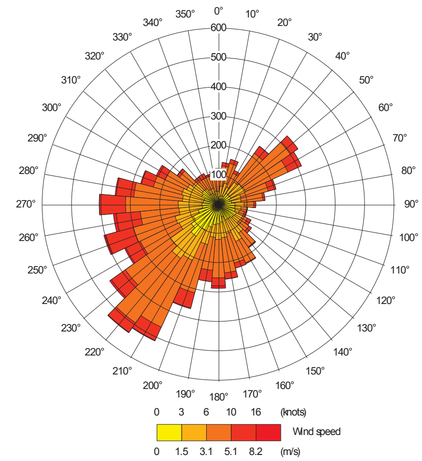
APPENDIX B:

WIND ROSES FOR SUTTON BONINGTON 2015-2019

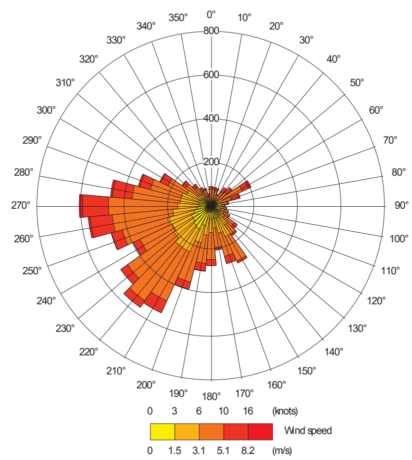
2015



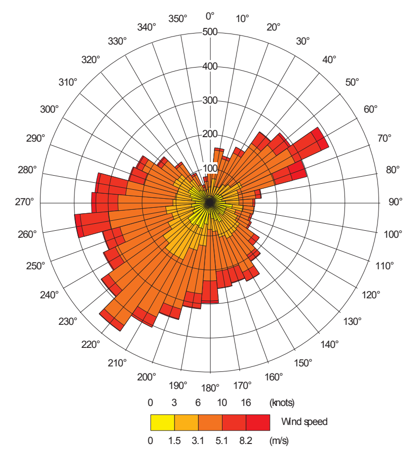
2016



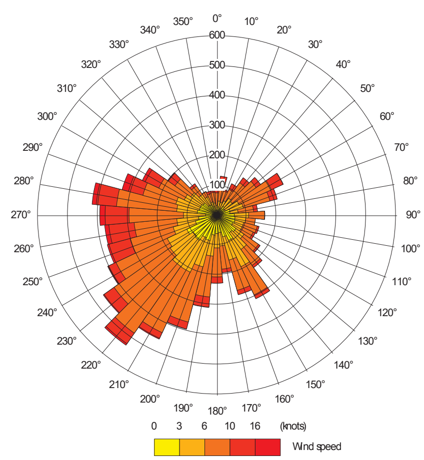
2017



2018



2019



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APPENDIX C:

EXISTING (BASELINE) AIR QUALITY

Measurements of air quality in the vicinity of the Proposed Development have been collated. Based on the measurements, estimates of annual mean concentrations of all pollutants assessed have been derived. The background concentrations are added to modelled plant contributions to determine that overall concentrations are compliant with air quality standards.

C1 Nitrogen Dioxide

The proposed location of the Proposed Development is located within the Rushcliffe local authority with Broxtowe, Erewash, North West Leicestershire and Nottingham County Council all being in close proximity. Annual air quality reports for all five local authorities have been reviewed to identify any monitoring sites located within 5 km of the proposed location of the energy facility. Table C1 presents the automatic and diffusion tube monitoring sites identified together with the annual mean concentrations measured since 2013. It should be noted that the diffusion tube concentrations are all reported by local authorities after bias correction has been applied. As there were 20 diffusion tubes within 5 km of the Proposed Development, only the closest five diffusion tube sites have been selected.

Table C1 shows that the annual mean AQS objective for NO_2 is met at all monitoring locations even when the diffusion tubes are next to the road. The Ruddington and Weston-on-Trent monitoring sites are specifically set up to capture high concentrations from the current coal-fired power station. These show lower concentrations than the roadside monitoring sites. These are likely to be more representative of the air quality at the maximum impact point from the Proposed Development than the roadside diffusion tube monitoring site concentrations.

In order to assist local authorities with their responsibilities under Local Air Quality Management (LAQM), the Department for Environment Food and Rural Affairs (DEFRA) provides modelled background concentrations of pollutants across the UK on a 1 km by 1 km grid. This model is based on known pollution sources and background measurements and is used by local authorities in lieu of suitable monitoring data. Mapped background concentrations of ammonia have been downloaded for the grid squares containing the Proposed Development and immediate surroundings. Concentrations will vary over the modelling domain area. Therefore, the maximum mapped background concentration within the modelling domain has been calculated from the 2017 mapped background concentrations. The maximum annual mean nitrogen dioxide concentration from the 2017 mapped background data within the modelling domain is 24.6 $\mu g/m^3$. This is above the annual mean concentrations measured at the two power station monitoring sites and similar to the annual mean concentrations measured at some of the roadside monitoring locations. The maximum annual mean nitrogen dioxide concentration from the 2017 LAQM mapped data within the modelling domain has been used as a conservative estimate of baseline concentrations for the assessment.

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Table C1: Annual mean nitrogen dioxide concentrations measured at local monitoring sites

Local Authority	Site Identifier	Distance from Proposed Development (km)	Automatic (A) or Diffusion Tube (D)	Type	Annual mean NO_2 (DT results bias corrected) (µg/m^3)						
					2013	2014	2015	2016	2017	2018	2019
Broxtowe	8 – The Manor Pub, Toton	3.8	D	Roadside	-	-	-	31	29	-	-
Broxtowe	7 – 31, Hickton Drive, Chilwell	3.9	D	Roadside	27	26	26	27	26	-	-
NW Leicestershire	20N Derby Road Kegworth	4.0	D	Roadside	31	27	29	30	25	-	-
NW Leicestershire	47N 12 Derby Road Kegworth	4.0	D	Roadside	39	31	36	34	30	-	-
NW Leicestershire	51N 40mph sign N of petrol station	4.0	D	Roadside	36	31	31	33	26	-	-
Erewash	EBC 23 – Langdale Drive	4.1	A	Suburban	-	-	-	-	-	19.9	-
-	Ruddington	6.2	A	PS Specific	-	-	11.7	12.6	11.9	11.3	11.4
-	Weston-on-Trent	10.0	A	PS Specific	-	-	12.7	12.9	117	12.9	115
Nottingham City	Nottingham Centre	11.9	A	Urban Background	-	-	31.6	31.2	29.7	27.5	277
Nottingham City	Nottingham Western Boulevard	12.0	A	Roadside	-	-	-	39.0	36.4	34.1	33.1

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C2 Sulphur Dioxide

Annual mean sulphur dioxide concentrations measured at the two power station specific monitoring sites at Ruddington and Weston-on-Trent. Annual mean concentrations are also measured at Nottingham Centre urban background monitoring site. Table C2 shows the annual mean sulphur dioxide concentrations recorded at the three monitoring sites from 2015 to 2019.

The LAQM modelled background concentrations from 2001 include sulphur dioxide annual mean concentrations. The highest LAQM modelled background concentration across the full modelling domain for the assessment is 20.5 μg/m^3. This is much higher than the annual mean concentrations measured at the three local monitoring sites over the past five years. This is due to sulphur dioxide concentrations having significantly reduced over the past 15 years. Therefore, the maximum measured concentration from the three local monitoring sites over the past five years has been taken as the baseline concentration of sulphur dioxide for this assessment.

Table C2: Annual mean sulphur dioxide concentrations measured at local monitoring sites

Monitoring location	Distance from Proposed Development (km)	Year	Annual mean concentration (μg/m^3)
Ruddington	6.2	2015	1.5
		2016	1.3
		2017	1.3
		2018	1.6
		2019	1.2
Weston-on-Trent	10	2015	1.0
		2016	1.0
		2017	11
		2018	1.4
		2019	1.1
Nottingham Centre	11.9	2015	2.3
		2016	2.0
		2017	2.0
		2018	2.4
		2019	2.2

C3 Carbon Monoxide

Annual mean carbon monoxide concentrations are not routinely measured at most monitoring sites. The closest monitoring site to measure carbon monoxide concentrations is Leeds Centre which is over 100 km away from the Proposed Developments location. Therefore, the maximum annual mean carbon monoxide concentration within the assessments modelling domain from the LAQM mapped background concentrations in 2001 has been used as a conservative estimate of baseline concentrations of carbon monoxide. The maximum annual mean carbon monoxide concentration from the LAQM mapped background within the assessment modelling domain is 458 μg/m^3.

C4 Particulate matter

PM_{10} concentrations are recorded at two local monitoring sites, Nottingham Centre and Nottingham Western Boulevard. The annual mean PM_{10} concentrations from these two monitoring sites are shown in Table C3 from 2015 to 2019.

NCC received 16.07.2020

The LAQM mapped background data from 2017 shows a maximum PM_{10} concentration of 18.7 µg/m^3 across the assessment modelling domain. This is at a similar level to the annual mean concentrations measured at the two monitoring locations in Nottingham. The maximum LAQM mapped background data within the assessment modelling domain of 18.7 µg/m^3 has been used as the baseline concentrations for the assessment.

Table C3: Annual mean PM_{10} concentrations measured at local monitoring sites

Monitoring location	Distance from Proposed Development (km)	Year	Annual mean concentration (µg/m^3)
Nottingham Centre	11.9	2015	17.3
		2016	17.4
		2017	17.9
		2018	16.3
		2019	18.1
Nottingham Western Boulevard	12.0	2015	-
		2016	19.8
		2017	17.8
		2018	18.0
		2019	19.8

$PM_{2.5}$ concentrations are recorded at the Nottingham Centre monitoring site. The annual mean $PM_{2.5}$ concentrations monitored between 2015 and 2019 are shown in Table C4.

The LAQM mapped background data from 2017 shows a maximum $PM_{2.5}$ concentration of 11.9 µg/m^3 across the assessment modelling domain. This is at a similar level to the annual mean concentrations measured at the Nottingham Centre monitoring site. The maximum LAQM mapped background data within the assessment modelling domain of 11.9 µg/m^3 has been used as the baseline concentration for the assessment.

Table C4: Annual mean $PM_{2.5}$ concentrations measured at local monitoring sites

Monitoring location	Distance from Proposed Development (km)	Year	Annual mean concentration (µg/m^3)
Nottingham Centre	11.9	2015	11.5
		2016	11.9
		2017	11.6
		2018	10.0
		2019	10.8

C5 Hydrogen Chloride

Hydrogen Chloride is measured on behalf of DEFRA, as part of the UK Eutrophying and Acidifying Atmospheric Pollutants (UKEAP) project. The closest monitoring site to the proposed location of the Proposed Development is at Sutton Bonington which is 3.5 km from the proposed site. Hydrogen Chloride concentrations were measured until January 2016. The maximum hourly mean concentrations recorded at the site between 2011 and 2015 has been taken to be a conservative estimate of the annual mean hydrogen chloride concentration which is 0.42 µg/m^3.

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C6 Hydrogen Fluoride

Baseline concentrations of hydrogen fluoride are not measured locally or nationally. The EPAQS report "Guidelines for halogens and hydrogen halides in ambient air for protecting human health against acute irritancy effects" (EPAQS, 2006) contains some estimates of baseline levels, reporting that measured concentrations have been in the range of 0.036 µg/m^3 to 2.35 µg/m^3.

The maximum measured baseline hydrogen fluoride concentration, therefore, has been used as the baseline concentration as a conservative estimate.

C7 Ammonia

Ammonia is measured on behalf of DEFRA, as part of the UK Eutrophying and Acidifying Atmospheric Pollutants (UKEAP) project. The closest monitoring site to the proposed location of the Proposed Development is at Sutton Bonington which is 3.5 km from the proposed site. Ammonia concentrations were measured until January 2016. The maximum hourly mean concentration recorded at the site between 2015 and 2019 has been taken to be a conservative estimate of the annual mean ammonia concentration which is 5.3 µg/m^3 (gaseous ammonia).

C8 Volatile Organic Compounds

Benzene concentrations are measured as part of the Automatic and Non-automatic Hydrocarbon Network, Benzene is measured at the Nottingham Centre monitoring site which is approximately 11.9 km to the north-east of the proposed site.

Table C5 shows the annual mean concentrations of Benzene measured at Nottingham Centre for the last five years of available data (2014–2018).

Table C5: Annual mean Benzene concentrations measured at Nottingham Centre

Monitoring location	Year	Annual mean concentration (µg/m^3)
Nottingham Centre	2014	0.77
	2015	0.70
	2016	0.59
	2017	0.58
	2018	051

The LAQM mapped background concentrations from 2001 included both Benzene and 1,3-butadiene. The maximum LAQM mapped background concentrations within the assessment modelling domain are 0.81 µg/m^3 and 0.35 µ/m^3 for Benzene and 1,3-Butadiene respectively. These values have been used as baseline concentrations of volatile organic compounds within the assessment.

C9 Polycyclic Aromatic Hydrocarbons (PAHs)

Polycyclic Aromatic Hydrocarbons (PAHs) are measured as part of the PAH network. There are no monitoring locations near to the Proposed Development. For the purpose of this assessment, benzo[a]pyrene is considered as this is the only PAH for which an AQAL has been set. The annual mean benzo[a]pyrene concentrations monitored at all the UK urban industrial monitoring sites are presented in Table C6.

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The maximum monitored concentration over the last 5 years for all urban industrial sites has been used for the purpose of this assessment which is 3.6 ng/m^3. This is more than ten times the AQAL of 0.25 ng/m^3.

Table C6: Annual mean benzo[a]pyrene concentrations measured at all UK urban industrial monitoring sites

Monitoring location	Year	Annual mean concentration (ng/m^3)
Liverpool Speke	2014	0.15
	2015	0.13
	2016	0.18
	2017	0.07
	2018	0.10
Middlesbrough	2014	0.49
	2015	0.29
	2016	0.19
	2017	0.14
	2018	0.17
Port Talbot Margam	2014	0.60
	2015	0.79
	2016	0.93
	2017	0.64
	2018	0.70
Royston	2014	0.92
	2015	0.41
	2016	0.52
	2017	0.34
	2018	0.38
Scunthorpe Low Stanton	2014	3.60
	2015	3.50
	2016	1.10
	2017	0.83
	2018	0.78
Scunthorpe Town	2014	3.50
	2015	1.30
	2016	1.10
	2017	0.80
	2018	1.70
South Hiendley	2014	0.44
	2015	0.26
	2016	0.31
	2017	0.19
	2018	0.23

C10 Polychlorinated Biphenyl (PCBs)

Polychlorinated Biphenyl (PCBs) are monitored on a quarterly basis at several urban and rural stations in the UK as part of the Toxic Organic Micro Pollutants (TOMPs) network. There are no monitoring sites near to the Proposed Development with measure PCBs. Table C7 shows the PCB concentrations from all monitoring sites across the UK. The maximum annual mean concentrations measured across the UK has been used as the baseline concentration for this assessment which is 128.93 pg/m^3.

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Table C7: Annual mean concentrations of PCBs

Monitoring location	Year	Annual mean concentration (pg/m^3)
Hazelrigg	2014	25.84
	2015	41.68
	2016	52.58
	2017	33.16
	2018	22.22
High Muffles	2014	26.11
	2015	33.43
	2016	37.76
	2017	31.63
	2018	8.86
London Nobel House	2014	107.49
	2015	121.39
	2016	110.46
	2017	121.87
	2018	46.63
Manchester Law Courts	2014	128.93
	2015	97.99
	2016	92.60
	2017	97.27
	2018	40.10
Weymouth	2014	17.00
	2015	20.95
	2016	38.61
	2017	32.26
	2018	11.23

C11 Heavy Metals

Metals are measured as part of the Rural Metals and UK Urban/Industrial Networks. The closest monitoring site to the Proposed Development location which monitors heavy metals is over 40 km away. It is considered that the urban industrial monitoring sites are likely be a conservative estimate of the conditions close to the Proposed Development (UK Urban Industrial Sites which recorded heavy metals are Pontardawe Tawe Terrace, Port Talbot Margam, Runcorn Weston Point, Scunthorpe Low Stanton, Scunthorpe Town and Walsall Bilston Road). A summary of data from all UK urban industrial monitoring sites is presented in Table C8.

On closer examination of the data from the six UK urban industrial monitoring sites, the maximum annual mean nickel concentrations measured at the Pontardawe Tawe Terrace monitoring site are more than ten times higher than at the other five monitoring sites. This is due to the Pontardawe Tawe Terrace monitoring site being close to a metals manufacturing site which emits high concentrations of nickel. As there are no metal manufacturing sites near to the Proposed Development the Pontardawe Tawe Terrace monitoring site annual mean nickel concentrations have not been included in the baseline assessment. The maximum annual mean nickel concentration measured at the other five sites has been reported in Table C8 instead.

Mercury is only measured at the Runcorn Weston point urban industrial site which ceased monitoring mercury in August 2018. The maximum annual mean mercury concentration between 2014 and 2018 from Runcorn Weston Point monitoring site has been used in the assessment.

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Antimony is not measured at any of the urban industrial sites and, therefore, maximum annual mean concentrations from Beacon Hill monitoring site between 2010 and 2013 have been used as the nearest monitoring site and the most recent monitoring data.

The maximum annual mean concentration shown in Table C8 for each metal has been used as the baseline concentration for the assessment.

The ratio of total Cr to Cr (VI) in ambient air varies depending on local emission sources. A review by the UK's Expert Panel on Air Quality Standards (EPAQS) indicates that Cr(VI) constitutes between 3 % and 33 % of airborne Chromium (EPAQS, 2009), while the US Department of Health suggests the ratio is between 10 % and 20 % (US Department of Health and Human Services Public Health Service Agency for Toxic Substances and Disease Registry, 2008). For this assessment, it is considered that a 20 % Cr (VI) to total Cr ratio is a conservative assumption, given the lack of known local sources of this substance.

Table C8: Maximum annual mean concentrations of heavy metals measured ay any UK urban industrial monitoring site

Substance	**Annual mean concentrations (ng/m^3)**				
	2014	**2015**	**2016**	**2017**	**2018**
Cadmium	2.50	2.20	0.89	1.40	1.20
Mercury	15.0	19.0	15.0	19.0	16.0
Antimony	-	1.20[1]	1.50[2]	0.95[3]	0.88[4]
Arsenic	1.20	0.95	1.00	1.10	0.82
Chromium	11.0	5.6	12.0	5.5	15.0
Chromium (VI)	2.2	1.1	2.4	1.1	3.0
Copper	80	56	23	22	18
Lead	57	63	22	20	19
Manganese	77	93	93	110	93
Nickel	2.3	4.1	2.4	1.5	18
Vanadium	7.1	9.5	9.2	12.0	9.8

[1] 2010 data; [2] 2011 data; [3] 2012 data; [4] 2013 data

NCC received 16.07.2020

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NCC received 16.07.2020

APPENDIX 8-2: HUMAN HEALTH RISK ASSESSMENT

NCC received 16.07.2020

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UTG/20/PMP/380/R
Job No: 2122.C91164.001
June 2020

HUMAN HEALTH RISK ASSESSMENT FOR THE PROPOSED EMERGE CENTRE AT RATCLIFFE-ON-SOAR
prepared for
DR A READ, RATCLIFFE-ON-SOAR REDEVELOPMENT MANAGER
by
S J Griffiths

SUMMARY

This human health risk assessment quantifies the potential impact of the emissions from the proposed East Midlands Energy Re-Generation (EMERGE) Centre on human health. The assessment considers the impact of species released to air, which can subsequently accumulate in the environment, at the maximum impact point and at the most impacted local receptors.

Impacts from the Proposed Development have been assessed against the Intake Dose (ID), for pollutants where there is no exposure threshold for toxicity, and against the Tolerable Daily Intake (TDI) in combination with existing exposure levels (the mean daily intake, MDI), for pollutants where a threshold exists.

For agricultural adult and residential adult receptors, the combined process contribution and MDI were well below the applicable TDI for all species for both ingestion and inhalation exposure. Similarly, the process contribution was well below the applicable ID for all species for both ingestion and inhalation exposure for adult receptors.

For agricultural child and residential child receptors, the combined process contribution and existing exposure level were well below the applicable TDI for all species in relation to inhalation exposure. The process contribution was also well below the applicable ID for all species for both ingestion and inhalation exposure for child receptors.

The total accumulation of dioxins in an infant, considering the breast milk pathway, was also well below the applicable ingestion TDI for both agricultural and residential receptors, noting that there are no other ingestion pathways for infants.

The TDI for ingestion was exceeded for cadmium, chromium and nickel for both agricultural and residential child receptors. However, this was due to the level of existing exposure which comprised 138.9%, 160.0% and 177.1% of the TDI for a child for cadmium, chromium and nickel respectively.

The process contributions from the Proposed Development are exceptionally small being only 0.03%, 0.2% and 0.35% of the TDI for cadmium, chromium and nickel respectively at the worst-case impact point based on an agricultural child receptor.

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The process contributions are 0.02%, 0.03% and 0.05% of the TDI for cadmium, chromium and nickel respectively at the worst-case impact point based on a residential child receptor.

The TDIs applied are set at a level that can be ingested daily over a lifetime without appreciable health risk, and the ID is a threshold below which there are considered to be negligible risks to human health.

Given that the impacts associated with emissions from the Proposed Development are below the TDI in combination with the MDI, or below the ID, or are extremely small relative to the TDI, it can confidently be concluded that emissions to air associated with operation of the Proposed Development will not result in appreciable health risks.

Prepared by **Approved for publication**

Master copy signed by S J Griffiths & K Askari (17/06/2020)

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1 INTRODUCTION

This human health risk assessment (HHRA) study quantifies the potential impact of emissions from the proposed East Midlands Energy Re-Generation (EMERGE) Centre, to be located on the Ratcliffe-on-Soar Power Station site, on human health.

For most substances released from the Proposed Development, the most significant effects on human health will arise by inhalation. The Air Quality Assessment Levels (AQALs) outlined within the Air Quality Assessment report (Appendix 8-1 of the ES) have been set by the various authorities at a level which is considered to protect human health, including vulnerable groups. If the concentrations in the atmosphere are less than the AQALs, then the pollutant is unlikely to have an adverse effect on human health.

For some pollutants which accumulate in the environment, inhalation is only one of the potential exposure routes. Therefore, other exposure routes, in particular ingestion, are considered in this assessment.

Impacts from pollutants which accumulate in the environment result from long-term exposure (over a number of years) and hence the assessment presented considers emissions from the Proposed Development taking into account the effects of buildings associated with the Proposed Development and those likely to remain in place on the wider Power Station site over the long term. This is Scenario A in the Air Quality Assessment report (Appendix 8-1 of the ES).

The existing coal-fired Power Station will have at most nine months of concurrent operation with the Proposed Development. The existing on-site Open Cycle Gas Turbines are restricted to 500 hours of operation per year and are not a substantial source of species which accumulate in the environment. Therefore, these two sources have not been considered.

A comparison between impacts at receptors under Scenarios A and C in the Air Quality Assessment report (Appendix 8-1 of the ES), which considers emissions from the Proposed Development taking into account the effects of buildings associated with the Proposed Development and those associated with the existing Power Station, showed negligible differences in impacts at the local receptors. The outcome of the assessment may therefore also be considered as robust for the unlikely scenario where the buildings associated with the existing Power Station are not demolished.

This assessment considers emissions from the Proposed Development during normal operational conditions. Non-routine emissions, such as those which may occur during the commissioning process, or other short-term events, typically only occur infrequently. These are detected by the process control system, rectified within a short time period and tightly regulated by the Environment Agency (EA). For this reason, no detailed consideration of impacts associated with non-routine or emergency events is included within this assessment. Abnormal operation will be considered as part of the environmental permit application process.

The assessment has been undertaken using the “Industrial Risk Assessment Program - Human Health” (IRAP-h View – Version 5.1.0) produced by Lakes Environmental. This model is well established for use in HHRAs in the UK, in particular for energy recovery plants.

All emission concentrations in this report are referenced to 11% oxygen, dry, 273.15 K and a pressure of 101.3 kPa unless otherwise specified.

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2 CHEMICALS OF POTENTIAL CONCERN (COPC)

This report considers the release of substances from the Proposed Development to atmosphere which have the potential to harm human health. The Proposed Development will be designed to meet the emission limits values (ELVs) for new plant set in the Industrial Emissions Directive (IED, Directive 2010/75/EU) and the Best Available Technique Associated Emission Levels (BAT AELs) set in the recently published Waste Incineration BAT Reference document (WI BREF) conclusions.

These emissions include:

- nitrogen dioxide, sulphur dioxide, particulate matter, carbon monoxide and ammonia;
- acid gases – hydrogen chloride and hydrogen fluoride;
- total organic carbon (TOC);
- metals – mercury, cadmium, thallium, antimony, arsenic, lead, cobalt, copper, manganese, nickel and vanadium;
- dioxin and furans;
- dioxin like polychlorinated biphenyls (PCBs); and
- polycyclic aromatic hydrocarbons (PAHs).

For most substances released from the Proposed Development, the most significant effects on human health will arise by inhalation. An Air Quality Assessment (Appendix 8-1) has been undertaken to determine the impact of atmospheric concentrations of the pollutants listed above based on the levels transposed under UK Law in the UK Air Quality Strategy and those set by the Environment Agency. These levels have been set at a level which is considered to protect human health.

Some pollutants, including polychlorinated dibenzodioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), dioxin-like polychlorinated biphenyls (PCBs) and heavy metals, accumulate in the environment, which means that inhalation is only one of the potential exposure routes. Therefore, their impacts cannot be evaluated in terms of their effects on human health simply by reference to ambient air quality standards. An assessment needs to be made of the overall human exposure to the substances of the local population and the risk that this exposure causes.

The following species have been considered chemicals of potential concern (COPC) for the purpose of this assessment:

- Benzene (representing TOC);
- Benzo[a]pyrene (representing PAH emissions);
- Mercury (Hg);
- Mercuric chloride ($HgCl_2$);
- Cadmium (Cd);
- Arsenic (As);
- Chromium (Cr), trivalent and hexavalent;
- Nickel (Ni); and
- Dioxins (PCDD/Fs) (individual congeners) and dioxin like PCBs.

The above are all regulated under the IED and/or WI BREF, with the exception of PAHs. However, as monitoring is required by legislation in the UK, benzo[a]pyrene has been included in the assessment to represent PAH emissions.

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3 ASSESSMENT CRITERIA

A detailed Human Health Risk Assessment has been carried out using the model "Industrial Risk Assessment Program – Human Health" (IRAP-h View – Version 5.1.0). IRAP calculates the total exposure through each of the different pathways so that a dose from inhalation and ingestion can be calculated for each receptor. By default, these doses are then used to calculate a cancer risk using the United States Environmental Protection Agency (USEPA) approach. However, the Environment Agency (England) recommends that the results be assessed using the UK's approach, as set out in the Environment Agency document "Human Health Toxicological Assessment of Contaminants in Soil" (Environment Agency, 2009). This approach involves two types of assessment as follows:

- For substances with a threshold level for toxicity, a Tolerable Daily Intake (TDI) is defined. This is defined as "an estimate of the amount of a contaminant, expressed on a bodyweight basis, which can be ingested daily over a lifetime without appreciable health risk." A Mean Daily Intake (MDI) is also defined, which is the typical intake from background sources (including dietary intake) across the UK. In order to assess the impact of the Proposed Development, the predicted intake of a substance due to emissions from the Proposed Development is added to the MDI and compared with the TDI.

- For substances without a threshold level for toxicity, an Index Dose (ID) is defined. This is a level of exposure which is associated with a negligible risk to human health. The predicted intake of a substance due to emissions from the Proposed Development is compared directly with the ID without taking account of background levels.

Substances can reach the body either through inhalation or through ingestion (oral exposure) and the body handles chemicals differently depending on the route of exposure. For this reason, different TDI and IDs are defined for inhalation and oral exposure.

Table 1 sets out the TDIs and IDs, as applicable, for the COPCs relevant to emissions from the Proposed Development. These have been derived from the Environment Agency report series 'Contaminants in soil: updated collation of toxicological data and intake values for humans' knows as the TOX reports[1], each of which covers an individual COPC. Both TDI and IDs are expressed in units of micrograms per kilogram of bodyweight per day (µg/kgbw/day). The Environment Agency withdrew the TOX reports for nickel and mercury in 2015 and 2018, respectively, following updated information from the European Food Safety Authority (EFSA) which suggested lower ingestion TDIs. The recommended ingestion values in the EFSA reference material have been applied in this assessment.

Table 2 presents the mean daily intake (MDI) for each of the COPCs for an adult and a child, where available, again derived from the TOX reports. Where it was necessary to extrapolate from a total daily intake, body masses of 70 kg and 20 kg were assumed for an adult and child, respectively, with an additional correction factor of 0.74 applied for children, in line with the Environment Agency's 2009 assessment guidance.

Table 3 compares the available MDIs to those COPCs with TDIs. Note that this comparison is not relevant in relation to IDs as discussed.

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[1] Available from the Contaminated Land: Applications in Real Environments (CL:AIRE) website: https://www.claire.co.uk/useful-government-legislation-and-guidance-by-country/177-tox-reports-for-sgv-derivation

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Table 1: Index Dose (ID) and Tolerable Daily Intake (TDI) for COPCs

Substance	ID Ingestion µg/kgbw/day	ID Inhalation µg/kgbw/day	TDI Ingestion µg/kgbw/day	TDI Inhalation µg/kgbw/day	Reference
Arsenic	0.3	0.002	-	-	SC050021/TOX 1
Benzene	0.29	1.4	-	-	SC050021 (Benzene)
Benzo[a]pyrene	0.02	0.00007	-	-	R&D PUBLIC'N TOX 2
Cadmium	-	-	0.36	0.0014	SC050021/TOX 3
Chromium	-	0.001	3.0	-	R&D PUBLIC'N TOX 4
Chromium VI	-	-	3.0		
Mercuric chloride	-	-	0.57*	0.06	SC050021 (Mercury) [Withdrawn] EFSA, 2012*
Methyl mercury	-	-	0.19*	0.23	
Mercury (elemental)	-	-	-	0.06	
Nickel	-	-	2.8**	0.006	SC050021/TOX 8 [Withdrawn] EFSA, 2015**
Dioxin and dioxin like PCBs	-	-	2 pg WHO-TEQ/kgbw/day		SC050021/TOX 12

Table 2: Mean Daily intake MDI for COPCs

Substance	MDI based on 70 kg adult (µg/kgbw/day)		MDI based on 20 kg child (µg/kgbw/day)		Reference
	Intake Ingestion	Intake Inhalation	Intake Ingestion	Intake Inhalation	
Arsenic	0.07	0.0002	0.19	0.0005	SC050021/TOX 1
Benzene	0.04	2.9	0.11	7.4	SC050021 (Benzene)
Benzo[a]pyre	-	-	-	-	R&D PUBLIC'N TOX 2
Cadmium	0.19	0.0003	0.5	0.0007	SC050021/TOX 3
Chromium	1.9	0.0009	4.8	0.002	R&D PUBLIC'N TOX 4
Chromium VI	0.19	-	0.48	-	
Mercuric chloride	0.014	-	0.037	-	SC050021 (Mercury) [Withdrawn] EFSA, 2012*
Methyl mercury	0.007	-	0.019	-	
Mercury (elemental)	-	0.0007	-	0.002	
Nickel	1.9	0.0037	4.96	0.0096	SC050021/TOX 8 [Withdrawn] LQM, 2015
Dioxin and dioxin like PCBs	0.7 pg WHO-TEQ/kg bw/day		1.8 pg WHO-TEQ/kg bw/day		SC050021/TOX 12

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Table 3: Mean Daily intake expressed as a % of the TDI for relevant COPCs

Substance	MDI based on 70 kg adult as % of TDI		MDI based on 20 kg child as % of TDI	
	Intake Ingestion	Intake Inhalation	Intake Ingestion	Intake Inhalation
Cd	52.8%	21.4%	138.9%	50.0%
Cr	63.3%	-	160.0%	-
Cr VI	6.3%	-	16.0%	-
$HgCl_2$	2%	-	6.5%	-
Methyl Hg	3.7%	-	10.0%	-
Hg (elemental)	-	1.2%	-	3.3%
Ni	67.9%	62%	177%	160%
Dioxin and dioxin like PCBs	35%		90%	

It can be seen that the MDIs for cadmium, chromium and nickel from existing sources exceeds the TDI for children. The implications for these pollutants are discussed below.

3.1 Chromium

The MDI for chromium is set for chromium III and taken from the Environment Agency report "Contaminants in Soil: Collation of Toxicological Data and Intake Values for Humans. Chromium"[1]. This states that 'there do not appear to be any published reports on the adverse effects in humans resulting from ingested chromium III'. It is also noted that the Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment (COT) reviewed chromium as part of the UK Food Surveillance Programme in 1998 and concluded that the "current levels of exposure to chromium in the diet, which is mainly in the trivalent form, do not warrant any major concern in terms of toxicity, or deficiency."

The World Health Organisation (WHO) International Programme on Chemical Safety has reviewed the daily intake of chromium from foods and found that existing levels do not represent a toxicity problem (IPCS, 1988). The WHO conclude that "in the form of trivalent compounds, chromium is an essential nutrient and is relatively non-toxic for man and other mammalian species."

The Environment Agency TOX report explains that the TDI has been derived from the USEPA's Reference Dose of 3 µg/kgbw/day for chromium VI. This is the only explicitly derived safety limit for oral exposures of chromium. The report recommends that the USEPA Reference Dose is applied to all the chromium content as a starting point. Therefore, the TDI presented in Table 1 is actually the TDI for chromium VI, not total chromium. Assessing the total dietary intake of chromium against this TDI is therefore highly conservative.

3.2 Cadmium

The key determinant of cadmium's toxicity potential is its chronic accumulation in the kidney. The Environment Agency in its TOX report "Contaminants in Soil: Collation of Toxicological Data and Intake Values for Humans. Cadmium" explains that chronic exposure to levels in excess of the TDI might be associated with an increase in kidney disease in a proportion of those exposed, but (small) exceedances lasting for shorter periods are of less consequence. Therefore, assessing a lifetime exposure is appropriate. If the exposure of a receptor is assessed over a lifetime (i.e. a period as a child and adult), the lifetime MDI is below the TDI.

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3.3 Nickel

The ingestion MDI and TDI for nickel have been revised following the publication by the European Food Safety Authority of new expert opinion relating to the reproductive and developmental effects in experimental animals. The MDI exceeds the TDI for children for both inhalation and ingestion. The updated MDI for inhalation is 0.259 µg/day for an adult which, assuming an inhalation rate of 20 m^3/day, equates to an atmospheric concentration of around 13.0 ng/m^3. A review of the monitoring data of nickel across the UK between 2015 and 2019 (excluding the three sites at Sheffield Tinsley, Pontardawe Tawe Terrace and Swansea Coedgwilym, which are close to significant sources of nickel) has shown that annual mean concentrations were well below this concentration, averaging 1.6 ng/m^3 with a maximum of 9.6 ng/m^3, the latter associated with a heavily trafficked urban traffic site. Across rural and urban background sites, concentrations averaged 0.79 ng/m^3 with a maximum of 2.6 ng/m^3.

Therefore, the recommended MDI for inhalation is conservative for rural locations, such as that where the Proposed Development is located, which are away from significant sources of nickel.

Applying the maximum background concentration from an urban background site of 2.6 ng/m^3, the MDI would be 0.052 µg/day or 12% of the inhalation TDI for an adult and 32% of the TDI for a child. These have been used as the values of the MDI for inhalation for adults and children for the remainder of this analysis.

3.4 Assessment Criteria

The TDI for each pollutant has been set at a level which can be ingested daily over a lifetime without appreciable health risk, and the ID for each pollutant without a toxicity threshold has been set at a level which is associated with a negligible risk to human health. Therefore, if the total exposure is less than the TDI or ID for a pollutant, it can be concluded that the impact of the Proposed Development is negligible and the effect is not significant.

4 METHODOLOGY FOR ESTIMATING EXPOSURE TO EMISSIONS

The Industrial Risk Assessment Program – Human Health model, IRAP-h View, created by Lakes Environmental, is based on the USEPA Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities (USEPA, 2005). This Protocol is a development of the approach defined by Her Majesties Inspectorate on Pollution (HMIP) in the UK in 1996 (HMIP, 1996), taking account of further research since that date. The exposure pathways included in the IRAP model are shown in Figure 1 and Table 4.

Exposure to gaseous contaminants has the potential to occur by direct inhalation or vapour phase transfer to plants. In addition, exposure to particulate phase contaminants may occur via indirect pathways following the deposition of particles to soil. These pathways include:

- ingestion of soil and dust;
- uptake of contaminants from soil into the food chain (through home-grown produce and crops); and
- direct deposition of particles onto above ground crops.

The other relevant pathways through which inhalation and ingestion occur and the receptors that have been considered to be impacted via each pathway are shown in Table 4.

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Table 4: Exposure Pathways Considered in the Assessment

Pathway	Residential Receptor	Agricultural Receptor
Direct inhalation	Yes	Yes
Ingestion of soil	Yes	Yes
Ingestion of home-grown produce	Yes	Yes
Ingestion of home-grown produce	-	Yes
Ingestion of home-grown chickens	-	Yes
Ingestion of home-grown poultry	-	Yes
Ingestion of home-grown beef	-	Yes
Ingestion of home-grown pork	-	Yes
Ingestion of home-grown milk	-	Yes
Ingestion of breast milk by infants	Infants only	

It is noted that some households may keep chickens and consume eggs and potentially the birds. The impact on these households is considered to be between the impact at an agricultural receptor and a standard resident receptor. The approach used in this report considers an agricultural receptor and a residential receptor at the point of maximum impact as a complete worst case.

As shown in Figure 1, the pathway from the ingestion of mother's milk in infants is considered within the assessment. This considers all dioxins. The IRAP model calculates the amount of these COPCs entering the mother's milk and being passed on to the infants. The impacts are then compared against the TDI.

4.1 Pathways Excluded from Assessment

The intake of COPCs via dermal absorption, groundwater and surface water exposure pathways is very limited and as such these pathways are excluded from this HHRA. The justification for excluding these pathways is highlighted in the following sections.

4.1.1 Dermal Absorption

Both the HMIP and the USEPA note that the contribution from dermal exposure to soils impacted by thermal treatment facilities is typically a very minor pathway and is typically very small relative to contributions resulting from exposures via the food chain. This reflects the infrequent and sporadic nature of such exposure and low dermal absorption factors.

The USEPA, 2005 protocol provides an example from the risk assessment conducted for the Waste Technologies, Inc. hazardous thermal treatment in East Liverpool, Ohio. This indicated that for an adult subsistence farmer in a subarea with high exposures, the risk resulting from soil ingestion and dermal contact was 50-fold less than the risk from any other pathway and 300-fold less than the total estimated risk.

The HMIP,1996 document provides a screening calculation using conservative assumptions, which states that the intake via dermal absorption is 30 times lower than the intake via inhalation, which is itself a minor contributor to the total risk.

As such the pathway from dermal absorption is deemed to be an insignificant risk and has been excluded from this assessment.

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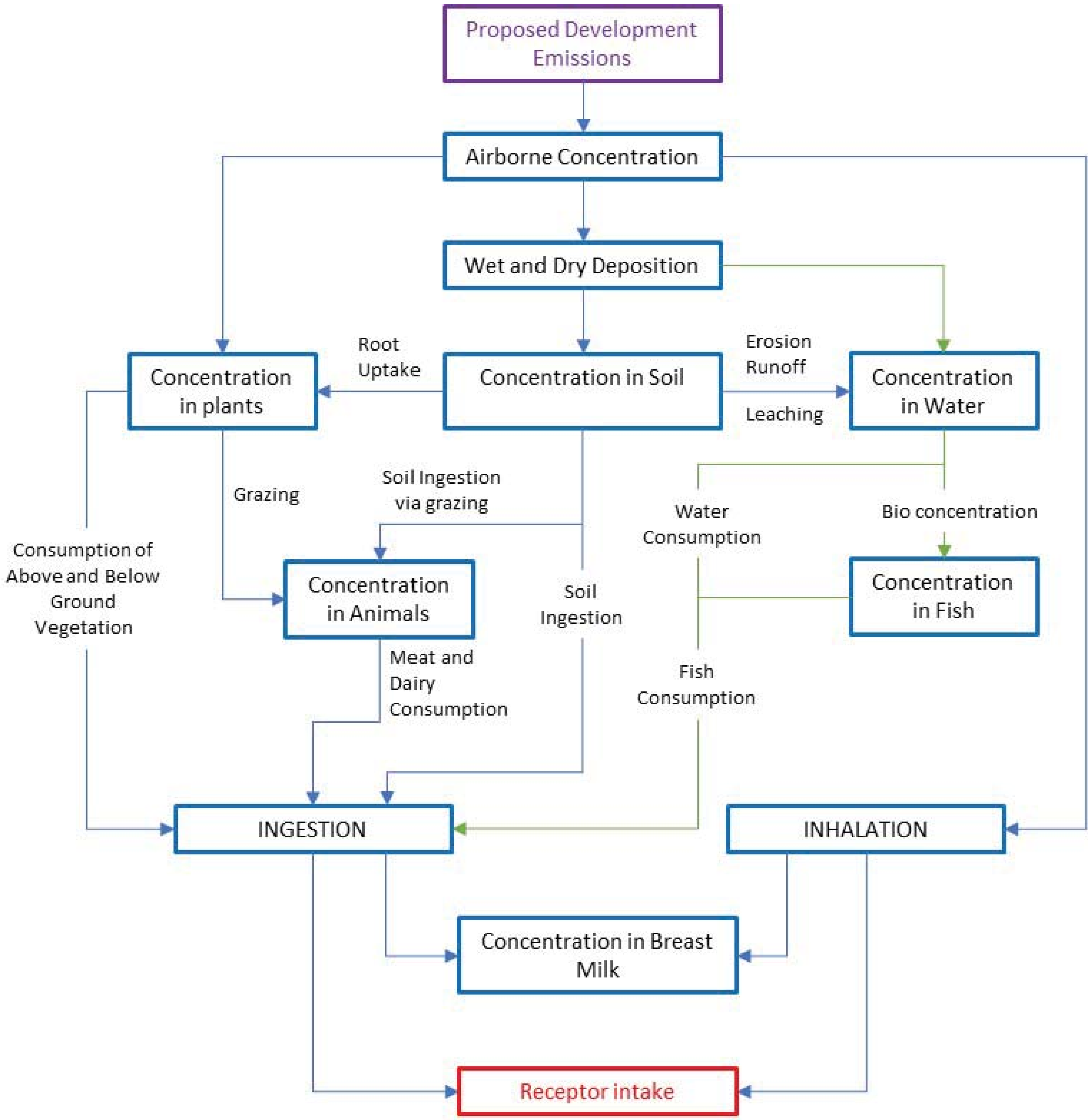

Figure 1: Exposure pathways for receptors

Pathways in green are only relevant where surface water consumption and local fisheries for food consumption are present in the study area.

4.1.2 Groundwater

Exposure via groundwater can only occur if the groundwater is contaminated and consumed untreated by an individual. The USEPA's 2005 protocol concludes that the build-up of dioxins in an aquifer over realistic travel times relevant to human exposure was predicted to be so small as to be essentially zero. As such the pathway from groundwater is deemed to be an insignificant risk and has been excluded from this assessment.

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4.1.3 Surface Water

A possible exposure pathway is via deposition of emissions directly onto surface water via local drinking water supplies or rainwater storage tanks.

Surface water generally goes through several treatment steps and as such any contaminants would be removed from the water before consumption. It is noted that run-off to rainwater tanks may not go through the same treatment. However, rain water tanks have a very small surface area and as such the potential for deposition and build-up of COPCs is limited. Therefore, the pathway from contaminated surface water is deemed to be an insignificant risk and has been excluded from this assessment.

4.1.4 Fish Consumption

The consumption of locally caught fish has been excluded from the assessment. Whilst it is noted that fish makes up a proportion of the UK diet, it is not likely that this would be sourced wide-scale from close proximity to the Proposed Development.

Whilst there are a number of waterbodies and rivers local to the Proposed Development, a review of local fishing sites[2] within 8 km showed that all were associated with coarse fishing as opposed to game fishing. Similarly, a review of local surface water abstraction licenses confirmed that these were not associated with the provision of fish for human consumption.

Based on the above, there is a negligible little risk associated with exposure via this pathway and it has therefore been excluded from this HHRA.

5 SENSITIVE RECEPTORS

This assessment considers the possible effects on human health at key receptors, where humans are likely to be exposed to the greatest impact from the Proposed Development, and at the point of maximum impact of annual mean emissions.

For the purposes of this assessment, receptor locations have been categorised as ‘residential’ or ‘agricultural’. Residential receptors represent a known place of residence that is occupied within the study area. Agricultural receptors represent a farm holding or area land of horticultural interest.

The emissions from the Proposed Development are expected to be significant only in the locality of the facility. The specific receptors identified in the Air Quality Assessment Report have been considered in this assessment. In addition, a receptor has been assessed at the point of maximum impact, as a worst-case scenario. The sensitive receptors are listed in Table 5 and shown in Figure 2.

[2] https://fishinginfo.co.uk/index.html#index

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Table 5: Modelled Human Receptors

Reference	Description	OS Grid Reference	Receptor Type
R1	Church Lane, Thrumpton	451059, 331118	Residential
R2	Wood Farm, Thrumpton	451487, 330914	Agricultural
R3	Hillside Cottage	451869, 330662	Residential
R4	Stonepit Farm	452143, 329669	Agricultural
R5	Winking Hill Farm	450969, 329726	Agricultural
R6	Gotham Primary School	453241, 330149	Residential *
R7	Main Street, Ratcliffe-on-Soar Village	449619, 329082	Residential
R8	Lock Lane, Sawley	449231, 330563	Residential
R9	Redhill Marina and Redhill Farm, Sawley	449353, 330111	Agricultural
R10	Kingston Hall, Gotham Road	450696, 327912	Residential
R11	Middlegate Farm	449420, 329814	Agricultural
R12	Little Lunnon, Barton-in-Fabis	452175, 332499	Residential
R13	Kegworth Road, Kingston -on-Soar	449943, 327760	Residential
R14	Cranfleet Farm	449485, 331365	Agricultural
R15	Trent Lock	448961, 331206	Residential
R16	Ludford Close, Long Eaton	449413, 331970	Residential
R17	Maximum Impact location	452000, 330300	Agricultural and Residential

*Included as indicative of the residential housing receptors local to the school.

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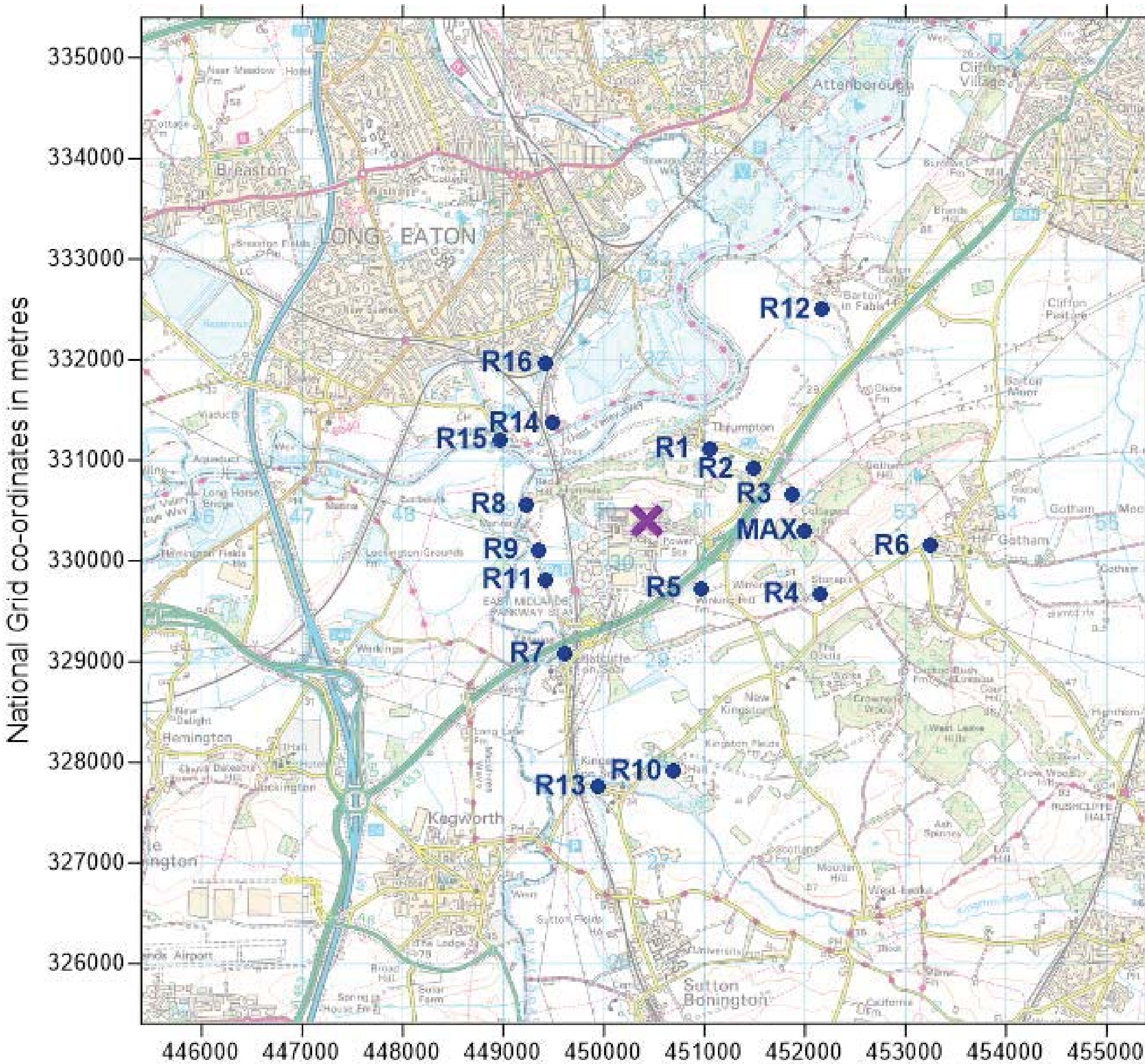

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Figure 2: Proposed Development and Human Receptor Locations

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6 IRAP MODEL ASSUMPTIONS AND INPUTS

This section details assumptions used within the IRAP model and in the processing of the IRAP outputs and provides justifications where appropriate, in particular in relation to user defined inputs.

6.1 Concentrations in Soil

The concentration of each chemical in the soil is calculated from the deposition results of the air quality modelling for vapour phase and particle phase deposition. The critical variables in calculating the accumulation of pollutants in the soil are as follows:

- the lifetime of the Proposed Development is taken as 30 years; and
- the soil mixing depth is taken as 2 cm in general and 20 cm for produce.

The split between the solid and vapour phase for the substances considered depends on the specific physical properties of each chemical. In order to assess the amount of substance which is lost from the soil each year through volatilisation, leaching and surface run-off, a soil loss constant is calculated. The rates for leaching and surface run-off are taken as constant, while the rate for volatilisation is calculated from the physical properties of each substance as contained in the IRAP COPC database.

6.2 Concentrations in Plants

The concentrations in plants are determined by considering direct deposition and air-to-plant transfer for above ground produce, and root uptake for above ground and below ground produce. The calculation takes account of the different types of plant. For example, uptake of substances through the roots will differ for below ground and above ground vegetables, and deposition onto plants will be more significant for above ground vegetables.

6.3 Concentrations in Animals

The concentrations in animals are calculated from the concentrations in plants, assumed consumption rates and bio-concentration factors. These vary for different animals and different substances, since the transfer of chemicals between the plants consumed and animal tissue varies. It is also assumed that 100 % of the plant materials eaten by animals is grown on soil contaminated by emission sources. This is likely to be a highly pessimistic assumption for UK farming practice.

6.4 Concentrations in Humans

6.4.1 Intake via Inhalation

Intake via inhalation is calculated from inhalation rates of typical adults and children and atmospheric concentrations. The inhalation rates used for adults and children are taken from the Environment Agency’s 2009 guidance and are:

- adult – 20 m^3/day; and
- child – 7.2 m^3/day.

The calculation also takes account of time spent outside, since most people spend most of their time indoors.

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The inhalation rate is multiplied by the air concentration (in µg/m^3) of each COPC at each receptor point used to calculate the daily inhalation dose. This is then divided by 70 kg for adult receptors or 20 kg for child receptors to calculate the daily exposure in µg/kgbw/day.

6.4.2 Intake via Soil Ingestion

This calculation allows for the ingestion of soil and takes account of different exposure frequencies. It allows for ingestion of soil attached to unwashed vegetables, unintended ingestion when farming or gardening and, for children, ingestion of soil when playing.

6.4.3 Ingestion of Food

The calculation of exposure due to ingestion of food draws on the calculations of concentrations in animals and plants and takes account of different ingestion rates for the various food groups by different age groups. For most people, locally produced food is only a fraction of their diet and so exposure factors are applied to allow for this.

6.4.4 Breast Milk Ingestion

For infants, the primary route of exposure is through breast milk. The calculation draws on the exposure calculation for adults and then allows for the transfer of chemicals in breast milk to an infant who is exclusively breast-fed. The only intake pathway considered for a breast feeding infant is through breast milk, with dioxins being the COPC of concern due to their high solubility in fat and consequent ability to accumulate in breast milk. The modelled scenario consists of the accumulation of pollutants in the food chain up to an adult receptor, the accumulation of pollutants in breast milk and finally the consumption of breast milk by an infant.

The default IRAP parameters were used and are as follows:

- Exposure duration of infant to breast milk – 1 year;
- Proportion of ingested dioxin that is stored in fat – 0.9;
- Proportion of mother's weight that is stored in fat – 0.3;
- Fraction of fat in breast milk – 0.04;
- Fraction of ingested contaminant that is absorbed – 0.9;
- Half-life of dioxins in adults – 2,555 days;
- Ingestion rate of breast milk – 0.688 kg/day.

6.5 Estimation of COPC Concentration in Media

The IRAP-h model uses a database of physical and chemical parameters to calculate the COPC concentrations through each of the different pathways identified. The base physical and chemical parameters have been used in this assessment.

In order to calculate the COPC concentrations, a number of site-specific data are required. Meteorological data were obtained for the period 2015 to 2019 from the Sutton Bonnington weather station, as used within the Air Quality Assessment Report (Appendix 8-1 of the ES). These data provide the annual average precipitation which can be used to calculate the other rainfall-related, site-specific IRAP-h input parameters, as presented in Table 6. The data were also used to calculate the average wind speed.

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Table 6: IRAP input parameters based on local meteorology

Input Variable	Assumption	Value
Annual average wind speed	From met data	3.36 m/s
Annual average precipitation	From met data	64.79 cm
Annual average evapotranspiration	70% of annual average precipitation	45.35 cm/y
Annual average irrigation	0% of annual average precipitation	0 cm/y
Annual average runoff	10% of annual average precipitation	6.48 cm/y

6.6 Dispersion Modelling Approach

IRAP requires dispersion modelling inputs providing air concentrations, wet deposition and dry deposition for species in the vapour phase, particle phase and bound particle phase together with a specific input for mercury vapour. The modelling is required for each of these four components based on a 1 g/s release rate, with the actual emission release rates subsequently being put directly into IRAP.

The emissions modelling was carried out using the ADMS dispersion model, based on the same stack parameters as detailed in the Air Quality Assessment (Appendix 8-1 of the ES) which are reproduced in Table 7 for ease of reference. Table 8 shows the assumptions that have been made with regard to the deposition of the different phases. These are consistent with assumptions used in other HHRAs for energy recovery plants which have been agreed with the Environment Agency. ADMS was run with dry deposition switched on but with plume depletion switched off to provide a worst-case calculation of dry deposition, using the dry deposition velocities in Table 8. The ADMS output was then post-processed to add the estimated wet deposition based on the wet to dry deposition ratios included in Table 8. The dry and wet deposition were then converted into annual totals and the files converted to a suitable format for input into the IRAP model.

Table 7: Stack parameters used for IRAP dispersion modelling

Parameter	Value
Stack location	450435, 330403
Stack height (m)	110
Internal effective diameter (m)	2.75
Temperature (°C)	140
Reference oxygen content (% volume)	11 %
Water content (% volume)	6.41 %
Oxygen content (% volume, dry)	17.4 %
Volume flow rate (Nm^3/s)	94.8
Volume flow rate (Am^3/s)	118.7
Flue gas exit velocity (m/s)	20

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Table 8: Deposition Assumptions

Deposition Phase	Dry Deposition Velocity (m/s)	Ratio of Wet deposition to Dry deposition
Vapour	0.005	2:1
Particle	0.010	2:1
Bound Particle	0.010	2:1
Mercury Vapour	0.029	No wet deposition

6.7 Modelled Emissions

As noted, the IRAP model requires the emission rate of each COPC to be input to the model. Table 9 details the assumed emission concentrations and associated emission rates for the non-dioxin species and Table 10 provides the emissions data for dioxins and dioxin-like PCBs. The origin of these numbers is provided in the text immediately after Table 10.

Table 9: COPC emissions use in the assessment

COPC	Emission concentration (mg/Nm^3)	Emission rate (g/s)
Benzene (surrogate for TVOC)	10	9.48E-01
Benzo[a]pyrene (BaP)	0.0001	9.48E-06
Mercury (Hg elemental)	0.00004	3.79E-06
Mercuric chloride ($HgCl_2$)	0.0096	9.10E-04
Cadmium (Cd)	0.01	9.48E-04
Arsenic (As)	0.025	2.37E-03
Chromium (Cr)	0.092	8.72E-03
Chromium (Cr), hexavalent	0.00013	1.23E-05
Nickel (Ni)	0.22	2.09E-02

Table 10. Dioxin and dioxin-like PCB emissions used in the assessment

COPC	ng I-TEQ/Nm^3	I_TEF equivalence factor	Annual mean concentration (ng/Nm^3)	Emission Rate g/s
TetraCDD,2,3,7,8	0.0019	1	0.0019	1.80E-10
PentaCDD,1,2,3,7,8	0.0074	0.5	0.0148	1.40E-09
HexaCDD,1,2,3,4,7,8	0.0017	0.1	0.017	1.61E-09
HexaCDD,1,2,3,7,8,9	0.0013	0.1	0.013	1.23E-09
HexaCDD,1,2,3,6,7,8	0.0016	0.1	0.016	1.52E-09
HeptaCDD,1,2,3,4,6,7,8	0.0010	0.01	0.10	9.48E-09
OctaCDD,1,2,3,4,6,7,8,9	0.00024	0.001	0.24	2.28E-08
TetraCDF,2,3,7,8	0.0017	0.1	0.017	1.61E-09
PentaCDF,2,3,4,7,8	0.016	0.5	0.032	3.03E-09
PentaCDF,1,2,3,7,8	0.00084	0.05	0.0168	1.59E-09
HexaCDF,1,2,3,4,7,8	0.013	0.1	0.13	1.23E-08
HexaCDF,1,2,3,7,8,9	0.00024	0.1	0.0024	2.28E-10
HexaCDF,1,2,3,6,7,8	0.0049	0.1	0.049	4.65E-09
HexaCDF,2,3,4,6,7,8	0.0052	0.1	0.052	4.93E-09

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COPC	ng I-TEQ/Nm³	I_TEF equivalence factor	Annual mean concentration (ng/Nm³)	Emission Rate g/s
HeptaCDF,1,2,3,4,6,7,8	0.0026	0.01	0.26	2.46E-08
HeptaCDF,1,2,3,4,7,8,9	0.00024	0.01	0.024	2.28E-09
OctaCDF,1,2,3,4,6,7,8,9	0.00024	0.001	0.24	2.28E-08
Total	**0.06**			
Dioxin-like PCBs	-	-	-	2.99E-10

The emission rates are based on the following assumptions:

1. Benzene

   a. It has been assumed that the entire total volatile organic carbon (TVOC) emissions consist only of benzene; and
   b. TVOC emission concentrations are based on emission at the higher end of the daily BAT-AEL.

2. Benzo[a]pyrene

   a. No emission limits for BaP are set in the IED or WI BREF; and
   b. Figure 8.121 in the WI BREF sets out emission levels recorded for periodically monitored BaP emissions to air from plant incinerating predominantly municipal solid waste (MSW), demonstrating that emissions from most reference plant, including all recently commissioned plant, are well below 0.1 µg/m³. This concentration has therefore been used as an upper estimate of BaP emissions.

3. Mercury

   a. Mercury emission concentrations are based on emissions at the higher end of the daily BAT-AEL; and
   b. For the partitioning of mercury, the IRAP defaults have been used. It has been assumed that of the total mercury emitted, 51.8% is lost to the global cycle, 48.0% is deposited as divalent mercury (considered to be $HgCl_2$) and 0.2% is emitted as elementary mercury. This approach has been used for many HHRAs in the UK.

4. Cadmium

   a. The WI BREF sets a combined higher end BAT AEL of 0.02 mg/Nm³ for cadmium and thallium; and
   b. The assessment assumes cadmium emission at 50% of the BAT AEL based on the assumption that each metal contributes half of the BAT AEL.

5. Group III Metals – Arsenic, Chromium and Nickel

   a. The emissions of these three metals are based on the maximum emission levels recorded during monitoring at 18 municipal waste incinerators (MWI) and wood-waste incinerators between 2007 and 2015 operating in the UK under the provisions of the IED. These are detailed in Table A1 of the Environment Agency guidance on assessing group 3 metals stack emissions from incinerators (Environment Agency, 2016). Table 11 presents the concentrations demonstrating that that the maximum value represents a worst-case assumption. Table 11 also presents the

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concentrations expressed as a percentage of the higher end of the Group 3 BAT AEL.

Table 11: Monitored Group 3 metals data from MWI and Waste Wood Co-incinerators (Environment Agency, 2016)

	Measured Concentrations (mg/Nm^3)			Expressed as a percentage of WI BREF BAT AEL higher end of 0.3 mg/Nm^3		
Arsenic	0.025	0.0010	0.0002	8.33%	0.33%	0.067%
Total Chromium	0.092	0.0084	0.0002	30.67%	2.80%	0.067%
Chromium VI	1.3E-04	3.50E-05	2.30E-06	0.043%	0.012%	0.00077%
Nickel	0.220	0.015	0.0025	73.33%	5.00%	0.83%
The two highest nickel concentrations are outliers at 73% and 45% of the higher end of the BAT AEL. The third highest concentration was 0.053 mg/Nm^3 or 18% of the BAT AEL						

6. Dioxins and Furans

a. These are a group of similar halogenated organic compounds, which are generally found as a complex mixture. The toxicity of each compound is different and is generally expressed as a Toxic Equivalent Factor (TEF), which relates the toxicity of each individual compound to the toxicity of 2,3,7,8-TCDD, the most toxic dioxin. Dioxins and furans are assumed to be emitted at the higher of the BAT AEL of 0.06 ng I-TEQ/Nm^3 where I-TEQ denotes ‘international toxic equivalence’. A full list of the international toxic equivalency factors (I-TEFs) for dioxins is included in Table 10; and

b. The split of the different dioxins and furans is based on a standard profile for municipal waste incinerators derived by Her Majesty’s Inspectorate of Pollution (HMIP), one of the predecessors of the Environment Agency (HMIP,1996), scaled to deliver the BAT AEL.

7. Dioxin-like PCBs

a. The WI BREF does not set a separate BAT AEL for dioxin like PCBs;

b. The Defra report on emissions from waste management facilities (Defra, 2011) reports minimum, median and maximum PCB emissions from five energy from waste plants as 1.5×10^{-9}, 1.0×10^{-8} and 1.8×10^{-8} g/tonne of waste respectively;

c. Emissions in this study have therefore been based on the maximum emission level in the Defra report combined with the higher case (low calorific value) annual tonnage of 524,550 tonnes per year for the Proposed Development and then converted to a g/s emission rate;

d. The IRAP software, and the HHRAP database which underpins it, does not include any data on individual PCBs, but it does include data for take-up and accumulation rates within the food chain for two groups of PCBs, known as Aroclor 1254 and Aroclor 1016. Each Aroclor is based on a fixed composition of PCBs. In the absence of any data on the specification of PCBs within incinerator emissions, it has been assumed that the PCBs are released in each of the two Aroclor compositions and the highest impact of the two used in the assessment.

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7 RESULTS

7.1 Processing of IRAP Results

The impacts resulting from inhalation exposure are calculated using the annual air concentrations at the receptor points as output from the IRAP model using the approach set out in Section 7.4.1.

The impacts resulting from ingestion exposure utilise the intake pathway results output by the IRAP model, which are expressed in mg/kgbw/day. These outputs are then converted to units of µg/kgbw/day for comparison with the relevant TDIs and IDs.

The TDI for dioxins and dioxin like PCBs is expressed as WHO-TEQ based on the World Health Organisation (WHO) toxic equivalence approach. The results for ingestion and inhalation for each individual dioxin must therefore be multiplied by the WHO toxic equivalency factors (WHO-TEF) and summed before comparison to the TDI. The WHO-TEF values for dioxins are set out in Table 12.

In order to include the impact of dioxin-like PCBs it has been assumed, as a worst-case assumption, that the emissions have a WHO-TEF of 1. This reflects uncertainty as to whether the emissions reported in Defra, 2011 were expressed with a TEF factor applied. If the latter applies, then the results would already be expressed as a toxic equivalent and a factor of 1 is appropriate. If it does not, then the use of a TEF of 1 is highly precautionary as WHO-TEF factors for PCBs are at least an order of magnitude lower than 1.[3]

Table 12: WHO-TEF values applied to dioxins

COPC	WHO-TEF
TetraCDD,2,3,7,8	1
PentaCDD,1,2,3,7,8	1
HexaCDD,1,2,3,4,7,8	0.1
HexaCDD,1,2,3,7,8,9	0.1
HexaCDD,1,2,3,6,7,8	0.1
HeptaCDD,1,2,3,4,6,7,8	0.01
OctaCDD,1,2,3,4,6,7,8,9	0.0003
TetraCDF,2,3,7,8	0.1
PentaCDF,2,3,4,7,8	0.3
PentaCDF,1,2,3,7,8	0.03
HexaCDF,1,2,3,4,7,8	0.1
HexaCDF,1,2,3,7,8,9	0.1
HexaCDF,1,2,3,6,7,8	0.1
HexaCDF,2,3,4,6,7,8	0.1
HeptaCDF,1,2,3,4,6,7,8	0.01
HeptaCDF,1,2,3,4,7,8,9	0.01
OctaCDF,1,2,3,4,6,7,8,9	0.0003

[3] https://www.who.int/ipcs/assessment/tef_values.pdf

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7.2 Assessment against TDI – Point of Maximum Impact

Table 13 presents the impacts of emissions from the Proposed Development at the point of maximum impact for an adult and a child agricultural receptor relative to the TDI for the relevant COPCs. Table 14 presents the impacts at the same location for an adult and a child residential receptor. Each table presents the MDI (background intake), process contribution (the impact due to emissions from the Proposed Development) and the overall impact (MDI plus process contribution), all expressed as a percentage of the relevant TDI for impacts through ingestion and through inhalation.

The impact on agricultural receptors at the maximum impact location will represent the very worst-case scenario, as it is assumed that this receptor type is exposed through direct inhalation, and ingestion from soil and home-grown eggs and meat, beef, pork, and milk.

There is no MDI available for evaluating the total impacts related to inhalation of mercuric chloride. It should, however, be noted that the withdrawn mercury TOX report[1] states that most of the daily mean intake of mercury in ambient air will be in the elemental form. Given that both elemental mercury and mercuric chloride have been assigned the same inhalation TDI (see Table 1) and that the elemental mercury inhalation MDI comprises only a small percentage of the TDI, it is reasonable to assume that the MDI for mercuric chloride will be negligible.

Table 13: TDI impact analysis for agricultural receptors at the maximum impact point

COPC	MDI as % of TDI		Process contribution as % of TDI		Total as % of TDI	
	Ingestion	Inhalation	Ingestion	Inhalation	Ingestion	Inhalation
Adult – Agricultural						
Cadmium	52.78%	21.43%	0.01%	0.43%	52.79%	21.86%
Chromium	63.33%	-	0.12%	-	63.46%	-
Chromium VI	6.33%	-	0.00018%	-	6.33%	-
Mercuric chloride	2.46%	-	0.02%	0.010%	2.47%	0.010%
Methyl mercury	3.68%	-	0.0047%	-	3.69%	-
Mercury (elemental)	-	1.17 %	-	0.00004%	-	1.17%
Nickel	67.9 %	12.4 %	0.230%	2.22%	68.1%	14.6%
Dioxins and Dioxin-like PCBs	35.0%		0.81%		35.8%	
Child – Agricultural						
Cadmium	138.89%	50.0%	0.03%	0.54%	138.92%	50.5%
Chromium	160.0%	-	0.20%	-	160.2%	-
Chromium VI	16.0%	-	0.00029%	-	16.0%	-
Mercuric chloride	6.49%	-	0.03%	0.012%	6.52%	0.012%
Methyl mercury	10.00%	-	0.0095%	-	10.01%	-
Mercury (elemental)	-	3.3%	-	0.000051%	-	3.3%
Nickel	177.1%	32.1%	0.35%	2.80%	177.5%	34.9%
Dioxins and Dioxin-like PCBs	90.0%		1.14%		91.1%	

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Table 14: TDI impact analysis for residential receptors at the maximum impact point

COPC	MDI as % of TDI		Process contribution as % of TDI		Total as % of TDI	
	Ingestion	Inhalation	Ingestion	Inhalation	Ingestion	Inhalation
Adult – Residential						
Cadmium	52.78%	21.43%	0.01%	0.43%	52.79%	21.86%
Chromium	63.33%	-	0.01%	-	63.34%	-
Chromium VI	6.33%	-	0.00001%	-	6.33%	-
Mercuric chloride	2.46%	-	0.002%	0.010%	2.46%	0.01%
Methyl mercury	3.68%	-	0.0018%	-	3.69%	-
Mercury (elemental)	-	1.17%	-	0.00004%	-	1.17%
Nickel	67.9%	12.4%	0.02%	2.2%	67.9%	14.6%
Dioxins and Dioxin-like PCBs	35.0%		0.02%		35.0%	
Child – Residential						
Cadmium	138.89%	50.0%	0.02%	0.54%	138.91%	50.5%
Chromium	160.0%	-	0.03%	-	160.0%	-
Chromium VI	16.0%	-	0.00004%	-	16.0%	-
Mercuric chloride	6.49%		0.01%	0.012%	6.50%	0.012%
Methyl mercury	10.00%	-	0.0049%	-	10.00%	-
Mercury (elemental)	-	3.3%	-	0.000051%	-	3.3%
Nickel	177.1%	32.1%	0.051%	2.80%	177.2%	34.9%
Dioxins and Dioxin-like PCBs	90.0%		0.05%		90.1%	

The TDI is an estimate of the amount of a contaminant, expressed on a bodyweight basis, which can be ingested daily over a lifetime without appreciable health risk. As shown in Table 13 and Table 14, for the worst-case receptor the overall impact (including the contribution from existing dietary intakes) is less than the TDI for chromium VI, mercury (including compounds) and dioxins. Therefore, there would not be an appreciable health risk based on the emission of these pollutants.

For adult farmer and adult residential receptors, the overall impact is less than the TDI for all COPCs considered. Hence, it can be concluded that there would not be an appreciable health risk to adult receptors based on the emission of these pollutants.

For a child receptor, the cadmium, chromium and nickel MDIs (i.e. the intake sourced from existing dietary intake) exceeds the TDI. However, the process contribution is exceptionally small and the exceedance is a reflection of the fact the MDI is over 100% of the TDI in each case. On this basis, it is not considered that the Proposed Development would increase the health risks from cadmium, chromium or nickel for children significantly. Further discussion of the impact from each of these pollutants is provided below.

7.2.1 Cadmium

As noted in Section 3.2, the key determinant of cadmium's toxicity potential is its chronic accumulation in the kidney. The Environment Agency explains that chronic exposure to levels in

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excess of the TDI might be associated with an increase in kidney disease in a proportion of those exposed, but (small) exceedances lasting for shorter periods are of less consequence. When lifetime exposure is assessed (i.e. a period being a child and an adult) the overall impact is well below the TDI. Therefore, there would not be an appreciable health risk based on the emission of cadmium over a lifetime of an individual.

7.2.2 Chromium

As shown in Table 11, the concentrations of total chromium in emissions from municipal waste incineration processes are typically 2.80% of the higher end BAT-AEL, with only a fraction of this being in the hexavalent form. Even using the worst-case assumption that emissions of chromium are the maximum monitored concentration level from an existing waste incineration facility (30.67% of the BAT-AEL), the process contribution is only 0.2% of the TDI for the agricultural child scenario at the point of maximum impact. Consequently, although the TDI is predicted to be exceeded, this is due to existing dietary intake.

Almost all toxicological opinion is that chromium III compounds are of low oral toxicity. The WHO has reviewed the daily intake of chromium from foods and found that existing levels do not represent a toxicity problem, stating that “in the form of trivalent compounds, chromium is an essential nutrient and is relatively non-toxic for man and other mammalian species”.

The TDI is based on the USEPA’s Reference Dose for chromium VI, which is significantly more toxic than chromium III. Considering that the existing levels of chromium a) already exceed the TDI, b) are not considered to represent a problem in practice, and c) that that the process contribution is small, it can be concluded there would not be an appreciable health risk associated with the additional emission of chromium over the lifetime of an individual.

7.2.3 Nickel

For nickel, the MDI for ingestion exceeds the TDI for the child receptor. However, this is a reflection of the fact the MDI is over 100% of the TDI. The process contribution is exceedingly small at 0.35% of the TDI. The assessment uses the conservative assumption that the process contribution is based on emissions of nickel at 73.3% of the group draft BAT-AEL. As outlined in Table 11, this is the maximum of the monitoring data and is an outlier. The third highest concentration was 18% and the mean 5% of the group draft BAT-AEL. Assuming the Proposed Development operates as per the 3rd highest concentration – i.e. 18% of the group draft BAT-AEL – the process contribution would be 0.10% of the ingestion TDI at the point of maximum impact for the agricultural child receptor. On this basis, it is not considered that the Proposed Development would significantly increase the health risks from nickel for children.

7.2.4 Breast Milk Exposure

The total accumulation of dioxins in an infant, considering the breast milk pathway and based on an adult agricultural receptor at the point of maximum impact feeding an infant, is 0.237 pg WHO-TEQ / kg-bw / day, which is 11.8% of the TDI. For a residential type receptor, the impact is only 0.22% of the TDI. There are no other ingestion pathways for an infant receptor. As the process contribution is less than the TDI, it is considered that the Proposed Development will not increase the health risks from the accumulation of dioxins in infants significantly.

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7.3 Assessment against ID – Point of Maximum Impact

Table 15 presents the impacts of emissions from the Proposed Development at the point of maximum impact for an adult and a child agricultural receptor relative to the ID for the relevant COPCs. Table 16 presents the impacts at the same location for an adult and a child residential receptor. Each table presents the process contribution (the impact due to emissions from the Proposed Development) expressed as a percentage of the relevant ID for impacts through ingestion and through inhalation.

The ID is the level of exposure which is associated with a negligible risk to human health. As shown, for this worst-case receptor the process contribution is well below the ID for both agricultural and residential receptors. Therefore, emissions from the Proposed Development are considered to have a negligible impact on human health.

Table 15: ID impact analysis for agricultural receptors at the maximum impact point

COPC	Process contribution as % of ingestion ID	Process contribution as % of inhalation ID
	Adult – Agricultural	
Arsenic	0.061%	0.76%
Benzene	0.067%	0.43%
Benzo[a]pyrene	0.181%	0.09%
Chromium VI	-	5.56%
	Child – Agricultural	
Arsenic	0.11%	0.95%
Benzene	0.16%	0.54%
Benzo[a]pyrene	0.26%	0.11%
Chromium VI	-	7.00%

Table 16: ID impact analysis for residential receptors at the maximum impact point

COPC	Process contribution as % of ingestion ID	Process contribution as % of inhalation ID
	Adult – Residential	
Arsenic	0.023%	0.76%
Benzene	0.071%	0.43%
Benzo[a]pyrene	0.002%	0.09%
Chromium VI	-	5.56%
	Child – Residential	
Arsenic	0.054%	0.95%
Benzene	0.126%	0.54%
Benzo[a]pyrene	0.005%	0.11%
Chromium VI	-	7.00%

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7.4 Maximum Impact at a Receptor

This section considers the impacts at the most impacted receptor. The impact depends on both the location and whether the receptor is agricultural or residential. The maximum ingestion impacts are seen at the agricultural receptor Wood Farm (R2) whereas the maximum ingestion impacts are seen at the residential receptor Hillside Cottage (R3). The ingestion and inhalation impacts are presented for both locations in Table 17 and Table 18.

Table 17: TDI impact analysis for agricultural receptors at the most impacted receptor with respect to ingestion (R2)

COPC	MDI as % of TDI		Process contribution as % of TDI		Total as % of TDI	
	Ingestion	Inhalation	Ingestion	Inhalation	Ingestion	Inhalation
Adult - Agricultural						
Cadmium	52.78%	21.43%	0.01%	0.33%	52.79%	21.76%
Chromium	63.33%	-	0.10%	-	63.43%	-
Chromium VI	6.33%	-	0.00014%	-	6.33%	-
Mercuric chloride	2.46%	-	0.01%	0.007%	2.47%	0.01%
Methyl mercury	3.68%	-	0.0036%	-	3.69%	-
Mercury (elemental)	-	1.17%	-	0.00003%	-	1.17%
Nickel	67.9%	12.4%	0.18%	1.7%	68.0%	14.1%
Dioxins and Dioxin-like PCBs	35.0%		0.62%		35.6%	
Child - Agricultural						
Cadmium	138.89%	50.0%	0.02%	0.42%	138.91%	50.4%
Chromium	160.0%	-	0.15%	-	160.2%	-
Chromium VI	16.0%	-	0.00022%	-	16.0%	-
Mercuric chloride	6.49%	-	0.02%	0.009%	6.51%	0.009%
Methyl mercury	10.00%	-	0.0073%	-	10.01%	-
Mercury (elemental)	-	3.3%	-	0.000039%	-	3.3%
Nickel	177.1%	32.1%	0.270%	2.15%	177.4%	34.2%
Dioxins and Dioxin-like PCBs	90.0%		0.88%		90.9%	

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Table 18: TDI impact analysis for residential receptors at the most impacted receptor with respect to ingestion (R3)

COPC	MDI as % of TDI		Process contribution as % of TDI		Total as % of TDI	
	Ingestion	Inhalation	Ingestion	Inhalation	Ingestion	Inhalation
Adult – Residential						
Cadmium	52.78%	21.43%	0.01%	0.37%	52.78%	21.80%
Chromium	63.33%	-	0.01%	-	63.34%	-
Chromium VI	6.33%	-	0.00001%	-	6.33%	-
Mercuric chloride	2.46%	-	0.002%	0.008%	2.46%	0.01%
Methyl mercury	3.68%	-	0.0016%	-	3.69%	-
Mercury (elemental)	-	1.17%	-	0.00003%	-	1.17%
Nickel	67.9%	12.4%	0.02%	1.9%	67.9%	14.3%
Dioxins and Dioxin-like PCBs	35.0%		0.02%		35.0%	
Child – Residential						
Cadmium	138.89%	50.0%	0.02%	0.47%	138.90%	50.5%
Chromium	160.0%	-	0.02%	-	160.0%	-
Chromium VI	16.0%	-	0.00003%	-	16.0%	-
Mercuric chloride	6.49%	-	0.01%	0.011%	6.50%	0.011%
Methyl mercury	10.00%	-	0.0042%	-	10.00%	-
Mercury (elemental)	-	3.3%	-	0.000044%	-	3.3%
Nickel	177.1%	32.1%	0.044%	2.42%	177.2%	34.5%
Dioxins and Dioxin-like PCBs	90.0%		0.05%		90.0%	

As shown, for the most impacted receptors the overall impact (including the contribution from existing dietary intakes) is less than the TDI for chromium VI, mercury (including compounds) and dioxins. Therefore, there would not be an appreciable health risk based on the emission of these pollutants.

For a child receptor the cadmium, chromium and nickel MDI (that sourced from existing dietary intake) exceeds the TDI for ingestion. However, the process contribution is exceptionally small and the exceedance is a reflection of the fact the MDI is over 100% of the TDI. On this basis, it is not considered that the Proposed Development would increase the health risks from cadmium, chromium or nickel for children significantly at the highest impacted receptors.

The total accumulation of dioxins in an infant, considering the breast milk pathway and based on the adult agricultural receptor at R2 feeding an infant, is 0.182 pg WHO-TEQ / kgbw /day which is 9.1% of the TDI. The equivalent impact based on a residential receptor at R3 is 0.004 pg WHO-TEQ / kgbw /day which is 0.19% of the TDI. As the process contribution is well below the TDI, it is considered that the Proposed Development will not increase the health risks from the accumulation of dioxins in infants significantly.

As shown in Table 19 and Table 20, the process contributions for the maximum impacted receptors are well below the ID for all relevant COPCs. Therefore, emissions from the Proposed Development are considered to have a negligible impact on human health.

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Table 19: ID impact analysis for agricultural receptors at the most impacted receptor with respect to ingestion (R2)

COPC	Process contribution as % of ingestion ID	Process contribution as % of inhalation ID
Adult – Agricultural		
Arsenic	0.047%	0.58%
Benzene	0.051%	0.33%
Benzo[a]pyrene	0.139%	0.07%
Chromium VI	-	4.27%
Child – Agricultural		
Arsenic	0.08%	0.73%
Benzene	0.12%	0.42%
Benzo[a]pyrene	0.20%	0.08%
Chromium VI	-	5.38%

Table 20: ID impact analysis for residential receptors at the most impacted receptor with respect to inhalation (R3)

COPC	Process contribution as % of ingestion ID	Process contribution as % of inhalation ID
Adult – Residential		
Arsenic	0.020%	0.65%
Benzene	0.061%	0.37%
Benzo[a]pyrene	0.002%	0.07%
Chromium VI	-	4.82%
Child – Residential		
Arsenic	0.047%	0.82%
Benzene	0.109%	0.47%
Benzo[a]pyrene	0.004%	0.09%
Chromium VI	-	6.07%

7.5 Uncertainty and Sensitivity Analysis

To account for uncertainty in the modelling, the impact on human health was assessed for a receptor at the point of maximum impact.

To account for uncertainty in the dietary intake of a person, both residential and agricultural receptors have been assessed at the maximum impact point. The agricultural receptor is assumed to consume a greater proportion of home grown produce, which has the potential to be contaminated by the COPCs released, than for a residential receptor. In addition, the agricultural receptor includes the pathway from consuming animals grazed on land contaminated by the emission source. This conservatively assumes that 100% of the plant materials eaten by the animals is grown on soil contaminated by emission sources.

The agricultural receptor at the point of maximum impact is considered the upper maximum of the impact of the Proposed Development.

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7.6 Non-standard Operating Conditions

The assessment has considered the impacts of emissions under normal operating conditions. This section gives further consideration to other than normal operating conditions, namely start-up and shutdown and operation in the event of emission limits being exceeded (such as the failure of abatement systems).

Article 46(6) of the IED states that:

"… the waste incineration plant … shall under no circumstances continue to incinerate waste for a period of more than 4 hours uninterrupted where emission limit values are exceeded.

The cumulative duration or operation in such conditions over 1 year shall not exceed 60 hours."

Article 47 states that:

"In the case of a breakdown, the operator shall reduce or close down operations as soon as practicable until normal operations can be restored."

In addition Annex VI, Part 3, 2 of the IED states the emission limit values applicable in the circumstances described in Article 46(6) and Article 47:

"The total dust concentration in the emissions into the air of a waste incineration plant shall under no circumstances exceed 150 mg/Nm^3 expressed as a half-hourly average. The air emission limit values for TOC and CO set out in points 1.2 and 1.5(b) shall not be exceeded."

The above conditions in the IED ensure that the maximum period of operation during which the applicable IED ELVs could be exceeded is restricted to 60 hours per year. Such conditions will be sporadic and short-term in nature and, hence, are unlikely to significantly affect the long-term impacts of the Proposed Development.

Start-up of the Proposed Development from cold will be conducted using low sulphur light fuel oil. During start-up, waste will not be introduced onto the grate unless the temperature within the oxidation zone is above 850°C as required by Article 50, paragraph 4[a] of the IED. During start-up, the flue gas treatment plant will be operational as will be the combustion control systems and emissions monitoring equipment.

The same is true during plant shutdown where waste will cease to be introduced to the grate. The waste remaining on the grate will be combusted, the temperature not being permitted to drop below 850°C through the combustion of the support auxiliary fuel. During this period the flue gas treatment equipment is fully operational, as will be the control systems and monitoring equipment. After complete combustion of the waste, the auxiliary burners will be turned off and the plant will be allowed to cool. Start-up and shutdown are infrequent events. The Proposed Development is designed to operate continuously, and ideally only shutdown for each line for its annual maintenance programme.

In relation to the magnitude of dioxin emissions during plant start-up and shutdown, research has been undertaken by AEA Technology on behalf of the Environment Agency (AEA Technology, 2012). Whilst elevated emissions of dioxins (within one order of magnitude) were found during shutdown and start-up phases where the fuel was not fully established in the combustion chamber, the report concluded that:

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"The mass of dioxin emitted during start-up and shutdown for a 4-5 day planned outage was similar to the emission which would have occurred during normal operation in the same period. The emission during the shutdown and restart is equivalent to less than 1% of the estimated annual emission (if operating normally all year)."

Therefore, there is no justification for additional impact modelling considerations associated with start-up and shutdown operations or upset operating conditions.

8 CONCLUSIONS

This assessment has considered the potential impact on health of COPCs released to air from the Proposed Development at the maximum impact point and at the most impacted local receptors.

For agricultural adult and residential adult receptors, the combined process contribution and existing exposure level (MDI) were well below the applicable TDI for all species for both ingestion and inhalation exposure. Similarly, the process contribution was well below the applicable ID for all species for both ingestion and inhalation exposure for adult receptors.

For agricultural child and residential child receptors, the combined process contribution and existing exposure level were well below the applicable TDI for all species in relation to inhalation exposure. The process contribution was also well below the applicable ID for all species for both ingestion and inhalation exposure for child receptors.

The total accumulation of dioxins in an infant, considering the breast milk pathway, was also well below the applicable ingestion TDI for both agricultural and residential receptors, noting that there are no other intake pathways for infants.

The TDIs applied are set at a level that can be ingested daily over a lifetime without appreciable health risk, and the ID is a threshold below which there are considered to be negligible risks to human health. As these assessment criteria are not exceeded, it can confidently be concluded that operation of the Proposed Development will not result in any significant health risk in relation to the above exposure routes.

The TDI for ingestion was exceeded for cadmium, chromium and nickel for both agricultural and residential child receptors. However this was due to the level of existing exposure which comprised 138.9%, 160.0% and 177.1% of the TDI for a child for cadmium, chromium and nickel respectively.

The process contributions from the Proposed Development are exceptionally small, being only 0.03%, 0.2% and 0.35% of the TDI for cadmium, chromium and nickel respectively at the worst-case impact point based on an agricultural child receptor. The process contributions are 0.02%, 0.03% and 0.05% of the TDI for cadmium, chromium and nickel respectively at the worst-case impact point based on a residential child receptor.

This process contribution for nickel is based on the worst-case assumption that emissions of nickel are 73.3% of the BAT-AEL cited in the Environment Agency's guidance for assessing the impacts of Group 3 metals. The analysis by the Environment Agency states that this is an outlier, with emissions of 18% of the BAT-AEL providing a more appropriate upper figure for emission levels. Using the alternative value would reduce the process contribution impacts by a factor of four. Given the extremely low process contribution, it is considered that the Proposed Development will not increase the health risks from nickel for children significantly.

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The cadmium TDI is based on long-term accumulation effects on the kidney. If the exposure over a lifetime (i.e. a period as a child and adult) is considered, the overall impact is well below the TDI, so there would not be an appreciable health risk based on the emission of cadmium.

Total chromium is assessed against the TDI for chromium VI. Assessing the total dietary intake of chromium against this TDI is highly conservative as oral intake of chromium III is not considered to pose a significant health risk. Therefore, it is concluded that as the process contribution is so small and the TDI is set at a highly conservative level, there would not be an appreciable health risk based on the emission of chromium.

Given that the impacts associated with emissions from the Proposed Development are below the TDI in combination with the MDI, or below the ID or extremely small relative to the TDI, it can confidently be concluded that emissions to air associated with operation of the Proposed Development will not result in appreciable health risks.

NCC received 16.07.2020

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NCC received 16.07.2020

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NCC received 16.07.2020

APPENDIX 8-3: PLUME VISIBILITY ASSESSMENT

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UTG/20/PMP/379/R
Job No: 2122.C91164.001
June 2020

PLUME VISIBILITY ASSESSMENT FOR THE PROPOSED EMERGE CENTRE AT RATCLIFFE-ON-SOAR

prepared for
DR A READ, RATCLIFFE-ON-SOAR REDEVELOPMENT MANAGER
by
V Kulambi

SUMMARY

This plume visibility report quantifies the potential impact of the operation of the proposed East Midlands Energy Re-Generation (EMERGE) Centre to be located on the Ratcliffe-on-Soar power station site.

The furthest distance from the stack that a visible plume is predicted to occur is 607 m which means that the visible plume would not extend above the nearest residential receptors (closest human receptor is 850 m). Using the Environment Agency's significance criteria, the visual impact from the plume from the Proposed Development can be classed as medium as the plume length exceeds the distance to the site boundary for more than 5% of the year. However, this does not extend above any residential properties.

The average visible plume is predicted to occur for 25% of daylight hours and is predicted to extend beyond the site boundary for an average of 7% of daylight hours. The maximum distance a visible plume extends from the stack is 607 m. However, the majority of visible plumes dissipate within 100 m of the stack.

Prepared by	**Approved for publication**

Master copy signed by (pp) J Lines & S J Griffiths (15/06/2020)

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CLIENT DISTRIBUTION LIST

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CONTENTS

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1 INTRODUCTION

This plume visibility report quantifies the potential impact of the operation of the proposed East Midlands Energy Re-Generation (EMERGE) Centre to be located on the Ratcliffe-on-Soar power station site.

There is the potential for the plume to be visible under certain circumstances due to the water vapour in the exhaust gases condensing as they cool. However, the water vapour in the gases mixes with the ambient air as the plume disperses, so that the plume ceases to be visible once the water vapour content is low enough. If the exhaust gases are hot and dry, or if the weather conditions promote rapid dispersion and slow cooling, it is more likely that the water vapour will disperse before it condenses, so that the plume is not visible at all.

2 ASSESSMENT CRITERIA

A previous version of Environment Agency H1 guidance note for assessing the impact of releases to air (Environment Agency, 2003) provided a methodology to quantify the potential impact from visible plumes. This methodology has not been incorporated into the latest version of the Environment Agency's guidance (Environment Agency, 2016). However, in lieu of any other appropriate methodology, this has been used for the purpose of this assessment. The criteria against which the results of the dispersion modelling can be assessed are detailed in Table 1.

Table 1: Summary of Qualitative Plume Visibility Impacts

Impact	Qualitative description
Zero	No visible impacts resulting from the operation.
Insignificant	Plume length extends boundary < 5% of the daylight hours per year. No local sensitive receptors.
Low	Plume length extends boundary < 5% of the daylight hours per year. Sensitive local receptors.
Medium	Plume length extends boundary > 5% of the daylight hours per year. Sensitive local receptors.
High	Plume length extends boundary > 25% of the daylight hours per year with obscuration. Sensitive local receptors.

3 ASSESSMENT METHODOLOGY

The number and extent of the visible plume has been predicted using the plume visibility module in ADMS 5.2. The model setup is identical to that used for the air quality assessment (Environmental Statement, Appendix 8-1), except for the selection of plume visibility and the input of initial water content in the plume. The initial water vapour mixing ratio of the plume is 0.126 kg/kg (mass of water vapour per unit mass of dry release at the stacks). ADMS 5.2 defines the plume to be visible at a particular downwind distance if the ambient humidity at the plume centreline is below 98% above which it is considered the plume would be indistinguishable from clouds.

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The distance from the stack to the site boundary has been estimated for each wind direction to enable the number of daylight hours per year that the visible plume extends over the site boundary to be calculated. Daylight hours have been assumed to be from 5 a.m. to 9 p.m. every day throughout the year. This will be an overestimation for the winter months and, therefore, the assessment can be classed as a worst case.

4 PLUME VISIBILITY RESULTS

Table 2 details the plume visibility results during daylight hours.

Table 2: Plume Visibility Results

Year	Percentage of daylight hours the plume is visible	Furthest distance from stack a plume is visible (m)	Percentage of time there is a visible plume extending beyond the site boundary
2015	22%	516	5%
2016	27%	502	8%
2017	23%	545	6%
2018	27%	607	10%
2019	26%	516	6%

The furthest distance from the stack that a visible plume is predicted to occur is 607 m which means that the visible plume would not extend above the nearest residential receptors (closest human receptor is 850 m away). Using the Environment Agency's significance criteria detailed in Table 1, the visual impact from the Proposed Development plume can be classed as medium as the plume length exceeds the distance to the site boundary for more than 5% of the year. However, this does not extend above any residential properties.

Table 3 and Table 4 give a further breakdown of the last distance that a plume is visible from the stack and the percentage of visible plumes that exceed set distances from the stack. This shows that, on average, visible plumes are predicted to occur for 25% of daylight hours and are predicted to extend beyond the site boundary for an average of 7% of daylight hours. The maximum distance a visible plume extends from the stack is 607 m. The breakdown in Table 4 shows that the majority of visible plumes dissipate within 100 m of the stack.

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Table 3: Detailed Results of all Plumes Visible During Daylight Hours

	2015	2016	2017	2018	2019	Average
Total number of visible plumes during daylight hours	1230	1514	1305	1480	1426	1391
% of daylight hours with visible plume predicted to occur	22%	27%	23%	27%	26%	25%
Total number of visible plumes predicted to extend beyond site boundary during daylight hours	297	432	354	545	357	397
% of daylight hours a visible plume is predicted to extend beyond site boundary during daylight hours	5%	8%	6%	10%	6%	7%
Longest visible length of a plume during daylight hours (m)	511	496	538	602	512	532
Furthest distance from stack a plume is visible during daylight hours (m)	516	502	545	607	516	538

Table 4: Visible Plume Lengths for all Plumes Visible During Daylight Hours

Plume length	2015	2016	2017	2018	2019	Average
	Number of visible plumes in daylight hours					
> 20 m	1103	1330	1148	1345	1224	1230
> 50 m	613	736	718	847	691	721
> 100 m	225	295	340	422	267	309.8
> 200 m	51	64	82	103	55	71
	% of daylight hours a plume is visible					
> 20 m	20%	24%	21%	24%	22%	22%
> 50 m	11%	13%	13%	15%	12%	13%
> 100 m	4%	5%	6%	8%	5%	6%
> 200 m	1%	1%	1%	2%	1%	1%
	% of visible plumes of length					
> 20 m	90%	88%	88%	91%	86%	88%
> 50 m	50%	49%	55%	57%	48%	52%
> 100 m	18%	19%	26%	29%	19%	22%
> 200 m	4%	4%	6%	7%	4%	5%

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5 CONCLUSIONS

The furthest distance from the stack that a visible plume is predicted to occur is 607 m which means that the visible plume would not extend above the nearest residential receptors (closest human receptor is 850 m). Using the Environment Agency's significance criteria, the visual impact from the Proposed Development plume can be classed as medium as the plume length exceeds the distance to the site boundary for more than 5% of the year. However, this does not extend above any residential properties.

The average visible plume is predicted to occur for 25% of daylight hours and is predicted to extend beyond the site boundary for an average of 7% of daylight hours. The maximum distance a visible plume extends from the stack is 607 m. However, the majority of visible plumes dissipate within 100 m of the stack.

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NCC received 16.07.2020

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NCC received 16.07.2020

APPENDIX 8-4: CARBON ASSESSMENT AND SUSTAINABILITY

NCC received 16.07.2020

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UTG/20/PMP/387/R
Job No: 2122.C91164.001
June 2020

EMERGE CENTRE
CARBON ASSESSMENT AND SUSTAINABILITY

prepared for
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by

R M C Brandwood & S J Griffiths

SUMMARY

This report serves two purposes: firstly to determine the relative carbon impact of processing the waste in the EMERGE Centre (the Proposed Development) relative to the alternative option of disposing of waste in a landfill; and secondly to demonstrate credible options to deliver net zero carbon emissions from the Proposed Development in line with the UK Government's statutory target to reduce emissions of greenhouse gases to net zero by 2050.

The carbon assessment concludes that the recovery of energy from waste in the Proposed Development will deliver a net carbon benefit of 106 kt of carbon dioxide equivalent emissions per year for the expected Net Calorific Value (NCV) case and 125 kt of carbon dioxide equivalent emissions per year for the low NCV case, relative to the disposal of the equivalent volume of waste in landfill. The results have been demonstrated to be robust to the consideration of the carbon intensity of grid generation displaced by the Proposed Development, to assumptions regarding the capture rates of methane in landfill and to assumptions regarding the sequestration of biogenic carbon in landfill.

Decarbonisation of an energy recovery facility such as the Proposed Development can be achieved via either decarbonising the waste fuel or capturing CO_2 from the flue gases arising from combustion, or through a combination of both. The Climate Change Committee (CCC) report supporting the Government's 2050 net zero target recommends specific policy options aimed at reducing both the plastic and biogenic content of waste, which is expected to deliver significant additional decarbonisation of the waste stream when implemented. Similarly, recommended action in the transport sector involving electrification and hydrogen fuels should deliver significant decarbonisation of waste transport.

Carbon capture is costly and complex, but does hold the potential to deliver negative carbon emissions by also removing the biogenic emissions from the atmosphere. Again Government policy will be required to provide the supporting infrastructure and investment to allow widespread implementation, but this approach is supported by the CCC recommendations. Carbon Capture and Storage is being implemented on a large scale energy recovery plant in Norway, demonstrating that the sector is actively addressing this option.

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The Proposed Development will initially support the transition to the Government's 2050 net zero target by:

- Achieving R1 status from the start of operations making it more energy efficient than many other existing energy recovery plants in the UK;
- Reducing the emissions of CO_2 relative to disposal in landfill;
- Proactively identifying and implementing Combined Heat and Power opportunities; and
- Providing an anchor facility to establish the wider Ratcliffe-on-Soar site redevelopment as a low carbon and sustainable energy hub for the region.

Emissions of CO_2 from the Proposed Development will be reduced to net zero by 2050 through one or a combination of the following approaches:

- Elimination of non-biogenic carbon from the incoming waste stream;
- Implementation of on-site carbon capture from the EMERGE Centre and storage or usage;
- Implementation of on-site carbon capture from a separate biogenic waste stream to offset emissions of non-biogenic CO_2 from the EMERGE Centre, coupled with storage or usage; and/or
- Bilateral or energy from waste sector agreements to offset overall CO_2 emissions by implementing bio-energy with carbon capture and storage (BECCS) at the most cost-effective energy from waste or other biomass fuelled plants.

Uniper could also contribute to the decarbonisation of other sectors, where there is the opportunity to displace emissions using carbon based products, manufactured using CO_2 captured from the EMERGE Centre.

Overall, whilst Uniper cannot predict what technologies will be available in thirty years' time, a road map has been developed to set out a journey to achieve a net zero future at Ratcliffe-on-Soar. This is set out, with expectations of timelines, below. This journey is likely to feature a mix of the technologies that Uniper is exploring across the business, which includes, but is not limited to the approaches set out below. Ultimately full decarbonisation of the EMERGE Centre will be achieved using one of, or a combination of, the three longer term measures.

Day 1 of Operations (2025)	• EMERGE Centre will operate with R1 compliance, reducing greenhouse gas emissions by diverting waste from landfill and export abroad; and • EMERGE Centre designed to allow fuel flexibility should the nature of the incoming waste change over time and recycling levels increase.
Short Term (2025–2035)	• EMERGE Centre designed to be 'CHP ready' for connection to a district heating scheme, with industrial users or manufacturers to use lower carbon energy and heat generated by the facility; • Changes to the composition of the fuel mix to reduce the non-biogenic carbon contained in the incoming waste stream driven by Government policy on recycling; and • Potential co-location of a facility to recycle / reuse products extracted from the incoming waste stream reducing the non-biogenic content of the fuel mix and displacing CO_2 emissions associated with the production of products or feedstocks which the extracted products replace.

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Longer Term (2030–2050)	• Change in fuel stock to 100 % biomass waste (e.g. agricultural and construction industry wastes); • Carbon Capture and Use (and potentially storage); and/or • Bilateral or energy recovery sector agreements to offset overall CO_2 emissions by implementing BECCS.

Prepared by **Approved for publication**

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1 INTRODUCTION

Uniper UK Limited is bringing forward plans for development of an Energy Recovery Facility at the Ratcliffe-on-Soar Power Station site – known as the East Midlands Energy Re-Generation (EMERGE) Centre. This Proposed Development would generate energy from non-hazardous domestic and commercial waste left over from the recycling process.

The aims of this report are, firstly, to determine the relative carbon impact of processing the waste in the Proposed Development relative to the alternative option of disposing of waste in a landfill and, secondly, to demonstrate credible options to deliver net zero carbon emissions from the Proposed Development in line with the UK Government's statutory target to reduce emissions of greenhouse gases to net zero by 2050 [1].

Other aspects of sustainability are covered elsewhere in the Environmental Statement. These include the preliminary R1 calculation which demonstrates an R1 efficiency of 0.76 which would allow the Proposed Development to be classified as a recovery operation under the terms of the Waste Framework Directive and the assessment of the potential for combined heat and power (CHP) which would further increase the efficiency of the Proposed Development.

2 UNIPER AND SUSTAINABILITY

Sustainability is a high priority for Uniper and the company is committed to deploying its products and services, including the development of new facilities, in a socially and environmentally responsible manner. Uniper's sustainability strategy supports the 17 United Nations Sustainable Development Goals, including those relating to affordable and clean energy, industry innovation and infrastructure, responsible consumption and production and climate action.

Uniper's sustainability plan [2] includes commitments to:

- Monitor and optimise the carbon intensity of Uniper's generation portfolio;
- Include decarbonisation activities as a focus area for innovation; and
- Promote lower carbon fuels for power generation.

Specific targets include:

- Achieving carbon neutrality for our Generation portfolio in 2035.
- Maintaining a Uniper group-wide carbon intensity of 500 g of CO_2 per kilowatt hour (on average) through 2020; and
- Conducting, by 2022, at least 20 projects whose aims include decarbonisation.

Since the EU Emissions Trading Scheme began in 2005, the Uniper Group's full consolidated companies in Europe have reduced their annual carbon emissions by just over 73.2 million metric tons, equating to a reduction of almost 77 %[1]. The closure of the coal-fired power station at Ratcliffe-on-Soar by October 2025 in line with Government Policy will further reduce the company's UK CO_2 emissions.

Uniper announced at its annual results press conference for the 2019 financial year (in March 2020) that it intends to make its power generation portfolio in Europe climate-neutral by 2035.

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[1] https://cr.uniper.energy/app/uploads/2020/06/Uniper-Sustainability-Report-2019-EN.pdf

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The announcement is part of a fundamental strategic reorientation focusing on a secure and climate-friendly energy supply. Uniper will gradually reduce its own portfolio's carbon emissions and, at the same time, the company plans to offer its customers products and services that are increasingly climate-friendly. Uniper's new investment criteria stipulate that all future investment projects must not only make business sense but also contribute to the achievement of the company's decarbonisation targets. Between now and 2022, Uniper will invest more than €1.2 billion in projects that accelerate the transition to a lower-carbon energy world.

Currently the UK does not have enough facilities to handle the quantities of non-recyclable waste that the country produces. The UK is currently landfilling or exporting around 16 million tonnes of waste that would provide a reliable and sustainable source of domestically generated energy. The Proposed Development will prevent approximately 500,000 tonnes of residual waste going to landfill or being exported outside of the UK each year and will help the East Midlands meet its landfill diversion targets.

The Proposed Development forms part of a wider vision for the Ratcliffe-on-Soar site – to move towards becoming a zero carbon technology and energy hub for the East Midlands region. Specifically, the vision seeks to deliver.

- High value jobs;
- Modern industry and manufacturing served by an on-site sustainable ‘Energy Hub’;
- Research, development and innovation;
- A centre to foster regional talents (including universities and established industry);
- A national focal point for low and zero carbon technology; and
- The future addition of advanced recycling and reuse technologies.

3 CARBON ASSESSMENT

The UK sent around 11.6 million tonnes of municipal waste to landfill in 2018, around half of which was biodegradable [3]. As discussed, the Proposed Development will reduce waste to landfill by around 500,000 tonnes per year. This section compares the carbon burdens associated with the Proposed Development with the carbon burden associated with the equivalent volume of waste being sent to landfill. The assessment process considers emissions of the greenhouse gases CO_2, N_2O and CH_4.

3.1 Proposed Development

Emissions associated with the Proposed Development will comprise direct emissions from the Energy Recovery Plant and emissions associated with the transport of waste, reagents and by-products. The electricity produced by the Proposed Development will, however, displace electricity production from other generation sources and hence remove any greenhouse gas emissions associated with those sources.

3.1.1 Waste Throughput and Composition

The Proposed Development has been designed to process an estimated 472,100 tonnes of waste per year based on an average net calorific value (NCV) of 10 MJ/kg with an average availability of 90 % of the year. In addition, a sensitivity scenario whereby the waste NCV is assumed to fall to 9 MJ/kg with the waste throughput rising to 524,550 tonnes per year is also considered.

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The fuel for the Proposed Development will be a mixture of municipal solid waste (MSW) and commercial and industrial waste (C&I). Published waste compositions have been used to provide waste mixes with NCVs which meet the expected case (design point) and sensitivity scenario NCVs. Table 1 summarises the waste characteristics.

Table 1: Waste Characteristics

Scenario	Carbon content % mass	Biogenic carbon as % of carbon	Non-Biogenic carbon as % of carbon	Biogenic energy as % of total energy content	NCV (MJ/kg)	Waste throughput (t/y)
Expected NCV	26.18	59.93	40.07	55.9	10	472,100
Low NCV	23.97	62.41	37.59	58.1	9	524,550

The biogenic carbon content is composed of subfractions which are assumed to be 100 % biogenic (comprising paper, card, wood, garden waste, food waste, organic pet bedding / litter and other organics) or 50 % biogenic (comprising textiles, disposable nappies, other hygiene products, shoes, carpet, underlay, furniture, other combustibles and fines). Waste with higher CVs tends to be dominated by plastics and wood, whereas the organic subfractions become more significant at lower CVs. It should also be noted that the biogenic energy content is typically several percentage points lower that the corresponding biogenic carbon content.

3.1.2 Direct Emissions

The combustion of waste generates direct emissions of carbon dioxide (CO_2), the mass of which is determined using the carbon content of the waste. As carbon from biogenic sources has a neutral carbon burden, only the CO_2 emissions derived from fossil sources need to be considered in the assessment.

This aligns with the Government guidance as set out in “Energy from Waste: A Guide to the Debate” [4] which states, in paragraph 40, “Considering the energy from waste route, if our black bag of waste were to go to a typical combustion-based energy from waste plant, nearly all of the carbon in the waste would be converted to carbon dioxide and be released immediately into the atmosphere. Conventionally the biogenic carbon dioxide released is ignored in this type of carbon comparison as it is considered ‘short cycle’, i.e. it was only relatively recently absorbed by growing matter. In contrast, the carbon dioxide released by fossil-carbon containing waste was absorbed millions of years ago and would be newly released into the atmosphere if combusted in an energy from waste plant.” For landfill, paragraph 42 states “Burning landfill gas produces biogenic carbon dioxide which, as for energy from waste, is considered short cycle.”

It has been assumed that all carbon in the waste fuel is converted to CO_2 as waste incinerators have combustion efficiencies of close to 100 % [5] and this represents a worst-case assumption with respect to CO_2 emissions. The mass of fossil derived carbon dioxide produced is determined by multiplying the mass of fossil carbon in the fuel by the ratio of the molecular weights of carbon dioxide (44) and carbon (12) respectively as shown in the equation below:

$$Mass\ of\ fossil\ derived\ CO_2\ out = Mass\ of\ fossil\ derived\ C\ in \times \frac{Mwt\ CO_2}{Mwt\ C}$$

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Table 2 sets out the calculated fossil derived CO_2 emissions.

Table 2: Fossil derived CO_2 emissions

Parameter	Expected NCV	Low NCV
Fossil carbon in input waste (t C/y)	49,525	47,269
Fossil derived CO_2 emissions (t CO_2/y)	**181,591**	**173,318**

The process of recovering energy from waste also releases small amounts of nitrous oxide (N_2O) and methane (CH_4) into the atmosphere, which contribute to climate change. The impact of these emissions is reported as CO_2 equivalent (CO_2e) emissions and is calculated using the Global Warming Potential (GWP) multiplier. In this assessment the GWPs used are based on the 2019 Government greenhouse gas conversion factors for company reporting [6], which are based on the 100 year time horizon GWPs taken from the Intergovernmental Panel on Climate Change (IPCC) fourth assessment report (GWPs of 25 for CH_4, 298 for N_2O). Although the IPCC has prepared a fifth assessment report since (with GWPs of 28 for CH_4, 265 for N_2O), the methods have not yet been officially accepted for use under the United Nations Framework Convention on Climate Change (UNFCCC).

Emissions of nitrous oxide and methane will depend on combustion conditions and nitrous oxide emissions also depend on flue gas treatment. As these details will depend on the final design of the Proposed Development, which is not available at this stage, representative default emission factors from the IPCC [7] based on the waste NCVs have been used to determine the emissions of these gases, as shown in Table 3.

Table 3: N_2O and CH_4 emissions

Parameter	Expected NCV	Low NCV
CH_4 emission factor (kg CH_4 / TJ(net))	30	
CH_4 emission factor (kg CH_4 / t waste)	0.30	0.27
CH_4 GWP (kg CO_2e / kg CH_4)	25	
CH_4 emissions (t CH_4 / y)	141.6	141.6
CH_4 equivalent emissions (t CO_2e / y)	**3,541**	**3,541**
N_2O emission factor (kg N_2O / TJ(net))	4	
N_2O emission factor (kg N_2O / t waste)	0.040	0.036
N_2O GWP (kg CO_2e / kg N_2O)	298	
N_2O emissions (t N_2O / y)	18.9	18.9
N_2O equivalent emissions (t CO_2e / y)	**5,627**	**5,627**

The Proposed Development will be equipped with auxiliary burners which will burn gas-oil during the start-up and shutdown of each individual line. These will have a capacity of around 60 % of the boiler thermal input, with the average burner consumption during start-up being around 50 % of the burner duty (i.e. 30 % of the boiler thermal input). The number of start-ups and shutdowns per year per line would typically be two, with each start-up and shutdown taking a period of 16 hours and 1 hour respectively. Auxiliary burner emissions have been calculated

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based on the Government greenhouse gas conversion factor for gas-oil of 0.273 t CO_2e/MWh [8].

Table 4 shows the auxiliary burner emissions and the total direct emissions from the Proposed Development are shown in Table 5.

Table 4: Auxiliary burner emissions

Parameter	Value
Total boiler capacity (MW_{th} net)	166.3
Total Auxiliary burner duty (MW_{th} net)	49.9
Total Auxiliary burner operation (hours / y)	34
Total Auxiliary burner operation (MWh_{th} / y)	1,697
CO_2 equivalent emissions (t CO_2e / y)	**463**

Table 5: Total direct CO_2 equivalent emissions from the Proposed Development

Parameter	Expected NCV	Low NCV
Fossil derived CO_2 emissions (t CO_2e /y)	181,591	173,318
CH_4 emissions (t CO_2e /y)	3,541	3,541
N_2O emissions (t CO_2e /y)	5,627	5,627
Burner emissions (t CO_2e /y)	463	463
Total emissions (t CO_2e /y)	**191,223**	**182,950**

3.1.3 Grid Offset

Sending electricity to the grid offsets the carbon burden of producing electricity using other methods. In the case of an energy recovery plant, such as the Proposed Development, the displaced electricity would be the marginal source which is currently gas-fired power stations, for which the displacement factor is 0.349 t CO_2e/MWh [9]. Electricity generated by the Proposed Development would be exported to the National Grid. DEFRAs 'Energy from Waste – A Guide to the Debate 2014' (specifically, footnote 29 on page 21) states that "A gas fired power station (Combined Cycle Gas Turbine – CCGT) is a reasonable comparator as this is the most likely technology if you wanted to build a new power station today." Therefore, the assessment of grid offset uses the current marginal technology as a comparator.

It is considered that the construction of an energy recovery plant will have little or no effect on how nuclear, wind or solar plants operate when taking into account market realities (such as the phase-out of nuclear plants and the subsidies often associated with the development of wind and solar plants). Current energy strategy uses nuclear power stations to operate as baseload stations running with relatively constant output over a daily and annual basis, with limited ability to ramp up and down in capacity to accommodate fluctuations in demand. Power supplied from existing nuclear power stations is relatively low in marginal cost and has the benefit of extremely low CO_2 emissions. Wind and solar plants also have very low marginal operating costs and are supported by subsidies in many cases. This means that they will run when there is sufficient wind or sun and that this operation will be unaffected by the operation of the Proposed Development.

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Combined cycle gas turbines (CCGTs) are the primary flexible electricity source. Since wind and solar are intermittent, with the electricity supplied varying from essentially zero (on still nights) to more than 16 GW (on windy or sunny days), CCGTs supply a variable amount of power. However, there are always some CCGTs running to provide power to the grid.

Gas engines, diesel engines and open cycle gas turbines also make a small contribution to the grid. These are mainly used to provide balancing services and to balance intermittent supplies. As they are more carbon intensive than CCGTs, it is more conservative to ignore these. In addition, recent bidding of energy recovery plants into the capacity market mean that they are competing primarily with CCGTs, gas engines and diesel engines. It is therefore considered that CCGT is the correct comparator.

The average CO_2 emission figure for the period from 01/04/2018 to 31/03/2019 was 0.208 t CO_2e/MWh [9] and displacement of generation using this figure has also been considered.

It is recognised that the UK government has recently set a target which will require the UK to bring all greenhouse gas emissions to net zero by 2050. This is likely to drive changes to both the waste fuel composition in the UK and the future grid CO_2 intensity. The implications of these changes are discussed in Section 4.2.1.

The amount of CO_2 offset by the electricity generated by the Proposed Development is calculated by multiplying the net electricity generated by the grid displacement factor. The Proposed Development will have a gross generation capacity of 49.9 MWe with a parasitic load of 6.49 MWe resulting in a net generation capacity of 43.41 MWe. Based on an average availability of 90 %, corresponding to 7,884 hours per year, the annual generation sent out will be 342,244 MWh/year. Table 6 presents the calculated grid offset emissions.

Table 6: Grid offset emissions

Parameter	Value
Net Electricity Export Capacity (MWe)	43.41
Net Electricity Export (MWh)	342,244
CCGT CO_2 equivalent emissions (t CO_2e / y)	**119,443**
Grid average CO_2 equivalent emissions (t CO_2e / y)	71,187

3.1.4 Transport Emissions

In addition to the direct emissions from the Proposed Development, there are direct emissions associated with the transport of incoming waste, reagents (ammonia, lime and activated carbon) and auxiliary fuel (gas-oil) to the Proposed Development and the transport of residues, namely Incinerator Bottom Ash (IBA) and Air Pollution Control Residues (APCR) from the Proposed Development to suitably licensed waste treatment facilities. As set out in the transport assessment, it is assumed that 90 % of waste deliveries are via heavy goods vehicles (HGVs) and 10 % are via Refuse Collection Vehicles (RCVs).

At this stage of the project, details of the precise waste, reagent and fuel delivery providers and the disposal facilities are not yet established; hence, a representative assumption of 80 km has been assumed as a default.

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Table 7 sets out the assumptions used to determine the transport emissions.

Table 7: Transport Emission Assumptions

Parameter	Value	Source
Delivery Payloads		
HGV incoming waste payload (tonnes)	20	Transport assessment
RCV incoming waste payload (tonnes)	6.5	
HGV residue IBA removal (tonnes)	16	
HGV residue APCR removal (tonnes)	18	
HGV ammonia delivery (tonnes)	30	
HGV lime delivery (tonnes)	25	
HGV activated carbon delivery (tonnes)	25	
HGV gas-oil delivery (tonnes)	40	
Emission Factors		
HGV 100% loaded (kgCO_2e/km)	0.955	[8] HGV (all diesel), Articulated (> 3.5–33 tonnes)
HGV 0% loaded (kgCO_2e/km)	0.641	
RCV 100% loaded (kgCO_2e/km)	0.535	[8] HGV (all diesel), Rigid (> 3.5–7 tonnes)
RCV 0% loaded (kgCO_2e/km)	0.457	
Distances		
Waste to Proposed Development (km)	80	Default assumption
Proposed Development to disposal – IBA and APCR (km)	80	
Reagents to Proposed Development – Ammonia, lime and activated carbon (km)	80	
Gas-oil to Proposed Development (km)	80	

The carbon burden of transporting the waste is determined from the annual mass of each transported component, by calculating the total number of loads required and multiplying it by the transport distance to generate an annual one-way vehicle distance. This is multiplied by the respective empty and full carbon dioxide equivalence factor for HGVs or RCVs, as appropriate, to determine the overall burden of transport. It is recognised that this is conservative, as it may be possible to coordinate HGV movements to reduce the number of trips.

Tables 8 and 9 set out the relevant information and the calculated transport emissions for the expected and low NCV cases respectively.

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Table 8: Transport Emissions for Expected NCV Case

Parameter	Waste to Proposed Development HGVs	Waste to Proposed Development RCVs	IBA to disposal	APCR to disposal	Ammonia to Proposed Development	Lime to Proposed Development	Activated carbon to Proposed Development	Gas-Oil to Proposed Development
Annual tonnage	424,890	47,210	116,609	23,605	944	7,554	472	472
Number of loads per year	21,245	7,263	7,288	1,311	31.5	302	18.9	11.8
One way distance (km)	80	80	80	80	80	80	80	80
One way total vehicle distance (km/year)	1,699,560	581,046	583,044	104,911	2,518	24,172	1,511	944
Total CO_2 emissions (tCO_2e / y)	**2,712**	**576**	**930**	**167**	**4.0**	**39**	**2.4**	**1.5**
Total transport CO_2 emissions (tCO_2e / y)	**4,433**							

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Table 9: Transport Emissions for Low NCV Case

Parameter	Waste to Proposed Development HGVs	Waste to Proposed Development RCVs	IBA to disposal	APCR to disposal	Ammonia to Proposed Development	Lime to Proposed Development	Activated carbon to Proposed Development	Gas-Oil to Proposed Development
Annual tonnage	472,095	52,455	129,564	26,228	1,049	8,393	525	525
Number of loads per year	23,605	8,070	8,098	1,457	35.0	336	21.0	13.1
One way distance (km)	80	80	80	80	80	80	80	80
One way total vehicle distance (km/year)	1,888,380	645,600	647,819	116,567	2,798	26,857	1,679	1,049
Total CO_2 emissions (tCO_2e / y)	**3,013**	**641**	**1,034**	**186**	**4.5**	**43**	**2.7**	**1.7**
Total transport CO_2 emissions (tCO_2e / y)	**4,925**							

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3.2 Landfill

When waste is disposed of in landfill, the biogenic carbon degrades and produces landfill gas (LFG). LFG is comprised of methane and carbon dioxide and, given the high GWP of methane, it has a significant carbon burden. Some of the methane in the LFG can be recovered and combusted in a gas engine to produce electricity.

3.2.1 Direct Emissions

The direct emissions associated with LFG can be split into:

1. Carbon dioxide released in LFG;
2. Methane released in LFG; and
3. Methane captured and combusted in LFG engines and flares, producing carbon dioxide as a result of the combustion.

Since 1 and 3 result in the release of carbon dioxide derived from biogenic carbon in the waste, these should both be excluded from the calculation. The focus of this calculation is the methane which is released to atmosphere. This is calculated as follows:

1. The biogenic carbon in the waste comes from the waste composition set out in Table 1;

2. 50 % of the degraded biogenic carbon is released and converted into LFG. The released carbon is known as the degradable decomposable organic carbon (DDOC) content. This assumes a sequestration rate of 50 %, which is considered to be a conservative assumption and is consistent with DEFRA’s ‘Energy from Waste – A Guide to the Debate’ [4] and the associated carbon based modelling approach [10]. There is considerable uncertainty in the literature surrounding the amount of biogenic carbon that is sequestered in landfill. The high sequestration used in this assessment, combined with the use of high landfill gas capture rates, is considered to be conservative in that landfill would tend to be favoured over energy recovery plants. Therefore, it is not considered appropriate to give additional credit for sequestered carbon, although this is considered as a sensitivity (see Section 3.3.2.3);

3. LFG is made up of 57 % methane and 43 % carbon dioxide, based on a review of landfill methane emissions modelling carried out for DEFRA [11];

4. Based on the same report, the analysis assumes 68 % of the LFG is captured and that 10 % of the remaining 32 % is oxidised to carbon dioxide as it passes through the landfill cover layer. The unoxidized LFG is then released to atmosphere; and

5. Based on the same guidance, 90.9 % of the captured LFG is used in gas engines to generate electricity, although 1.5 % of this captured LFG passes through uncombusted and is released to atmosphere. The remainder is combusted in a flare. It is assumed that the flares fully combust the methane. Landfill gas engines are assumed to have an efficiency of around 36 % based on generation sent to grid (i.e. accounting for parasitic load).

Table 10 outlines the LFG assumptions and Table 11 shows the equivalent carbon emissions associated with landfill.

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Table 10: LFG Emission Assumptions

Parameter	Value	Source
DDOC content as % of biogenic C	50 %	[10]
CO_2 as % of LFG (by volume)	43 %	[11]
CH_4 as % of LFG (by volume)	57 %	[11]
LFG recovery efficiency of which	68 %	[11]
- % flared	9.1 %	[11]
- % (of recovered used in gas engines)	90.9 %	[11]
- % (of used in gas engines) leakage	1.5 %	[11]
Non recovered LFG of which	32 %	[11]
- % (of non- recovered) oxidised to CO_2	10 %	[11]
Conversion factor from C to CH_4	1.33	Ratio of molecular weights
Landfill gas engine efficiency	36 %	[11]
Methane GWP (CO_2e)	25	[6]
Methane net calorific value (MJ/kg)	50	Standard Value (e.g. [10])

Table 11: LFG Emissions

Parameter	Expected NCV	Low NCV
Biogenic carbon (t/y)	74,071	78,471
Total DDOC content (t/y)	37,035	39,236
Methane in LFG of which: (t/y)	28,147	29,819
- Methane captured	19,140	20,277
- Methane oxidised in landfill cap	901	954
- Methane released to atmosphere	8,106	8,588
Methane leakage through gas engines (t/y)	261	276
Total methane released to atmosphere (t/y)	8,367	8,864
CO_2e released to atmosphere (tCO_2e/y)	**209,182**	**221,609**

3.2.2 Grid Offset

The methane in the LFG that has been recovered can be used to produce electricity. This electricity will offset grid production, and results in a carbon benefit of sending waste to landfill. The power produced by an LFG engine is based on the amount of methane, the heat content of methane and the engine efficiency. The relevant parameters are included in Table 10. The same displacement assumptions as described in Section 3.1.3 for the Proposed Development have been made for landfill gas. The power generated by the LFG engines and the carbon dioxide offset are shown in Table 12.

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Table 12: LFG grid offset emissions

Parameter	Expected NCV	Low NCV
Methane captured (t/y) of which	19,140	20,277
- Methane flared (t/y)	1,742	1,845
- Methane leakage through gas engines (t/y)	261	276
- Methane used in gas engines (t/y)	17,137	18,155
Gas engine fuel use (GJ)	856,861	907,764
Power generated (MWh)	85,686	90,776
CCGT CO_2 equivalent emissions (t CO_2e / y)	**29,904**	**31,681**
Grid average CO_2 equivalent emissions (t CO_2e / y)	17,823	18,881

3.2.3 Transport

The carbon emissions associated with the transport of waste to landfill have been based on the assumptions in Table 13 reflecting that project specific details are not yet available. The calculation used the emission factors from Table 7. The transport emissions are set out in Table 14.

Table 13: Landfill Transport Emission Assumptions

Parameter	Value	Source
HGV incoming waste payload (tonnes)	20	Default assumption
Waste to landfill (km)	80	Default assumption

Table 14: Landfill Transport Emissions

Parameter	Expected NCV	Low NCV
Annual tonnage	472,100	524,550
Number of loads per year	23,605	26,228
One way distance (km)	80	80
One way total vehicle distance (km/y)	1,888,400	2,098,200
Total CO_2 emissions (tCO_2e / y)	**3,013**	**3,348**

3.3 Results

3.3.1 Assessment Results

The results of the assessment are shown in Table 15. It can be seen that there is net carbon benefit of 106 kt of carbon dioxide equivalent emissions per year for the expected NCV case and 125 kt of carbon dioxide equivalent emissions per year for the low NCV case.

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Table 15: Summary of Assessment Results

Parameter (all as tCO_2e)	Expected NCV	Low NCV
Landfill gas releases	209,182	221,609
Transport of waste to landfill	3,013	3,348
Offset of grid electricity by landfill gas engines	29,904	31,681
Total landfill emissions	**182,291**	**193,277**
Direct Proposed Development releases	191,223	182,950
Transport of waste to and outputs from the Proposed Development	4,433	4,925
Offset of grid electricity by Proposed Development generation	119,443	119,443
Total Proposed Development emissions	**76,212**	**68,432**
Net benefit of the Proposed Development	**106,079**	**124,845**

3.3.2 Sensitivity Assessment

This section considers the following sensitivities:

- Assumptions relating to the carbon intensity of displaced electricity generation;
- Collection efficiency assumptions for landfill sites; and
- Assigning a carbon sequestration benefit to the proportion of biogenic carbon in landfill.

3.3.2.1 Carbon Intensity of Displaced Generation

As discussed in Section 3.1.1, CO_2e emissions from a CCGT have been used as the comparator for the displacement of generation by both the Proposed Development and landfill gas engines. Table 6 and Table 12 include alternative figures for displaced CO_2e emissions based on recent grid average CO_2e emission figures [9].

Table 16 shows the effect of applying grid average CO_2e displacement figures on the total landfill and Proposed Development emissions. Additionally a case is presented where it is assumed that there is no carbon benefit from the displacement of grid generation, as would be the case where power generation has been completely decarbonised. It can be seen that applying the recent grid average displacement figure results in a net benefit for the Proposed Development of 70 kt and 89 kt of carbon dioxide equivalent emissions per year for the expected and low NCV cases respectively. Even assuming no benefit from displaced grid generation results in a net Proposed Development benefit of 16.5 kt and 37 kt of carbon dioxide equivalent emissions per year for the expected and low NCV cases respectively.

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Table 16: Sensitivity to assumptions regarding the carbon impacts of displacement of generation from the grid

Parameter (all as tCO_2e)	Expected NCV	Low NCV
Total landfill emissions applying grid average CO_2e displacement	194,373	206,076
Total Proposed Development emissions based on grid average CO_2e displacement	124,469	116,688
Net benefit of the Proposed Development	**69,904**	**89,388**
Total landfill emissions assuming no benefits from electricity displacement	212,196	224,957
Total landfill emissions assuming no benefits from electricity displacement	195,656	187,875
Net benefit of the Proposed Development	**16,540**	**37,082**

3.3.2.2 Collection Efficiency Assumptions for Landfill Sites

The review of landfill methane emissions modelling report produced for DEFRA [11] states that the collection efficiency for large, modern landfill sites was estimated to be 68 % and the collection efficiency for the UK as a whole was estimated to be 52 %. There have been suggestions in other guidance that a conservative figure of 75 % should be used. The sensitivity of the results to collection efficiency assumptions are presented in Table 17.

It can be seen that even assuming a very conservative figure of 75 % for collection efficiency, there remains a net Proposed Development benefit of 59.3 kt and 75.3 kt of carbon dioxide equivalent emissions per year for the expected and low NCV cases respectively.

Table 17: Sensitivity to assumptions regarding landfill gas capture rates

Parameter (all as tCO_2e)	Expected NCV	Low NCV
Total landfill emissions assuming 52 % methane collection efficiency	289,122	306,453
Total Proposed Development emissions	76,212	68,432
Net benefit of the Proposed Development	**212,909**	**238,021**
Total landfill emissions assuming 75 % methane collection efficiency	135,553	143,762
Total Proposed Development emissions	76,212	68,432
Net benefit of the Proposed Development	**59,341**	**75,330**

3.3.2.3 Consideration of Sequestration

Under landfill conditions a proportion of the biogenic carbon will not decompose and therefore this carbon would not be released to the atmosphere as would be the case if the waste is combusted in the Proposed Development. Whilst CO_2 associated with biogenic emissions is considered carbon neutral, if this fraction is permanently sequestered in landfill, it could reasonably be considered to constitute a net carbon benefit.

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The main assessment has not considered this sequestered carbon on the basis that a low fraction of DDOC of 50 % has been assumed (the converse is the sequestration fraction which is classified as high in [10] which considered increases in DDOC of up to 70 % as a sensitivity study). As the associated methane emissions are 25 times more potent that CO_2 in terms of GWP, any increase in DDOC soon offsets any benefits of sequestration.

Table 18 shows the effect on the assessment of considering sequestration alongside increasing levels of DDOC. It can be seen that including sequestration alongside the low assumed level of DDOC would suggest a disbenefit from the Proposed Development relative to landfill of around 30 kt and 20 kt of carbon dioxide equivalent emissions per year for the expected and low NCV cases respectively. However an increase of only 5 % in the assumed DDOC level removes any relative benefits of landfill associated with the inclusion of sequestration, supporting the discounting of sequestration in the main assessment due to the low assumed DDOC rate.

Table 18: Sensitivity to assumptions regarding sequestration and DDOC

Parameter (all as tCO_2e)	**Expected NCV**	**Low NCV**
CO_2 sequestration assuming 50 % DDOC	135,797	143,864
Total landfill emissions assuming 50 % DDOC with sequestration	46,495	49,413
Total Proposed Development emissions	76,212	68,432
Net benefit of the Proposed Development	**-29,718**	**-19,019**
CO_2 sequestration assuming 55 % DDOC	122,217	129,478
Total landfill emissions assuming 55 % DDOC with sequestration	78,002	82,792
Total Proposed Development emissions	76,212	68,432
Net benefit of the Proposed Development	**1,790**	**14,360**

3.3.3 Conclusions Relating to the Carbon Assessment

The assessment concludes that the recovery of energy from waste in the Proposed Development will deliver a net carbon benefit of 106 kt of carbon dioxide equivalent emissions per year for the expected NCV case and 125 kt of carbon dioxide equivalent emissions per year for the low NCV case, relative to the disposal of the equivalent volume of waste in landfill. A net benefit of 106 kt of carbon dioxide a year is the equivalent to avoiding the CO_2 released from heating around 39,250 UK homes.[2]

The results have been demonstrated to be robust to the consideration of the carbon intensity of grid generation displaced by the Proposed Development, to assumptions regarding the capture rates of methane in landfill and to assumptions regarding the sequestration of biogenic carbon in landfill.

[2] https://citu.co.uk/citu-live/what-is-the-carbon-footprint-of-a-house

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4 PATHWAYS TO 2050 NET ZERO EMISSIONS FROM THE PROPOSED DEVELOPMENT

4.1 UK Government Policy Context

4.1.1 CCC Net Zero Report

The UK Government has legislated to set a binding target of net zero greenhouse gas emissions by 2050. The target was supported by a report by the Committee on Climate Change (CCC) setting out the potential pathways to deliver the target [12][13]. The report concludes that achieving net zero is necessary, feasible and cost-effective, but will only be credible if clear, stable and well-designed policies to reduce emissions further are introduced across the economy without delay.

Policies relating to both waste and transport are clearly relevant to the Proposed Development achieving net zero by 2050, noting also Uniper's stated ambition to reduce the climate impacts of its own activities in Europe to net zero by 2035. Carbon capture and storage (CCS) is also a relevant technology in the context of industrial emissions, including from energy recovery plants.

4.1.1.1 Policy on Waste

The core measures relating to waste in the CCC report include stopping five key biodegradable waste streams (food, paper / card, wood, textiles and garden waste) going to landfill by 2030 (or earlier) and increasing recycling rates in England from around 45 % today to 65 % by 2035. It is noted that many of the core opportunities for waste are already included in government and devolved administration plans. Opportunities to go beyond core policy in the waste sector involve additional emissions reduction from the treatment of waste water, ending the sending of biodegradable waste to landfill by 2025 and increasing recycling rates to 70 % across the UK, again by 2025. This will require regulation and enforcement, with supporting actions through the waste chain, including a mandatory ban on biodegradable waste from key waste streams going to landfill by 2025, the introduction of separate food waste collection by 2023 and supporting measures to increase recycling rates. The abatement costs for the waste sector are estimated at £30–100/t CO_2e reflecting the higher costs of alternative waste treatments compared to landfill.

The importance of personal action to reduce food waste, separate food waste where collection is available, and reducing, reusing, recycling other waste is also noted. Around 10 million tonnes of food is wasted each year, with 70 % of this being discarded within households.

In addition to the issues associated with biogenic waste in landfill, the report noted that the UK uses five million tonnes of plastic each year, nearly half of which is packaging. Plastic waste does not decompose and can last for hundreds of years in landfill, soils and oceans, damaging natural habitats and essential ecosystems.

The diversion of waste from landfill through the landfill tax is cited as an example of an important and effective policy, having driven a reduction of over 75 % in biodegradable waste being sent to landfill and a diversion to other disposal routes such as recycling. The ongoing emission of methane from waste degrading in legacy landfill sites is cited as a residual problem which will require additional effort to offset in order to achieve net zero.

The waste sector is notably singled out as the only sector not covered by the EU Emissions Trading Scheme to meet the performance indicators laid out by the CCC in relation to the second carbon budget period of 2013 to 2017.

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The report noted that in order to deliver net zero, additional private sector investment is required in alternative waste disposal facilities, specifically naming anaerobic digestion, mechanical biological treatment and incineration as technologies to deal with waste diverted from landfill. It is noted that there are risks of offshoring waste if this does not happen.

4.1.1.2 Policy on Transport

As shown in Table 15, transport emissions associated with the delivery of waste and consumables to the EMERGE Centre and the removal of APCR and IBA from the facility, could contribute up to 5 ktCO_2e per year. These emissions will need to be addressed to achieve net-zero by 2050, hence Government transport policy is also a relevant factor.

Transport is noted as a key problem sector which is now the largest source of UK greenhouse gas emissions and has seen emissions rise by 6 % from 2013 to 2017.

The key policies relating to transport are geared around electrification of transport supported by a major expansion of renewable and other low-carbon power generation. Decarbonisation of heavy duty transport is recognised as a challenging area. Options for HGVs would include hydrogen powered vehicles, electric HGVs with fast high powered charging infrastructure and HGVs with on-road catenaries to charge the vehicles as they drive. It was estimated that a hydrogen-based switchover would require 800 refuelling stations to be built by 2050 and electrification would need 90,000 depot-based chargers for overnight charging. These measures would need to be coupled with the establishment of a hydrogen economy and/or decarbonisation of the power sector, to be effective.

The report recommends that trials of zero-emission HGVs and associated refuelling infrastructure should be planned from now until the early 2020s to develop an evidence base to enable decisions to be made on the most cost-effective and practical zero emission option. The Government must prepare to make this decision in the mid-2020s, with international coordination, to enable infrastructure to be developed ready for the deployment of zero emission HGVs in the late 2020s and throughout the 2030s. Vehicle and fuel taxation from the 2020s onwards should be designed to incentivise commercial operators to purchase and operate zero emission HGVs.

Opportunities to improve the logistical efficiency of HGVs should also be explored, including increased roll-out of urban consolidation centres to minimise journeys into busy urban centres and adjusting delivery times to ensure HGVs can avoid congestion.

In relation to transport by train, it is noted that rail electrification should be planned on a rolling basis to keep costs low, and trials of hydrogen trains on UK rail should be supported where necessary.

In terms of abatement costs, the CCC report suggests that the marginal costs for the transport sector may be negative due to lower fuel costs, being in the region of -£35/ tCO_2e.

4.1.1.3 Policy on CCS

Carbon Capture and Storage is seen as a necessity to achieve net zero, in relation to industry, bioenergy (to deliver net reductions in emission) and for hydrogen and electricity production. This would require a major CO_2 transport and storage infrastructure servicing at least five clusters and with some CO_2 transported by ships or HGVs. CCS on bioenergy (BECCS) would

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allow residual emissions to be tolerated particularly in hard to abate sectors and is a significant focus of the CCC report.

The CCC had previously recommended that the first CCS cluster should be operational by 2026, with two clusters, capturing at least 10 Mt CO_2, operating by 2030. For a net-zero target it is assumed to be very likely that more will be needed. At least one of the clusters should involve substantial production of low-carbon hydrogen. CO_2 infrastructure development should start as early as possible, and will need clusters in all areas with large industrial emissions. The Government will need to take a lead on infrastructure development, with long-term contracts to reward carbon capture plants and encourage investment. This year's budget has set aside £800 million for development of carbon capture in the industrial clusters. It is noted that the UK is well placed to deploy CCS at scale given its access to CO_2 storage potential [14].

4.1.2 Waste and Resources Strategy

The Government waste strategy published in December 2018 [15] sets out the wider Government approach with regards to waste policy. This includes a range of policy measures aimed at delivering a circular economy.

Key measures with regards to increasing recycling include:

- Invoking the 'polluter pays' principle and extending producer responsibility for packaging, ensuring that producers pay the full costs of disposal for packaging they place on the market;
- Stimulating the demand for recycled plastic by introducing a tax on plastic packaging with less than 30 % recycled plastic;
- Setting minimum requirements through eco-design to encourage resource efficient product design;
- Banning plastic products where there is a clear case for it and alternatives exist;
- Improving recycling rates by ensuring a consistent set of dry recyclable materials is collected from all households and businesses;
- Reducing greenhouse gas emissions from landfill by ensuring that every householder and appropriate businesses have a weekly separate food waste collection; and
- Improving urban recycling rates, working with business and local authorities.

Key areas for research and innovation include:

- Supporting further investment and innovation in resource efficiency;
- Launching a call for evidence on the development of standards for bio-based and biodegradable plastics; and
- Encouraging innovative waste treatment technologies that create transport fuels through the Renewable Transport Fuels Obligation.

In terms of the waste hierarchy, disposal in landfill is cited as the worst option and increased rates of recovery and recycling, together with generating much more energy from waste are noted as success factors in reducing this. The report notes that growth in the energy from waste sector and alternative residual waste treatment infrastructure will continue to divert further waste from landfill.

Driving greater efficiency from energy from waste plants is noted as a specific action requirement. This will include assessing and removing barriers to making use of heat produced when incinerating waste, noting the establishment of the BEIS heat networks investment project

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to help utilise energy from waste plants as a source of heat for district heat networks where possible.

The Government will also work closely with industry to secure a substantial increase in the number of energy recovery plants that are formally recognised as achieving recovery status, and will ensure that all future energy recovery plants achieve recovery status.

4.2 Achieving Net Zero at the Proposed Development

4.2.1 Changes to the Input Waste Stream

As detailed in Table 1, over 50 % of the carbon derived energy output from the Proposed Development will effectively be carbon neutral. The overall carbon intensity of the Proposed Development (excluding transport emissions for the purposes of comparison) at the start of operations will be around 560 gCO_2/kWh(e), which is considerably lower than coal, oil or open cycle gas turbines (937, 935 and 651 gCO_2/kWh(e) respectively [16]) but higher than CCGTs (349 gCO_2/kWh(e) [9]).

The efficiency of the Proposed Development will initially be optimised through ensuring that it achieved R1 status (recovery) and through identifying and implementing opportunities for CHP on the earliest feasible timescales.

Uniper recognises that to contribute toward the UK's ambitious net-zero carbon objectives the Proposed Development will need to reduce its carbon intensity over its operational life. The amount of carbon dioxide emitted by the Proposed Development will be a function of the fuel composition, over which Uniper will have limited control; however, it is clear that there is now a strong government policy direction which aims to decarbonise waste through a combination of reducing the biogenic carbon content, with a strong focus on removing food waste, and reducing the plastics content through the phasing out on non-recyclable plastic use in the wider economy.

To illustrate the potential improvements associated with decarbonisation of the waste stream, Uniper commissioned work to examine the impact of the removal of up to 100 % of food waste and up to 100 % of plastics from the incoming waste stream relative to the expected NCV case waste fuel, whilst maintaining the generation capacity of the Proposed Development. Table 19 shows the effect on the total non-biogenic and biogenic CO_2 emissions and the CO_2 generation intensity of removal of these two waste streams. It can be seen that these two measures alone would deliver a reduction of 61.4 kt of non-biogenic CO_2 relative to the expected NCV case and reduce the carbon intensity of generation to levels comparable with CCGT plants.

It should also be noted that these measures would also significantly increase the net benefit of the Proposed Development relative to disposal by landfill. Relative to the expected NCV case net benefit of 106kt CO_2e (see Table 15), the 50 % and 100 % removal cases increase the net benefits to 151 kt CO_2e and 217 kt CO_2e per year, respectively.

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Table 19: Impact on emissions of reducing food and plastic content of incoming waste (based on Proposed Development and auxiliary boilers)

Scenario	Non-biogenic carbon content %	Biogenic carbon content %	Non-biogenic CO_2e emissions t/y	Biogenic CO_2e emissions t/y (C neutral)	Carbon intensity gCO_2/kWh (excludes biogenic CO_2)
Expected NCV	40.1	59.9	191,223	271,593	559
25 % food and plastic removed	37.4	62.6	179,861	285,417	526
50 % food and plastic removed	34.2	65.8	166,268	301,767	486
75 % food and plastic removed	30.4	69.6	149,941	321,844	438
100 % food and plastic removed	25.7	74.3	129,739	346,511	379

The detailed design of the Proposed Development will be based upon specifications which allow the Proposed Development to operate on biomass alone (i.e. waste with no non-biogenic carbon component) which will ensure the Proposed Development is able to operate on carbon neutral waste fuels in the future should these be available.

The decarbonisation of the transport sector is also a Government priority with HGVs being recognised as a particular challenge. This will need to be incentivised by the Government with the required infrastructure put into place and is outside the scope of Uniper's influence. Uniper does, however, consider the sustainability qualifications during its contractor selection process and hence will be in a position to move to more sustainable delivery options as the technology develops. Uniper will also retain the existing rail delivery structure within the wider Ratcliffe-on-Soar Power Station site to allow future delivery of waste by rail should this option become available. The UK rail sector has an ongoing programme of electrification which could result in future waste deliveries to the Proposed Development having a very low carbon footprint.

4.2.2 Carbon Capture Options

In addition to removing the fossil carbon content of the fuel to be burned in the EMERGE Centre, there is a further option to reduce emissions of CO_2. This is to capture CO_2 from the flue gas of the plant. Capturing carbon from the flue gas of the EMERGE Centre, or from any of its associated material processing steps, can be applied in addition to any measures taken to reduce the amount of fossil carbon in the waste received by the site. In fact, this presents an opportunity as, where a greater amount of CO_2 is captured from the flue gas than arises from the non-biogenic share of the waste, then this can be termed carbon negative and represents a removal of greenhouse gas from the atmosphere. As illustrated in Table 19, capture of the whole CO_2 emission stream would result in substantial carbon negative emissions for the Proposed Development. Maintaining or reducing the share of the non-biogenic carbon in the fuel, coupled with the use of carbon capture, has the potential to more than offset the emissions from the EMERGE Centre.

Typically, carbon capture is thought of being achieved in one of three ways; pre-combustion, post-combustion or oxyfuel.

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Pre-combustion capture entails the treatment of the fuel to remove carbon prior to combustion in the plant. This would often be considered as being achieved first by gasifying the fuel, then treating it in such a way as to produce a hydrogen-rich fuel, while capturing the CO_2 deriving from the fuel borne carbon. Waste gasification has been demonstrated but, importantly, has not been demonstrated as a retrofit whilst also capturing CO_2. Furthermore, the fuel burned in the boiler to produce heat and electricity is very different in nature, which will greatly reduce the efficiency of the plant in producing electricity. Therefore this cannot be considered a viable option at this time, though it may be in the future as the technology further develops.

There is an opportunity with the EMERGE Centre to offset its CO_2 emissions by improved recovery of recyclable plastic waste fractions on site prior to combustion. The carbon associated with this fraction will not be emitted by the plant chimney, and hence the emissions are avoided. Furthermore, as these recovered fractions can themselves be further processed to provide virgin feedstock for plastics production or waste to liquid and gaseous fuels, they will displace the CO_2 emissions from other sectors.

In oxyfuel applications, the fuel is burned not in air, but instead in oxygen purified from the air, and a recirculated flue gas stream. This gives rise to a CO_2-rich flue gas stream that can itself be cleaned of impurities and conditioned in such a way as to allow transport and storage as desired. There has been considerable work undertaken on oxyfuel technology in, for example, coal-fired power plant, as this offers the potential in the future for lower cost capture of CO_2. However, the development of the technology is not such that it could be commercially deployed today. Furthermore, as oxyfuel operation of the plant alters markedly the combustion process and thermal balance of the plant, it is not immediately clear that this would lend itself to retrofit in the future.

Finally, post combustion carbon capture is the most developed process for capturing CO_2. This approach is the least intrusive to the host process as, in its simplest form, the only integration required is to the flue gas path to draw the combustion gases into the capture plant. The furnace, boiler and steam cycle, need not be interfered with. However, in practice, as the capture process has a considerable energy demand, it is generally the lowest cost approach to use steam from the power generation cycle to provide the thermal energy required by the process. Given that energy recovery plant would not as a rule be expected to operate flexibly (ramping up and down in load as a power station might) some of the pitfalls of this integration are less likely to become apparent. On this basis, post combustion capture would seem the most likely retrofit option. It is also, in principle, possible to fit amine scrubbing capture processes (analogous to the type used in post combustion) to any emission points associated with fuel pretreatment, where these evolve CO_2.

4.2.2.1 Post Combustion Capture Process

The post-combustion capture process would be situated downstream of the flue gas cleaning equipment and is based on the principle of chemical absorption of CO_2 by a solvent (Figure 1). These solvents are most commonly amine-based solutions, but alternatives such as amino acids and ammonia have also been tested by different developers. Subsequent desorption and thus release of a CO_2 product stream is a key part of these reversible processes.

A generic scheme for carbon capture on an energy recovery facility would include the following major process steps:

- CO_2 absorption;
- Treated flue gas cleaning / solvent recovery;
- Solvent cross heat exchanger;

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- CO_2 regeneration;
- CO_2 product compression; and
- Amine reclaiming.

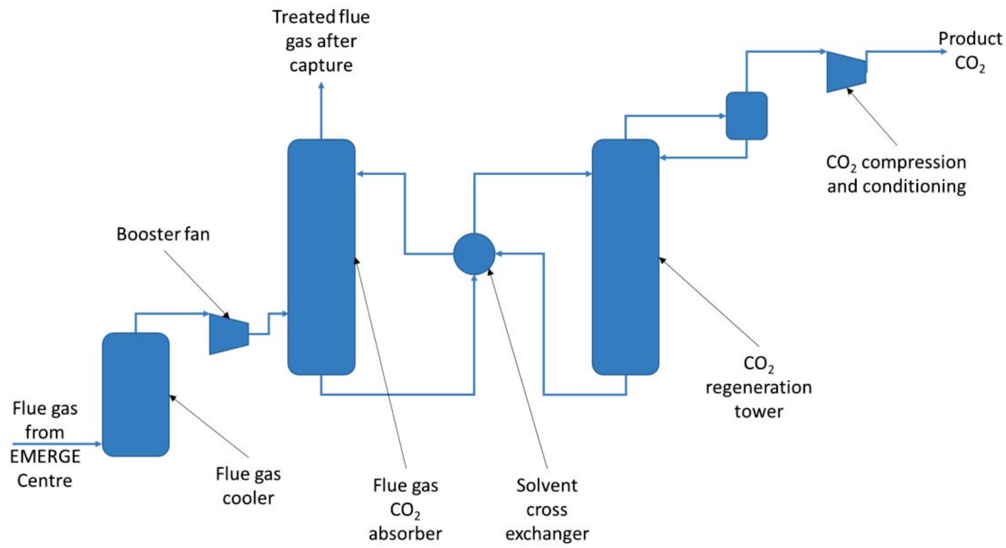

Figure 1: Post-Combustion Capture Process

On entering the capture process after leaving the flue gas cleaning plant, the flue gas is initially cooled down to approximately 40 °C. The flue gas then enters the CO_2 absorber and flows upwards through the packed column and out from the top of the absorber. Simultaneously, the solvent enters the absorber and flows counter-currently to the flue gas, the surface of the packing wetted by the solvent allows the CO_2 to react and be absorbed. Typically around 90 % removal of CO_2 would be achieved, though to achieve a zero fossil CO_2 emission for the EMERGE Centre, a capture plant would only need to be sized such that the CO_2 arising from the fossil carbon in the waste is removed from the flue gas.

The treated flue gas leaves the absorber through a washing section, to recover solvent and other reaction products, and is released to the atmosphere via the stack. The CO_2-rich solvent from the absorber then flows to the regenerator via the lean/rich heat exchanger. In the lean/rich heat exchanger, some of the heat from the CO_2-lean solvent leaving the regenerator is exchanged with the CO_2-rich solvent entering the regenerator, improving energy efficiency.

In the reboiler which is part of the regeneration stage, the solvent is heated up to approximately 120 °C to release the CO_2. The CO_2 stream produced exits from the top of the regenerator and is of a high purity. The regenerated lean solvent then leaves the bottom of the regenerator and is cooled down in the lean/rich heat exchanger. It may then pass through a trim cooler to further reduce the temperature before re-entering the absorber in order to complete a continuous cycle. The captured CO_2 is compressed and dried, or potentially liquefied, for transportation to storage or utilisation.

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4.2.2.2 Novel Capture Processes

There are a number of novel designs that are being developed to optimise aspects of the capture plant and the associated economics, which may become available to energy recovery plant. Whilst not specifically addressed here, there is also ongoing development work to optimise the conventional post combustion capture process by improving solvent chemistry to reduce thermal energy consumed in the process, or improve integration of processes to make the greatest use of the energy that is used in the process.

The following paragraphs introduce some developmental capture processes for post-combustion application.

Mass transfer in the conventional packed columns used for carbon capture is relatively poor, which is the primary reason for the capture equipment being large. The use of rotating solvent contactors or rotating packed beds (RPB) has been proposed as a means to improve this mass transfer, intensify the process, and ultimately the reduce the size of equipment involved. The principle is that rotating the packed column at a rate of hundreds of times per minute leads to better mass transfer being generated inside the RPB as the contact area between solvent and flue gas is increased. It is suggested that, with this intensified process, a higher concentration of solvent can be used and the volume of recirculating solvent circulated between absorber step and stripper unit can be reduced. This will reduce not only plant size, but also operating costs, although there will be additional electrical energy required to provide the motive power for rotation.

Rotary solid sorbent systems have also been proposed by companies such as Svante, who refer to them as rotating adsorption machines (RAMs). These units are available at small scale for demonstration, but perhaps not at the scale required for an energy recovery facility, although there are plans for testing larger units. In these units bespoke nano-materials (solid adsorbents) with very high storage capacity for CO_2 are formed into a solid matrix with the potential for quick adsorption and subsequent release of captured CO_2. This means that plant can be reduced in size and material inventories reduced. The form of the RAM is rather similar to the rotary air heater on large coal-fired boilers. In an air heater, thermal energy is removed by a matrix rotated from the hot flue gas and then given up to cold combustion air. In a RAM, a solid material is rotated into the flue gas where capture of CO_2 occurs, the material is then rotated into a regeneration stream where steam is added and the CO_2 given up. After purging and cooling steps the matrix can then be rotated back into the flue gas for further capture. Demonstration projects for RAMs are being developed in the cement and petrochemical sectors where capture rates would be comparable to that required here.

It is important to note that these developmental technologies may not yet be available at a scale to deploy commercially in the EMERGE Centre setting. However, it may not be necessary to treat the whole flue gas stream in order to achieve net zero emissions of fossil CO_2 from the installation. Therefore, the deployment of smaller module sizes of these technologies may be sufficient to meet the goal.

4.2.2.3 Impact on Plant

Whilst CO_2 capture from an energy recovery facility such as the Proposed Development is simpler than, for example, a coal-fired power station, it is still a significant undertaking. The main area of difference is that municipal solid waste contains much less sulphur than coal, and also produces less particulates than coal (due to the composition of the fuel and the flue gas cleaning train representing Best Available Techniques for this type of plant). This relatively clean flue gas means that less capital investment is required for gas cleaning [17].

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The carbon capture plant requires a significant amount of energy, in the form of steam, for the regeneration of the solvent and liberation of the product CO_2. The final compression and treatment (for pipe transport or liquefaction) of captured CO_2 also requires significant electrical power.

Finally, there will also be increases in cooling demand, water consumption and other utilities. There will also be additional consumption of other chemicals. The exact magnitude of these increases will depend on the capture process used and the extent of integration with the power island.

It should also be said that the application of post combustion capture is not widespread, and in particular not on waste fired plant, so there may some risks associated with excessive consumption of solvents used, due to trace constituents in the flue gas, and potentially also plant corrosion. These facets would require further investigation.

4.2.2.4 Cost Implications

The capital cost of a capture plant would add significantly to that of the overall development. For context, the ROAD project, one of Europe's furthest developed CO_2 capture projects and which was developed by Uniper in joint venture, would have cost between €185 million and €230 million in 2017 (plus Owner's costs), for a plant sized to capture 169 tph_{CO2} (with perhaps an additional 25–55 % of other integration costs). A smaller scale system, of the size required for the Proposed Development, might be relatively more costly due to economies of scale. However, at this scale the potential is opened up to make greater use of modularisation in design and build, and perhaps of common plant item designs.

Operating costs are also significant for CCS plant. When taking into account the maintenance, staffing, chemicals and energy costs (the latter being the greatest), based again on the ROAD project, the operating costs might be in the region of €25/teCO_2. These costs are discussed further in the ROAD close-out report [18]. Further additional costs might be incurred for use of a CO_2 transport system and storage, if not sold to the industrial sector.

4.2.2.5 Storage and Utilisation of Carbon Dioxide

The Aker Solutions provided plant, installed at the Twence Energy Recovery Facility in the Netherlands, will produce up to 100 kt_{CO2} per year, which will be liquefied and sold to industry. The Klemetrud plant in Norway is also developing a capture scheme, following a pilot scale trial. In this case the intention is to liquefy 400 $ktpa_{CO2}$ and export this to storage, again with Aker Solutions. At a smaller scale, the Saga City plant in Japan captured 10 tpd_{CO2} and sells it into the agricultural sector. In principle there are options to store CO_2 to sequester it from the environment (as Klemetrud), or to use it beneficially (as Twence and Saga). The exact use of the material will dictate whether or not the CO_2 is ultimately removed from the atmosphere or will ultimately be emitted in final emissions from another source. Whilst, from a climate perspective, the capture and storage of CO_2 has the greatest benefit, as this carbon is locked up rather than emitted, there may still be benefit in the capture and reuse even where the final user of the carbon will ultimately release the CO_2 into the atmosphere. This is as this type of recycling of carbon may still avoid the use of some other carbon bearing material with its own life cycle CO_2 emissions.

Options for utilisation, that will still ultimately lead to an emission of CO_2 from another point, are numerous.

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Food production, in particular in greenhouses, commonly use additional CO_2 to enhance growth rates of plants such as tomatoes. In large agricultural regions, particularly in countries like the Netherlands, there are CO_2 distribution networks to meet this demand, with flue gas being conveyed from combustion plant to end users. However, in some cases this demand has been met by burning gas in boilers or small combustion engines. Providing CO_2 from the EMERGE Centre where such situations arise in the UK would displace these gas consumers.

Elsewhere in the food industry CO_2 is used directly, for carbonation of drinks, preservation of meats and salads, refrigeration, as well as for decaffeination of coffee[3]. Food-quality CO_2 from the EMERGE Centre could be used in such applications.

The production of synthetic natural gas using CO_2 captured from emitters, and green hydrogen produced by electrolysis using renewable electricity gives the opportunity to provide several valuable services. Uniper has experience through a number of green hydrogen trials in Germany, including our Falkenhagen plant where methanation has being trialled as part of the EU funded Store & Go project[4] with a biogenic CO_2 source coupled to an electrolysis unit.

Building on Uniper's experience in carbon capture, the company is investigating the opportunities for synthetic fuel production, to allow offsetting of carbon emissions in other sectors. Again, here captured CO_2 and hydrogen are combined to produce fuels, with the aviation and shipping sectors being seen as particularly attractive end users due to the difficulty in decarbonising these types of emission sources. One such technology is that of Velocys[5], though others are being developed. The Velocys pilot facility in Oklahoma has been operated for 5,000 hours and works on the basis of combining CO with hydrogen over catalysts at elevated temperatures and pressures to produce liquid hydrocarbon fuels using well established Fischer-Tropsch chemistry. Recycling of CO_2 requires an additional source of energy and a catalyst to provide the correct building blocks for the Fischer-Tropsch chemistry to progress. An alternative fuel production route is discussed in [19], and involves the reaction of hydrogen with CO_2 to produce methanol. In this reference, CO_2 is naturally occurring, but there is no reason why it could not be sourced from flue gases or other processes associated with the EMERGE Centre. Further discussion of synthetic fuels is provided by Rosa [20].

The production of other chemical intermediates, besides methanol, where final products may be combusted or disposed in a way that releases carbon into the environment, has the potential to reduce CO_2 impacts on the environment. These intermediates, sometimes referred to as platform chemicals, are often considered as being biomass derived [21], but it is also possible that they may be derived from recycled CO_2, in much the same way as with the synthetic fuels mentioned previously. Such platform chemicals include, but are not limited to, methane, formic acid, ethylene and alcohols, and can be expanded further using Fischer-Tropsch chemistry. The chemicals also have the advantage of sustaining today's industrial base in the use of these materials to manufacture final products. Overall many chemical products manufactured today from fossil based feedstocks can be manufactured from CO_2 [22].

The Twence EfW plant has trialled the production of sodium bicarbonate using slipstream levels of CO_2 captured from its flue gas. This product is then used to clean the flue gas of the plant of other acid gases. The sodium carbonate is a lower cost feed than buying sodium bicarbonate directly, and whilst CO_2 is liberated in the flue gas as the acid gases are captured, the CO_2 associated with delivery to site of the bicarbonate feed is avoided [23].

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[3] https://www.co2gas.co.uk
[4] https://www.storeandgo.info/demonstration-sites/germany
[5] https://www.velocys.com/technology

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There will also be other users of CO_2 in industrial contexts, such as fire extinguishers, fire suppression, metal fabrication, and dry ice production, though it is expected that these users will be orders of magnitude lower than the potential in chemical and fuel manufacture. One exception is urea (fertiliser) manufacture, where CO_2 consumption is very high. However, this is not deemed to be an immediately accessible market to the EMERGE Centre as there appears to be no production in the UK[6]. This would then require the export of CO_2 to dovetail with existing urea production.

In contrast to the options discussed above, there are routes that permanently sequester the CO_2. These include mineralisation where air pollution control residues or other ashes from the EMERGE Centre are used to produce new engineered building materials. Locking up CO_2 in this way makes scenarios of this type analogous to storage in former oil or gas fields, or in aquifers, where the CO_2 is removed from the carbon cycle.

The International Energy Agency has reviewed options for CO_2 use, and identify building material production as a potential opportunity [24]. Here, residues from operations including power plant, energy centres (like the EMERGE Centre) or steelworks can be recycled into high value building materials using CO_2, rather than landfilled. The Carbon8 process is referenced by the IEA as having existing operations that convert 60 ktpa of residues into building products, by reaction with CO_2. This offers the potential for the EMERGE Centre to use its own combustion residues for carbon sequestration. Orbix has developed an analogous technology, known as Carbstone, in collaboration with VITO and Walloon CTP[7]. Again, slag materials from, for example, steelworks are milled, and the free oxide content hydrated. The mix is then formed into blocks (or whatever structure the final items are required to be), and exposed to heat and CO_2 in an autoclave. The blocks capture and fix of CO_2, and give an additional benefit as, given cement use can be avoided, the CO_2 associated with cement manufacture and transport can be avoided[8].

In the majority of these cases, where either a CO_2 reuse stream is to be added later, or CO_2 is to be taken and stored, there will be some form of CO_2 capture process integrated with the flue gas path, either of the EMERGE Centre itself, or in its fuel pre-processing steps where these generate a product stream bearing CO_2. Where CO_2 concentration is relatively low, it is likely that this plant will be of a form similar to a post combustion capture plant (with CO_2 removal by a solvent, with subsequent recovery), but instead of CO_2 compression for transport the CO_2 will be produced in whichever form, be that liquid or compressed gas, required by its end user. If any pre-processing steps produce a high concentration CO_2 stream, then this step may be different, and perhaps be more similar to the gas purification considered for oxyfuel plant.

Wood, in work undertaken for BEIS [25], quoted that the CO_2 distribution market within the UK is dominated by three main providers: BOC, Air Products and Air Liquide. Between them, these organisations cover approximately 90 % of annual sales of around £200 million (based on other work undertaken by IBIS). The remaining 10 % presumably coming from direct sales by those producing CO_2 to end users. Typical prices for sale of carbon dioxide to industrial gas distributors are in the range of £30 to £40 per tonne, whilst for resale, these companies may charge upwards of £70 per tonne. This implies a current volume, met be existing sources, of c2.9 $mtpa_{CO2}$.

Whilst distribution of carbon dioxide to end users is currently dominated by three companies, the overall supply to the market is dominated by parties that need to remove CO_2 as a part of

[6] https://knoema.com/atlas/topics/Agriculture/Fertilizers-Production-Quantity-in-Nutrients/Urea-production
[7] https://www.orbix.be/en/technologies/carbonation
[8] https://www.orbix.be/en/carbonation-technology

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their own production processes, such as fertiliser manufacturers and bioethanol producers. There is also a small proportion of the UK industrial CO_2 gas supply provided by imports from Europe. However, since carbon dioxide carries relatively low value, long distance transport by road may not always be justified. Wood, again, quotes that target users for CO_2 should be within 100 km of the point of CO_2 production.

The economic case for recycling of captured CO_2 is not currently strong. If it were economic against today's alternatives, then operators of CO_2 emitters would be capturing and recycling CO_2 under today's market conditions.

Fertiliser manufacturers and bioethanol producers, as referenced above, have a need to separate CO_2 as it is a by-product of their manufacturing process. The EMERGE Centre would have an overall impact of reducing CO_2 emissions only where CO_2 it produces is used to displace CO_2 produced specifically for a given use, or to avoid life cycle CO_2 emissions from the use of other products. Where CO_2 is produced as a by-product and would otherwise need to be vented to atmosphere, there would therefore be no net CO_2 reduction if the EMERGE Centre displaced this CO_2 usage.

Therefore, assuming supply and demand are broadly balanced, there needs to be some greater market incentive in place to encourage the increase uptake of these CO_2 reuse technologies. These are likely to be highly specific to countries, or perhaps even regions, depending on prevailing regulations, and incentives in place, and particularly the size of the barriers to entry for products. However, it remains the case that to achieve a Net Zero CO_2 goal by 2050, these mechanisms will need to be put in place so that CO_2 emissions can be offset or displaced completely by products, be they fuels, building materials or platform chemicals, manufactured from recycled CO_2.

Uniper has completed work to understand the economic barriers to entry into markets for these recycled CO_2 materials. However, due to commercial considerations, these cannot be shared here. However, to give an indication for mixed mineralisation and agriculture use, the Twence project has estimated an additional income of €40–50/te_{CO2} captured is required to make this viable over and above current incentives for their scenario. For chemical production using recycled CO_2 the price of energy that can be accessed by users will have a great influence on overall economics. One source has suggested the additional income related to make the CO_2 use viable would be in the range of -\$80 to +\$320/te_{CO2} [26] though it is not clear under what circumstances the carbon price could be negative.

4.2.2.6 On-site Capture of CO_2 from Separate Waste Streams

The primary driver behind the Government's policy to remove biogenic component of waste from the waste stream (see Section 4.1) is to avoid the methane emissions associated with allowing this component to be landfilled.

This can be achieved in two ways, both of which offer potential routes to decarbonise emissions from the EMERGE Centre.

Firstly, preventing the entire waste stream from going to landfill and combusting it within energy recovery plants such as the EMERGE Centre fitted with an appropriate level of carbon capture would ensure net zero emissions from the facility. As shown in Table 19 this would require a capture rate of around 41 % based on the anticipated fuel composition, with potential to reduce to below 30 % if food waste and plastics are eliminated from the incoming waste.

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Secondly, non-biogenic CO_2 emissions could be offset through treatment of the removed biogenic component, for instance through the use of anaerobic digestion after material pretreatment.

In anaerobic digestion, the product biogas contains a mixture of methane and CO_2. This CO_2 requires removal if the ultimate aim is to inject the methane into the gas network or use it as a feedstock in subsequent processes. In addition to anaerobic digestion, a number of other processing options are being considered to complement the EMERGE Centre. An alternative processing scheme is to produce bioethanol from the pretreated waste. The final step in this scheme is to distil the ethanol, a process that also yields a concentrated CO_2 product stream that could be captured. The pretreated waste could also be used, following drying, as feed for a pyrolysis unit. The unit would produce a biochar (which locks-up part of the carbon) and a syngas. On cooling, heavier bio-oils condense out of the syngas stream, leaving a gaseous product rich in methane and CO_2. Again, this is a concentrated CO_2 stream where carbon capture can be applied.

These options are potentially very attractive for the Ratcliffe-on-Soar site given that:

- The site is well positioned for waste treatment from a fuel availability, transport and power production infrastructure perspective as outlined in the main Environmental Statement;
- The use of anaerobic digestion, pyrolysis or bioethanol production technologies yield a high concentration CO_2 streams relative to a combustion based energy from waste plant. This may offer cost-savings and a reduced capture plant footprint compared to capture from the flue gas of the EMERGE Centre itself; and
- The wider ambition of Uniper to turn the site into a low carbon centre for the UK.

This second approach of offsetting through treatment of the removed biogenic component also provides a level of reassurance that credible decarbonisation options remain in a partial policy failure situation where the regulation successfully reduces the biogenic carbon content of waste whilst failing to significantly reduce the plastic content, resulting in an overall increase in the non-biogenic carbon content of waste delivered to the EMERGE Centre.

4.2.2.7 Site Specific Issues for the Proposed Development

The energy from waste sector offers a number of attractions in relation to CCS, in particular that capture of CO_2 from the biogenic waste stream constitutes the removal of CO_2 from the atmosphere (BECCS) which could, at facility level, offset emissions associated with waste delivery or associated conventionally fired auxiliary plant. Similarly, BECCS could be used to decarbonise the waste sector by fitting CCS where it can be more cost-effective (for instance, on larger new plants close to offshore east coast storage) and offsetting CO_2 emissions from energy recover plants which are harder and more expensive to decarbonise (i.e. older plant or those more distant from the coast). This could be achieved through bilateral or energy recovery sector agreements to offset overall CO_2 emissions by implementing BECCS on the sector's own sites, or by agreement with operators of BECCS plant elsewhere. Alternatively, CCS on energy recovery plants could be used to support the UK meeting its 2050 net zero target by offsetting emissions from other hard to decarbonise sectors.

The Proposed Development site is not well suited for stand-alone CCS from a transport and storage perspective; being situated some 80 km from the coastline, this would lead to dedicated pipeline costs being prohibitive. Major geographical obstacles such as the M1 motorway and the River Trent may also provide challenges in relation to pipeline routing. There would, however,

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be potential for CCS in the event that national CO_2 transport and storage infrastructure is developed in the region.

Alternatives would include the capture, liquefaction and transport of CO_2 by road or rail to east coast storage sites or to potential CO_2 users. Such an approach would incentivise minimising the total CO_2 capture volume to that corresponding to the non-biogenic fraction alone plus any additional offsetting required, to reduce the plant size and transport costs. This is unless there is a significant economic incentive to capture the CO_2, such as may be prevalent where CO_2 recycling is deemed appropriate.

Whilst the Proposed Development site covered in the planning application is relatively constrained, there would be ample space on the wider Ratcliffe-on-Soar power station site, which is under Uniper ownership, to locate a carbon capture facility to treat the waste gases from the Proposed Development.

4.3 Conclusions Relating to Achieving Net Zero by 2050

Decarbonisation of an energy recovery facility such as the Proposed Development can be achieved via either decarbonising the waste fuel or capturing CO_2 from the flue gases arising from combustion, or through a combination of both. The CCC report supporting the Government’s net zero by 2050 target recommends specific policy options aimed at reducing both the plastic and biogenic content of waste, which is expected to deliver significant additional decarbonisation of the waste stream when implemented. Similarly, recommended action in the transport sector involving electrification and hydrogen fuels should deliver significant decarbonisation of waste transport.

Carbon capture is costly and complex, but does hold the potential to deliver negative carbon emissions from energy recovery plants by also removing the biogenic emissions from the atmosphere. Again, Government policy will be required to provide the supporting infrastructure and investment to allow widespread implementation, but this approach is supported by the CCC report recommendations. CCS is being implemented on a large scale energy recovery plant in Norway, demonstrating that the sector is actively addressing this option.

Energy from waste plants have successfully enabled the diversion of waste to landfill over the past decade leading to a substantial reduction in CO_2 emissions from the waste sector.

The Proposed Development will initially support the transition to the Government’s 2050 net zero target by:

- Achieving R1 status from the start of operations making it more energy efficient than other existing energy recovery plants in the UK;
- Reducing the emissions of CO_2 relative to disposal in landfill;
- Proactively identifying and implementing CHP opportunities; and
- Providing an anchor facility to establish the wider Ratcliffe-on-Soar site redevelopment as a low carbon and sustainable energy hub for the region.

Emissions of CO_2 from the facility will be reduced to net zero by 2050 through one or a combination of the following approaches:

- Elimination of non-biogenic carbon from the incoming waste stream;
- Implementation of on-site carbon capture from the EMERGE Centre with CO_2 storage or usage;

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- Implementation of on-site carbon capture from a separate biogenic waste stream to offset emissions of non-biogenic CO2 from the EMERGE Centre, coupled with storage or usage; and/or
- Bilateral or energy from waste sector agreements to offset overall CO2 emissions by implementing bio-energy with carbon capture and storage (BECCS) at the most cost-effective energy from waste or other biomass fuelled plants.

Furthermore, there is also the opportunity to use carbon based products, manufactured using CO_2 captured from the EMERGE Centre to displace emissions from other hard to decarbonise sectors.

5 ROADMAP TO NET ZERO EMISSIONS

Overall, whilst Uniper cannot predict what technologies will be available in thirty years' time, a road map has been developed to set out a journey to achieve a net zero future at Ratcliffe-on-Soar. This is set out, with expectations of timelines, below. This journey is likely to feature a mix of the technologies that Uniper is exploring across the business, which includes, but is not limited to the approaches set out below. Ultimately full decarbonisation of the EMERGE Centre will be achieved using one of, or a combination of, the three longer term measures.

Day 1 of Operations (2025)	• EMERGE Centre will operate with R1 compliance, reducing greenhouse gas emissions by diverting waste from landfill and export abroad; and • EMERGE Centre designed to allow fuel flexibility should the nature of the incoming waste change over time and recycling levels increase.
Short Term (2025–2035)	• EMERGE Centre designed to be 'CHP ready' for connection to a district heating scheme, with industrial users or manufacturers to use lower carbon energy and heat generated by the facility; • Changes to the composition of the fuel mix to reduce the non-biogenic carbon contained in the incoming waste stream driven by Government policy on recycling; and • Potential co-location of a facility to recycle / reuse products extracted from the incoming waste stream (circular economy) reducing the non-biogenic content of the fuel mix and displacing CO_2 emissions associated with the production of products or feedstocks which the extracted products replace.
Longer Term (2030–2050)	• Change in fuel stock to 100 % biomass waste (e.g. agricultural and construction industry wastes); • Carbon Capture and Use (and potentially storage); and/or • Bilateral or energy recovery sector agreements to offset overall CO_2 emissions by implementing BECCS.

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APPENDIX 8-5: VEHICLE EMISSIONS DISPERSION MODELLING

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FICHTNER
Consulting Engineers Limited

Uniper Energy

EMERGE Centre

Vehicle Emissions Dispersion Modelling

1 Introduction

Fichtner Consulting Engineers (Fichtner) has been engaged by Uniper Energy (the Client) to undertake dispersion modelling of vehicle emissions arising from the construction and operation of the proposed East Midlands Energy Re-Generation (EMERGE) Centre (the Proposed Development) to be located on the Ratcliffe-on-Soar power station site.

2 Objective

This technical note presents the methodology and results of the dispersion modelling study. The study considers the impact of emissions generated by vehicles on the public road network travelling to and from the Site during the construction and operational phases of the Proposed Development, both alone and in-combination with process emissions from the main stacks of the Proposed Development.

In 2017 the IAQM published the guidance document "Land-Use Planning & Development Control: Planning for Air Quality" (referred to within this report as the IAQM 2017 guidance). The IAQM 2017 guidance states that an air quality assessment is required where a development would cause a "significant change" in Light Duty Vehicles < 3.5t (LDV) or Heavy Duty Vehicles >3.5 t (HDVs). The indicative criteria to progress to an assessment are:

- A change in LDV flows of:
  - more than 100 Annual Average Daily Traffic (AADT) within or adjacent to an Air Quality Management Area (AQMA); or
  - more than 500 AADT elsewhere.
- A change in HDV flows of:
  - more than 25 AADT within or adjacent to an AQMA; or
  - more than 100 AADT elsewhere.

The Proposed Development is not within or adjacent to an AQMA. Traffic generation rates for the Proposed Development have been provided by the transport consultant for the project (AXIS). The change in vehicle flows for both the construction and operational phases exceeds the screening criteria along the A453 Remembrance Way between the junction with Barton Lane and W Leake Lane (the Site access) and junction 24 of the M1 motorway. Therefore, dispersion modelling has been undertaken to quantify the impact of emissions at sensitive receptor locations along the A453. This assessment considers emissions of nitrogen dioxide and particulate matter as PM_{10} and $PM_{2.5}$.

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3 Conclusions

The assessment has considered the impact of vehicle emissions generated by the construction and operational phases of the Proposed Development on concentrations of nitrogen dioxide and particulate matter at receptor locations along the A453 where development-generated vehicle numbers exceed the screening criteria presented in Section 2. This has considered the impact of vehicle emissions in isolation, and the in-combination impact of vehicle and process emissions. The assessment has been undertaken based on the following conservative assumptions:

- Vehicle emissions factors and background pollutant concentrations do not improve from 2017 levels in future years;
- The process contribution from the Proposed Development has been modelled to include the contribution from the EMERGE Centre and the OCGTs and the coal-fired power station, as per emissions scenario D detailed in Appendix 8.1 of the Environmental Statement; and
- For the assessment of the in-combination impact of vehicle and process emissions, the maximum contribution from any year of meteorological data from vehicle emissions has been added to the maximum contribution in any year from process emissions for each receptor. In reality, the maximum contributions from vehicle and process emissions are likely to occur under different meteorological conditions and therefore in a different years of meteorological data.

The main conclusions of the assessment are as follows:

1. No exceedance of any annual mean or short-term Air Quality Assessment Level (AQAL) is predicted;
2. The impact of vehicle emissions generated by the construction phase of the Proposed Development is predicted to be ‘negligible’ irrespective of the total concentration at all identified receptor locations;
3. The impact of vehicle emissions generated by the operational phase of the Proposed Development is predicted to be ‘negligible’ irrespective of the total concentration at all identified receptor locations; and
4. The in-combination impact of vehicle and process emissions during the operational phase of the Proposed Development is predicted to be ‘negligible’ at all identified receptor locations.

As the impact at all receptor locations is described as ‘negligible’ the significance of effect of vehicle emissions from the Proposed Development is predicted to be ‘not significant’.

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4 Methodology

Dispersion modelling has been undertaken using the model ADMS-Roads 5, developed and supplied by Cambridge Environmental Research Consultants (CERC). ADMS-Roads is routinely used for modelling of emissions of traffic for planning purposes. The model has been used to predict the concentration of pollutants at the identified sensitive receptors.

4.1 Scenarios considered

In order to investigate the impact of the Proposed Development on the surrounding area the following assessment scenarios have been considered:

1. 2023 baseline 1 plus committed developments (construction phase do-minimum);
2. 2023 baseline 1 plus committed developments plus Proposed Development construction traffic (construction phase do-something);
3. 2025 baseline 1 plus committed developments (operational phase do-minimum); and
4. 2025 baseline 1 plus committed developments plus Proposed Development traffic (operational phase do-something).

The effect of the Proposed Development is defined as the difference between the 'do-something' and 'do-minimum' scenarios, i.e. scenario 2 minus scenario 1 for the construction phase, and scenario 4 minus scenario 3 for the operational phase.

4.2 Model input data

The model requires input data that details the following parameters:

- Traffic flow data;
- Vehicle emission factors;
- Spatial co-ordinates of vehicle emissions;
- Discrete receptor points; and
- Meteorological data and parameters.

4.2.1 Traffic flow data

Traffic flow data has been provided by AXIS for the scenarios listed above. The assessment has considered traffic using the 'baseline 1' scenario. As detailed in the Transport Assessment for the project, the 'baseline 1' scenario assumes continued operation of the coal-fired power station, which is a worst-case scenario. The construction phase data is based on the maximum predicted daily movements during the construction phase as a conservative measure.

Traffic data for the above scenarios is detailed in Table 1 below. Vehicles have been modelled at the speed limit.

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Table 1: Traffic Data (24-Hour AADT)

Road link	Speed (kph)		Do-Minimum		Do-Something		Development Trips	
	LDVs	HDVs	LDVs	HDVs	LDVs	HDVs	LDVs	HDVs
2023 Construction Phase								
A453 E of Jct with Kegworth Road	112	96	35484	3843	36007	3970	522	128
A453 W of Jct with Kegworth Road	112	96	35948	3853	36470	3981	522	128
2025 Operational Phase								
A453 E of Jct with Kegworth Road	112	96	35985	3895	36013	4147	28	252
A453 W of Jct with Kegworth Road	112	96	36456	3906	36484	4158	28	252

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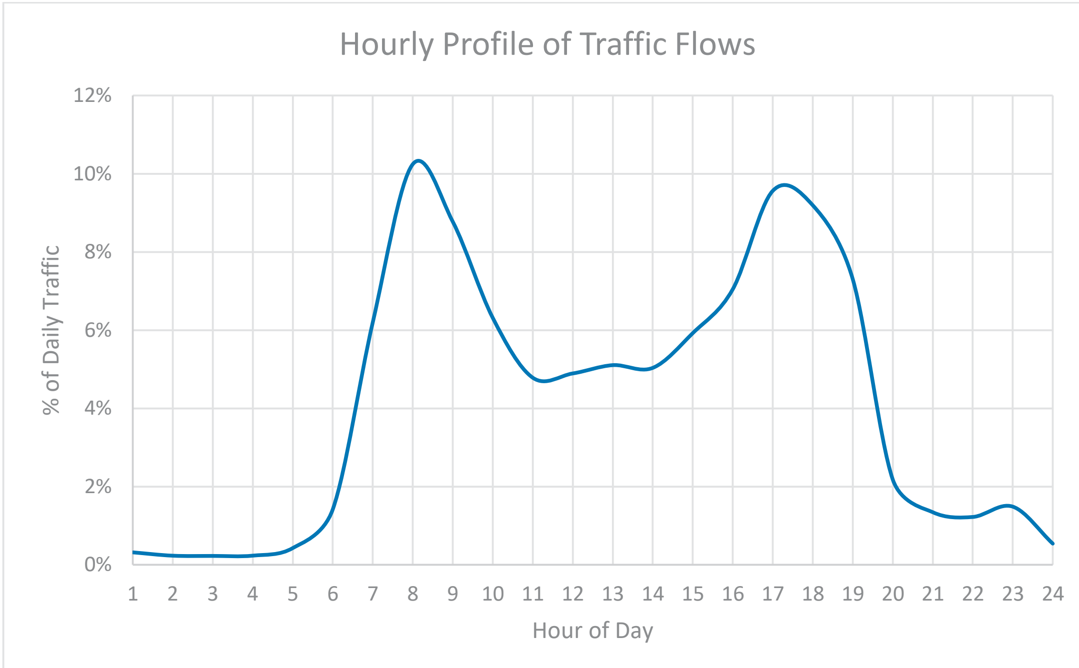
An hourly profile of baseline traffic as calculated from traffic count point data has been provided by AXIS. A graphical representation of this data is presented in Figure 1 below.

Figure 1: Hourly Profile of Traffic Flows



As shown in Table 1, the level of development-generated traffic is very low compared to the baseline flows (less than 2% of baseline flows). Therefore, the development-generated traffic will not significantly change the profile above. The above traffic profile has been applied as hourly time-varying emission factors for all modelled scenarios.

4.2.2 Vehicle emission factors

Emission factors for NO_X, PM_{10} and $PM_{2.5}$ have been determined for each scenario using the traffic data and the Emissions Factors Toolkit (EFT) v 9.0 (2VC) database of road traffic emission factors within ADMS-Roads. All roads were classified as "England (Rural)". Emissions for each link have been calculated using the EFT.

The EFT predicts that emissions from road vehicles will reduce in future years as newer, cleaner vehicles enter the fleet. However, evidence has shown that the rate of this reduction may not be occurring in the real world. As such, the assessment has taken a conservative screening approach in which emissions factors for 2017 (the earliest year available in the EFT). This eliminates any uncertainty as to how emissions factors will change in future years. This approach to emissions factors is in line with the position statement released by the IAQM in October 2018[1] relating to detailing with uncertainty in vehicle NOx emission factors.

[1] IAQM, Dealing with Uncertainty in Vehicle NOx Emissions Within Air Quality Assessments, October 2018

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4.2.3 Spatial co-ordinates of vehicle emissions

Street locations and widths were estimated from a desk-top mapping study and referenced to UK National Grid Reference (NGR) co-ordinates.

It is not possible to enter building dimension data into the ADMS-Roads dispersion modelling software to calculate building downwash. However, it is possible to define some roads as ‘street canyons’. A desk-stop study has been carried out through a review of aerial photos. There are no road sections in the study area that could be defined as street canyons.

4.2.4 Discrete receptor points

Five discrete receptor locations (residential properties) have been identified within 200 m of the A453 between the Site access and the M1 motorway. These receptors are listed in Table 2 below and their location shown in Appendix A.

Table 2: Road Traffic Emissions Human Sensitive Receptors

ID	Description	X (m)	Y (m)	Height (m)
R1	Dowells Barn Cottage	448267	328106	1.5
R2	Long Lane Farm	449215	328904	1.5
R3	Cedar Isle 1	449256	328933	1.5
R4	Cedar Isle 2	449632	329128	1.5
R5	Winking Hill Farm	450927	329760	1.5

4.2.5 Meteorological data and parameters

To calculate pollutant concentrations at identified receptor locations, the model uses sequential hourly meteorological data, including wind direction, wind speed, temperature, cloud cover and stability, which exert significant influence over atmospheric dispersion.

Sequential 1-hour meteorological data used in this assessment were taken from Sutton Bonington, located approximately 3.5 km south-west of the Proposed Development, for 2015 - 2019. This is the same data as used in the assessment of process emissions. The meteorological parameters used are the same as used in the process emissions modelling as detailed in Appendix 8.1 of the Environmental Statement, i.e. the surface roughness length has been set to 0.35 m for the study area and 0.25 m for the meteorological site.

A terrain file was used in the process emissions modelling to model the effect of terrain on airflow and dispersion of pollutants from the stacks. Terrain effects have much less influence on emissions from vehicles, especially as in this case the terrain is flat between the A453 and the receptors considered. Therefore, terrain effects have been excluded from the ADMS-Roads model.

4.3 Background data

For the purpose of the assessment the mapped background concentrations for each receptor point have been extracted from the DEFRA 2017 mapped background dataset and are presented.

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Table 3: Mapped Background Pollutant Concentrations

ID	Description	Nitrogen Dioxide	PM_{10}	$PM_{2.5}$
R1	Dowells Barn Cottage	18.00	18.10	10.84
R2	Long Lane Farm	16.30	15.91	10.09
R3	Cedar Isle 1	16.30	15.91	10.09
R4	Cedar Isle 2	16.83	16.20	10.22
R5	Winking Hill Farm	15.96	15.88	10.14

There is considerable uncertainty as to how background pollutant concentrations will change in the future, so as a conservative measure the 2017 background pollutant concentrations have been applied to the future year (2023 and 2025) scenarios – i.e. assuming no reduction in background pollutant concentrations.

4.4 Post modelling - conversion from NOx to nitrogen dioxide (NO_2)

The modelled road-NOx and the mapped background concentrations have been used as inputs in DEFRA's NOx to NO_2 calculator (V7.1) to convert modelled NOx to NO_2 in accordance with the methodology outlined in LAQM.(TG16).

When converting from NOx to NO_2 the following inputs have been used:

- The year has been taken as the same as the emissions data, i.e. 2017;
- The local authority has been selected as "Rushcliffe" or "North West Leicestershire District" as appropriate for each receptor; and
- The traffic mix has been selected as "All non-urban UK traffic".

4.5 Validation and verification

The ADMS-Roads Model has been validated against real world monitoring, however LAQM.TG(16) recommends that the model output is verified where possible. As there are no roadside pollutant monitoring locations along the roads for which traffic data is available it is not possible to undertake model verification. Checks have been taken on the following factors to ensure as accurate a model as possible:

- Traffic data;
- Road widths;
- Distance between sources and monitoring locations;
- Speed estimates;
- Street canyons;
- Background concentrations; and
- Monitoring data.

ADMS-Roads models often under-predict vehicle emissions, particularly of oxides of nitrogen. This has become less evident in the more recent versions of the EFT, which have corrected for higher real-world emissions from diesel vehicles in comparison to Euro standards. Nonetheless, as the model cannot be verified, there is the potential for under-prediction of emissions. To mitigate against this, the maximum modelled annual mean concentration from the five years of weather data has been presented for each receptor.

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5 Assessment Criteria

The IAQM 2017 guidance includes the following matrix which should be used to describe the magnitude of impact based on the change in concentration relative to the Air Quality Assessment Level (AQAL) and the overall predicted concentration with the scheme – i.e. the future baseline plus the process contribution.

Table 4: IAQM Magnitude of Change Descriptors

Long term average concentration at receptor in assessment year	% change in concentration relative to AQAL			
	1	2 – 5	6 – 10	> 10
75% of less of AQAL	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Moderate	Moderate	Substantial	Substantial

It is intended that the change in concentration relative to the AQAL (the process contribution) is rounded to the nearest whole number. Therefore, any impact which is between 0.5% and 1.5% will be classified as a 1% change in concentration.

The AQALs for each pollutant considered set out in Table 5 below:

Table 5: Air Quality Assessment Levels (AQALs)

Pollutant	AQAL (µg/m³)	Averaging Period	Frequency of Exceedances
Nitrogen dioxide	200	1 hour	18 times per year (99.79th percentile)
	40	Annual	-
Particulate matter (PM_{10})	50	24 hours	35 times per year (90.41st percentile)
	40	Annual	-
Particulate matter ($PM_{2.5}$)	25	Annual	-

Table 4 sets out the criteria for defining the magnitude of change. In accordance with the IAQM 2017 guidance, this considers the sensitivity of the receptor to additional pollution. The significance of the effect should then be determined based on professional scientific judgement taking into consideration the spatial extent of impacts and number of receptors impacted by the Proposed Development. An impact describes as 'moderate' or greater at a receptor location is classified as a significant effect for the purpose of this assessment.

This assessment has focused on the impact in relation to the annual mean AQAL for nitrogen dioxide, PM_{10} and $PM_{2.5}$. As shown in Table 5, there are also short term AQALs for nitrogen dioxide and PM_{10}. Local Air Quality Management Technical Guidance Note 16 (LAQM.(TG16)) states that if annual mean nitrogen dioxide concentrations are above 60 µg/m^3 (i.e. 150% of the AQAL), there is the potential for exceedences of the 1-hour AQAL.

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With regard to daily mean PM_{10}, LAQM(TG16) states that the number of exceedances of the AQAL per year can be predicted from the predicted annual mean concentration using the following relationship:

$$No. 24 - hour\ mean\ exceedances = -18.5 + 0.00145 \times annual\ mean^3 + (206/annual\ mean)$$

6 Results

6.1 Vehicle emissions

6.1.1 Construction phase

The results of the modelled vehicle emissions during the construction phase of the Proposed Development at the five identified sensitive receptor locations is presented in Table 6 below.

Table 6: Results – Construction Phase (2023) – Vehicle Emissions Only

Receptor	Do-Minimum		Do-Something		Impact		
	µg/m³	% AQAL	µg/m³	% AQAL	µg/m³	% AQAL	IAQM Impact Descriptor
Nitrogen Dioxide							
R1	26.03	65.08%	26.15	65.38%	0.12	0.30%	Negligible*
R2	23.77	59.43%	23.89	59.73%	0.12	0.30%	Negligible*
R3	24.04	60.10%	24.16	60.40%	0.12	0.30%	Negligible*
R4	25.15	62.88%	25.28	63.20%	0.13	0.33%	Negligible*
R5	20.70	51.75%	20.78	51.95%	0.08	0.20%	Negligible*
Particulate Matter as PM_{10}							
R1	19.03	47.57%	19.04	47.61%	0.02	0.04%	Negligible*
R2	16.77	41.91%	16.78	41.95%	0.02	0.04%	Negligible*
R3	16.80	42.00%	16.81	42.04%	0.02	0.04%	Negligible*
R4	17.15	42.89%	17.17	42.93%	0.02	0.04%	Negligible*
R5	16.41	41.03%	16.42	41.06%	0.01	0.02%	Negligible*
Particulate Matter as $PM_{2.5}$							
R1	11.45	45.80%	11.46	45.85%	0.01	0.04%	Negligible*
R2	10.65	42.59%	10.66	42.63%	0.01	0.04%	Negligible*
R3	10.67	42.68%	10.68	42.72%	0.01	0.04%	Negligible*
R4	10.85	43.40%	10.86	43.45%	0.01	0.05%	Negligible*
R5	10.49	41.97%	10.50	42.00%	0.01	0.03%	Negligible*
*Note: *Negligible irrespective of the total concentration*							

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As shown, the impact of construction phase vehicle emissions at all receptor locations is less than 0.5% of the annual mean AQAL and is described as 'negligible' irrespective of the total concentration in accordance with the criteria in Table 4. The maximum annual mean nitrogen dioxide concentration is predicted to be 26.15 µg/m³, well below the concentration at which there is the potential for exceedance of the hourly AQAL. Using the relationship detailed in Section 5, the predicted number of exceedances of the daily mean AQAL for PM_{10} is 2.33, well below the 35 permitted exceedances per year.

6.1.2 Operational phase

The results of the modelled of vehicle emissions during the operational phase of the Proposed Development at the five identified sensitive receptor locations is presented in Table 7 below.

Table 7: Results – Operational Phase (2025) – Vehicle Emissions Only

Receptor	Do-Minimum		Do-Something		Impact		
	µg/m³	% AQAL	µg/m³	% AQAL	µg/m³	% AQAL	IAQM Impact Descriptor
Nitrogen Dioxide							
R1	26.13	65.33%	26.20	65.50%	0.07	0.18%	Negligible*
R2	23.86	59.65%	23.94	59.85%	0.08	0.20%	Negligible*
R3	24.14	60.35%	24.21	60.53%	0.07	0.18%	Negligible*
R4	25.25	63.13%	25.33	63.33%	0.08	0.20%	Negligible*
R5	20.76	51.90%	20.82	52.05%	0.06	0.15%	Negligible*
Particulate Matter as PM_{10}							
R1	19.04	47.60%	19.06	47.64%	0.02	0.04%	Negligible*
R2	16.78	41.94%	16.79	41.98%	0.02	0.04%	Negligible*
R3	16.81	42.02%	16.83	42.06%	0.02	0.04%	Negligible*
R4	17.17	42.92%	17.18	42.96%	0.02	0.04%	Negligible*
R5	16.42	41.05%	16.43	41.08%	0.01	0.03%	Negligible*
Particulate Matter as $PM_{2.5}$							
R1	11.46	45.84%	11.47	45.88%	0.01	0.04%	Negligible*
R2	10.66	42.62%	10.67	42.66%	0.01	0.04%	Negligible*
R3	10.68	42.71%	10.69	42.75%	0.01	0.04%	Negligible*
R4	10.86	43.44%	10.87	43.48%	0.01	0.04%	Negligible*
R5	10.50	41.99%	10.50	42.02%	0.01	0.03%	Negligible*
*Note: *Negligible irrespective of the total concentration*							

The impact of operational phase vehicle emissions at all receptor locations is less than 0.5% of the annual mean AQAL and is described as 'negligible' irrespective of the total concentration in accordance with the criteria in Table 4. The maximum annual mean nitrogen dioxide concentration of 26.20 µg/m³ is well below the level at which there is the potential for exceedance of the hourly AQAL. Using the relationship shown in Section 5, the predicted number of exceedances of the daily mean AQAL for PM_{10} is 2.34, well below the 35 permitted exceedances per year.

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6.2 In-combination process and vehicle emissions

The dispersion model of process emissions has been re-run for the receptors listed in Table 2. All model parameters are as presented in Appendix 8.1 of the Environmental Statement. As the mapped background concentration is on a 1 x 1 km grid, it is unlikely to capture the spatial variation of emissions from the existing sources (the OCGTs and coal-fired power station). Therefore the results below present the in-combination impact of vehicles and process emissions the Proposed Development, the OCGTs and coal-fired power station, i.e. Scenario D as detailed in Appendix 8.1 of the Environmental Statement. As such, this represents a highly conservative assessment. The maximum contribution from process emissions from all years of meteorological data at each receptor is presented in Table 8, and the in-combination impact of operational phase process and vehicle emissions is presented in Table 9.

Table 8: Process Contribution – Emission Scenario D

Receptor	Nitrogen Dioxide		Particulate Matter as PM_{10}		Particulate Matter as $PM_{2.5}$	
	µg/m³	% AQAL	µg/m³	% AQAL	µg/m³	% AQAL
R1	0.21	0.53%	0.02	0.05%	0.02	0.08%
R2	0.18	0.45%	0.01	0.03%	0.01	0.05%
R3	0.18	0.45%	0.01	0.03%	0.01	0.05%
R4	0.13	0.33%	0.01	0.02%	0.01	0.03%
R5	0.09	0.22%	0.01	0.01%	0.01	0.02%

Table 9: Results – Operational Phase (2025) – Process + Vehicle Emissions

Receptor	Do-Minimum		Do-Something		Impact		
	µg/m³	% AQAL	µg/m³	% AQAL	µg/m³	% AQAL	IAQM Impact Descriptor
Nitrogen Dioxide							
R1	26.13	65.33%	26.41	66.03%	0.28	0.71%	Negligible
R2	23.86	59.65%	24.12	60.30%	0.26	0.65%	Negligible
R3	24.14	60.35%	24.39	60.97%	0.25	0.62%	Negligible
R4	25.25	63.13%	25.46	63.66%	0.21	0.53%	Negligible
R5	20.76	51.90%	20.91	52.27%	0.15	0.37%	Negligible*
Particulate Matter as PM_{10}							
R1	19.04	47.60%	19.07	47.69%	0.04	0.09%	Negligible*
R2	16.78	41.94%	16.80	42.01%	0.03	0.07%	Negligible*
R3	16.81	42.02%	16.84	42.09%	0.03	0.07%	Negligible*
R4	17.17	42.92%	17.19	42.98%	0.03	0.06%	Negligible*
R5	16.42	41.05%	16.44	41.09%	0.02	0.04%	Negligible*
Particulate Matter as $PM_{2.5}$							
R1	11.46	45.84%	11.49	45.95%	0.03	0.12%	Negligible*
R2	10.66	42.62%	10.68	42.71%	0.02	0.09%	Negligible*
R3	10.68	42.71%	10.70	42.79%	0.02	0.09%	Negligible*

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Receptor	Do-Minimum		Do-Something		Impact		
	µg/m³	% AQAL	µg/m³	% AQAL	µg/m³	% AQAL	IAQM Impact Descriptor
R4	10.86	43.44%	10.88	43.51%	0.02	0.08%	Negligible*
R5	10.50	41.99%	10.51	42.04%	0.01	0.05%	Negligible*
*Note: *Negligible irrespective of the total concentration*							

Using the criteria in Table 4, the in-combination impact of process and vehicle emissions on concentrations of particulate matter as PM_{10} and $PM_{2.5}$ is described as 'negligible' irrespective of the total concentration at all receptors considered. At R5 the in-combination impact of process and vehicle emissions on concentrations of nitrogen dioxide is also described as 'negligible' irrespective of the total concentration. At R1 – R4, the in-combination impact rounds to 1% of the AQAL. As the total concentration is below 94.5% of the AQAL at all receptors, the impact is described as 'negligible'.

The maximum annual mean nitrogen dioxide concentration is predicted to be 26.41 µg/m³, well below the concentration at which there is the potential for exceedance of the hourly AQAL. Using the relationship detailed in Section 5, the predicted number of exceedances of the daily mean AQAL for PM_{10} is 2.36, well below the 35 permitted exceedances per year.

Yours sincerely

FICHTNER Consulting Engineers Limited

[redacted]

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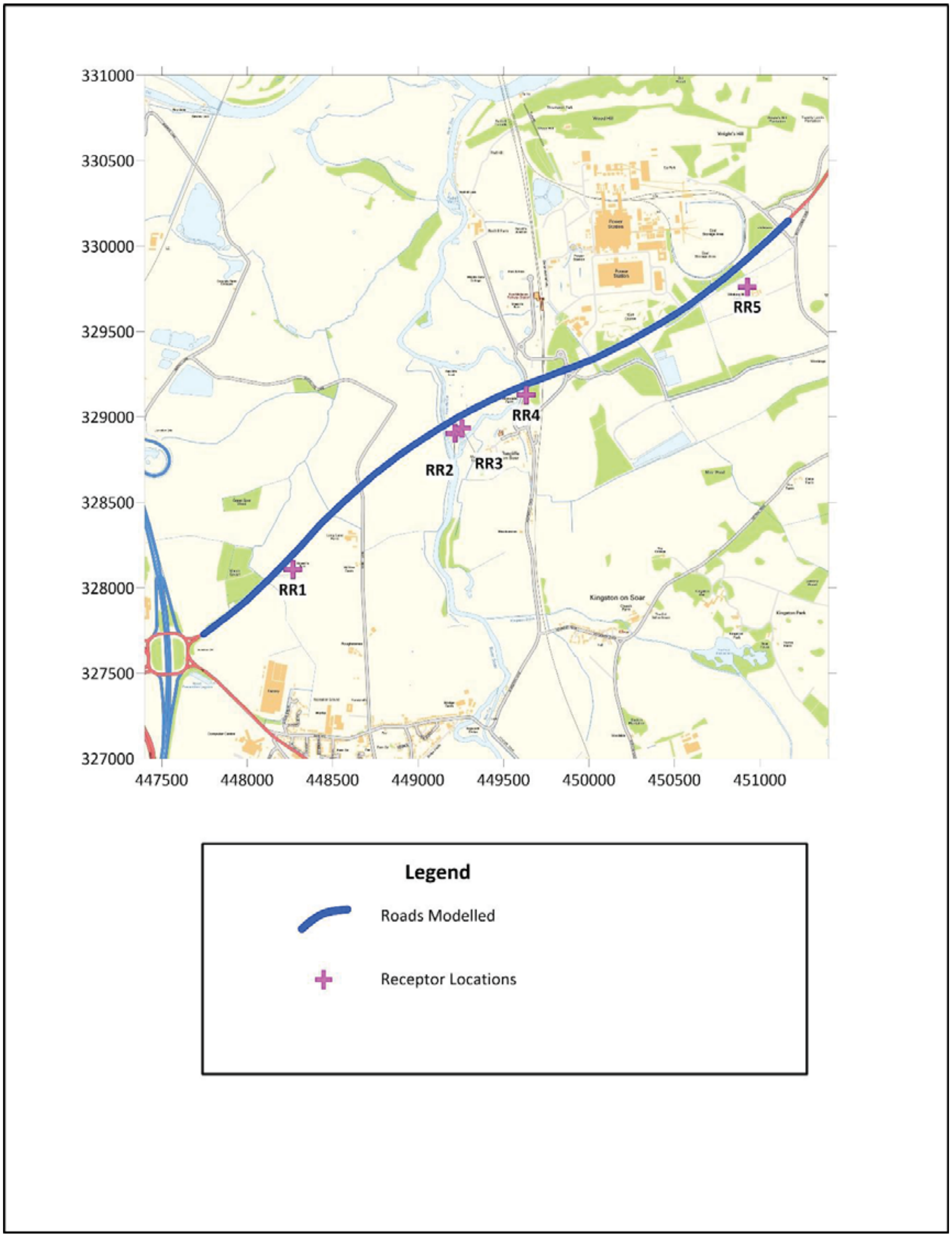
NCC received 16.07.2020

Appendices

NCC received 16.07.2020

A Roads Modelling Setup



NCC received 16.07.2020

APPENDIX 13-1: GAZETTEER OF HERITAGE ASSETS

Site Gazetteer

Site Number	3
Site Name	Microliths and one flint knife, Ratcliffe on Soar
Type of Site	Findspot
List Entry Number	
HER Number	ENT525; L227 - MNT227
Status	Non-designated
Easting	449750
Northing	330680
Parish	Ratcliffe on Soar, Rushcliffe
Council	Rushcliffe
Description	ARTEFACT SCATTER (Mes/Neo, (at some time) Mesolithic to Neolithic - 8000 BC to 2301 BC) A number of microliths and one Neo or possibly Mes flint knife found 1937. The area indicated falls on the S slope of a hill overlooking an extensive flood-plain. The field is under grass; nothing of significance was seen.

Site Number	4
Site Name	Two flint axes from shingle in River Trent, Thrumpton
Type of Site	Findspot
List Entry Number	
HER Number	ENT741; L385 - MNT385
Status	Non-designated
Easting	449700
Northing	331000
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	FINDSPOT (Pa-Neo, (at some time) Palaeolithic to Neolithic - 70000 BC to 2301 BC) From shingle in River Trent downstream from weir; 2 rough axeheads in flint, with secondary working on one; other much damaged.

Site Number	5
Site Name	Enclosure at Red Hill, Ratcliffe on Soar
Type of Site	Monument
List Entry Number	
HER Number	ENT743; L387 - MNT387
Status	Non-designated
Easting	449600
Northing	330300

NCC received 16.07.2020

Parish	Ratcliffe on Soar, Rushcliffe
Council	Rushcliffe
Description	RECTANGULAR ENCLOSURE (U, Unknown date) To the south of Red Hill, near the modern railway embankment, and NE of Red Hill Farm there is a rectangular enclosure with slightly raised banks which has been included in the scheduled area but which is probably Med or later in date. An enclosure at SK 495 302, with modern field boundaries to the E and S, may be the one mentioned above. The W boundary appears to be a plough headland, and the N boundary has been mutilated by ploughing. The enclosure cannot be identified in an area of rough pasture containing evidence of ridge and furrow .

Site Number	6
Site Name	Irregular enclosure, Ratcliffe on Soar
Type of Site	Monument
List Entry Number	
HER Number	ENT820; L427 - MNT426
Status	Non-designated
Easting	450800
Northing	330500
Parish	Ratcliffe on Soar, Rushcliffe
Council	Rushcliffe
Description	ENCLOSURE (U, Unknown date), LINEAR FEATURE (U, Unknown date) Double line and irregular enclosure, plus other marks, 1 mile NE of Ratcliffe close to NE-SW pylon line (soilmarks). The enclosure is located on a saddle between the much higher ground of Wright's Hill to the N and a small local elevation on its immediate S side. The linear mark appears to be angled across the S face of the elevation. The field is now under permanent grass and no surface indications of the marks are visible. Possibly of the IA/Ro period. Morph 7/2/1 UP enclosure. Position only on map. Data Held: Aerial Photograph (Aerial photograph). SNT2645. 1 BW print, CUCAP BR 55, SMR

Site Number	7
Site Name	Mes flint scraper, Thrumpton
Type of Site	Findspot
List Entry Number	
HER Number	ENT826; L433 - MNT432
Status	Non-designated
Easting	451100
Northing	331200
Parish	Thrumpton, Rushcliffe

NCC received 16.07.2020

Council	Rushcliffe
Description	FINDSPOT (Mes, Mesolithic - 8000 BC to 4501 BC) One microlithic flint (button scraper) was found, in his garden, by Mr R Wilson of Thrumpton. Penes the finder.

Site Number	8
Site Name	Neolithic macehead from the Trent, Thrumpton
Type of Site	Findspot
List Entry Number	
HER Number	ENT871; L479 - MNT477
Status	Non-designated
Easting	451000
Northing	331000
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	FINDSPOT (BA, Bronze Age - 2300 BC to 701 BC) Holed stone hammer-head from Thrumpton (probably BA). Mr Whitbread's collection. Siting not established. Present location of find Wollaton Hall Museum. Not drawn on map.

Site Number	9
Site Name	Coping stones of a Medieval well, Thrumpton
Type of Site	Findspot
List Entry Number	
HER Number	ENT872; L480 - MNT478
Status	Non-designated
Easting	451000
Northing	331000
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	FINDSPOT (Med, Medieval - 1066 AD to 1546 AD) Coping stones of a Med well.

Site Number	10
Site Name	Excavation East of Red Hill, Radcliffe on Soar by
Type of Site	Event - Intervention
List Entry Number	
HER Number	ENT 122, L501 - MNT499, L7957 - MNT7886

Site Gazetteer

Status	Event
Easting	449350
Northing	330550
Parish	Ratcliffe on Soar, Rushcliffe
Council	Rushcliffe
Description	Archaeological Intervention - Excavation

ENT 122
East of Red Hill trial excavation to determine age and purpose of site (SK 494336 given, incorrect).

L501 - MNT499
BUILDING (Ro, (at some time) Roman - 43 AD to 409 AD)
FLOOR (Ro, (at some time) Roman - 43 AD to 409 AD)
FOUNDATION (Ro, (at some time) Roman - 43 AD to 409 AD)
HEARTH (Ro, (at some time) Roman - 43 AD to 409 AD)
INHUMATION (Ro, (at some time) Roman - 43 AD to 409 AD)

Remains of large building with several rooms. Debris indicated two periods, early C2 to late C3 and early C4. Another complex with flue tile, building stone, coin of Tetricus and pottery. Sherds of black Belgic ware. Excavations 1956-60. Pottery ranges in date from C1 to C4, and seemed to be most plentiful close to the edge of the scarp to the E of Red Knob. It occurred down to a depth of c 20in, suggesting the Ro levels have been little disturbed by ploughing. One burial was found with a half pot in buff fabric, later C1. Near and below the skeleton was a hearth composed of waterworn pebbles. Pottery from this context includes some samian, grey and calcite-gritted wares and Derbys ware. A wall foundation was found on the edge of the scarp a few yards SW of the burial; the room to the N of it contained a burnt deposit 2ft thick. W of this room was a doorway and beyond it an area of stone paving. It appears that the Ro building is confined to the area on the top of Red Hill, and this is borne out by APs (taken 156 by RAF). Notes of these excavations and descriptions of the pottery have been deposited at NCM. Excavator also mentioned"fluted columns of red sandstone". Pottery is at NCM but there are no records of the excavation.

L7957 - MNT7886
ARTEFACT SCATTER (E Med, Early Medieval - 410 AD to 1065 AD)

Saxon pottery sherd with round stamp decoration. Incised bone handle - ?Saxon. A C6-C7 iron spearhead, from Houldsworth's excavation.

Site Number	11
Site Name	Machine excavation of pipeline, Red Hill, Ratcliffe on Soar
Type of Site	Event - Intervention
List Entry Number	
HER Number	ENT 754, L502 - MNT500, L7958 - MNT7887
Status	Event
Easting	449600
Northing	330200
Parish	Ratcliffe on Soar, Rushcliffe
Council	Rushcliffe
Description	Archaeological Intervention - Rescue excavation

NCC received 16.07.2020

ENT 754
Emergency excavations were carried out for the Ministry of Public Buildings and Works, during October and November 1963. This important site has for many years suffered from the attentions of untrained amateurs, whose diggings have done a considerable amount of damage. The added threat of building operations connected with the new power station occasioned the present excavations. The digging of a pipe-line by machine was watched.

L502-MNT500
ARTEFACT SCATTER (Ro, Roman - 43 AD to 409 AD)
IN SITU BURNT DEPOSIT (Ro, Roman - 43 AD to 409 AD)
INHUMATION (Ro, Roman - 43 AD to 409 AD)

The digging of a pipe-line by machine was watched, and evidence of Ro occupation was recorded. Levels of occupation silt with associated levels of burnt clay and 3 human burials were seen. Pottery ranging in date from C1 to C4 AD was recovered. 5 sherds of samian of C1 and C2, mortatria sherds, coarse potttery of C1-C2.

L7958 - MNT7887
ARTEFACT SCATTER (C4-C2 BC, (at some time) Iron Age - 399 BC to 100 BC)

The digging of a pipeline trench by machine was watched. 2 Iron Age sherds from the pipeline are from scored jars of the normal Trent Valley AB type. Scored ware from the middle to late IA was also recorded - C4-C2 BC.

Site Number	12
Site Name	Excavation at Greenfield's Site 1, Red Hill, Ratcliffe on
Type of Site	Event - Intervention
List Entry Number	
HER Number	ENT 123, L503 - MNT501
Status	Event
Easting	449800
Northing	330200
Parish	Ratcliffe on Soar, Rushcliffe
Council	Rushcliffe
Description	Archaeological Intervention - Trial Trenching

ENT 123
Emergency excavations were carried out for the Ministry of Public Buildings and Works, during October and November 1963. This important site has for many years suffered from the attentions of untrained amateurs, whose diggings have done a considerable amount of damage. The added threat of building operations connected with the new power station occasioned the present excavations. Site 1 (field 24, to be incorporated in the power station) Despite considerable trial trenching, no occupation was found.
Site 1 was directly threatened by building operations (connected with power station) and is now destroyed. An area of approximately 144m x 163m was covered with 131 test holes 1.22m square.

L503 - MNT501
ARTEFACT SCATTER (P Med, Post Medieval - 1547 AD to 1779 AD)
Site 1 (field 24, to be incorporated in the power station). Despite considerable trial trenching, no occupation was found. Some trenches, however, produced sherds of Post Medieval pottery.

NCC received 16.07.2020

Site Number	13
Site Name	Roman pottery, Thrumpton
Type of Site	Findspot
List Entry Number	
HER Number	ENT912; L520 - MNT518
Status	Non-designated
Easting	451000
Northing	331000
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	ARTEFACT SCATTER (Ro, Roman - 43 AD to 409 AD) In fields to rear of Council Houses, Main Street. Extensive but light scatter of pottery sherds (brought in farm "muck" from Glebe Farm, Barton?). Grid ref approx - not drawn on map.

Site Number	14
Site Name	Excavation at Greenfield's Site 4, Red Hill, Ratcliffe on
Type of Site	Event - Intervention
List Entry Number	
HER Number	ENT 752, L541 - MNT539
Status	Event
Easting	449400
Northing	330600
Parish	Ratcliffe on Soar, Rushcliffe
Council	Rushcliffe
Description	Archaeological Intervention - Trial Trenching ENT 752 Emergency excavations were carried out for the Ministry of Public Buildings and Works, during October and November 1963. This important site has for many years suffered from the attentions of untrained amateurs, whose diggings have done a considerable amount of damage. The added threat of building operations connected with the new power station occasioned the present excavations. Site 4 (field 6), a mound with a possible building beneath it. Site 4 remains undisturbed (other areas now destroyed). Trial trenches. Neither plans nor finds from this site are available now. L541 - MNT539 FEATURE (Ro, Roman - 43 AD to 409 AD) Site 4 - (field 6, a mound with a possible building beneath it). Trial trenches located an occupational level beneath the mound of red clay. The level was Ro in date and appeared to be associated with timber structures. No solid stuctural evidence was found. A date between Flavian and Antonine was suggested by the pottery. Neither plans nor finds from this site are available now.

NCC received 16.07.2020

Site Gazetteer

Site Number	15
Site Name	Excavation at Greenfield's Site 3, Red Hill, Ratcliffe on
Type of Site	Event - Intervention
List Entry Number	
HER Number	ENT 751, L543 - MNT541
Status	Event
Easting	449800
Northing	330500
Parish	Ratcliffe on Soar, Rushcliffe
Council	Rushcliffe
Description	Archaeological Intervention - Trial Trenching

ENT 751
Emergency excavations were carried out for the Ministry of Public Buildings and Works, during October and November 1963. This important site has for many years suffered from the attentions of untrained amateurs, whose diggings have done a considerable amount of damage. The added threat of building operations connected with the new power station occasioned the present excavations. Site 3 (field 11, due to be incorporated in the power station). Trial trenches were dug to locate a marking on an air photograph. Site 3 is now destroyed.

L543 - MNT541
ARTEFACT SCATTER (IA, (at some time) Iron Age - 700 BC to 42 AD)
GULLY (IA, (at some time) Iron Age - 700 BC to 42 AD)

Site 3 (field 11, due to be incorporated in the power station). Trial trenches were dug to locate a marking on an AP. The marking was of rectangular shape, but the excavations failed to prove this. 4 trenches revealed shallow features containing pottery sherds of late IA date. Site 3 now destroyed. 42 early IA sherds found in shallow gullies.

Site Number	16
Site Name	RED HILL: Ro pottery, Ratcliffe on Soar
Type of Site	Findspot
List Entry Number	
HER Number	ENT949; L560 - MNT558
Status	Non-designated
Easting	449500
Northing	330700
Parish	Ratcliffe on Soar, Rushcliffe
Council	Rushcliffe
Description	CASUAL FIND (ENT949)

Reported by H O Houldsworth, but unclear if he made the find.

ARTEFACT SCATTER (C1 to C4, (at some time) Roman - 43 AD to 399 AD)

At Red Hill: pottery scatter, C1 to C4, along the ridge.

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Site Gazetteer

Site Number	17
Site Name	Iron Age shield boss from River Trent, Ratcliffe on Soar
Type of Site	Findspot
List Entry Number	
HER Number	ENT1005; L616 - MNT613
Status	Non-designated
Easting	449520
Northing	330930
Parish	Ratcliffe on Soar, Rushcliffe
Council	Rushcliffe
Description	FINDSPOT (C3 BC, (at some time) Iron Age - 299 BC to 200 BC) The 3 pieces of horse armour (donated by Mr JA Mousley in 1928) were found 60ft below the bottom of the River Trent, near its junction with the River Soar, during the construction of the second Midland Railway over the River Trent, near Trent Junction, in November 1895. Recognised as an IA shield boss in 1994. Made of copper alloy (probably bronze), 894mm long, with boss near mid point of spine and a roundel at each terminal. 2 breaks in spine, 12 missing rivets and a few other missing fragments. Rivets show the backing of the shield (of wood or leather) was c 8mm thick. Of"Gaulish" type, C3 BC.

Site Number	18
Site Name	Ro coins from Nottingham/Wilford
Type of Site	Findspot
List Entry Number	
HER Number	ENT2432; L5232 - MNT5175
Status	Non-designated
Easting	450000
Northing	330000
Parish	Nottingham, Nottingham; Wilford, Nottingham
Council	Nottingham
Description	COIN HOARD (Roman - 43 AD to 409 AD), FINDSPOT (Roman - 43 AD to 409 AD) Having heard of some Ro coins lately plowed up about Nottm, I procured a parcel of them, but they proved common and most of Tetricus, tho' some also of Gallienus, Victorinus and Claudius Gothicus. Richard Cooper likewise told me of a pot of Ro money found at Wilford. Wilford - many Ro coins were dug up here a few years ago (ie c 1800), most of which were of the latter emperors. Old stone-paved ford and Ro coins at Wilford. Since it is not clear whether the 2 items referred to above were associated, the coins may be the hoard found before 1724, or the finds of early C19, or both.

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Site Gazetteer

Site Number	19
Site Name	Moat?, Ratcliffe on Soar
Type of Site	Monument
List Entry Number	
HER Number	ENT2437; L5237 - MNT5180
Status	Non-designated
Easting	450710
Northing	330340
Parish	Ratcliffe on Soar, Rushcliffe
Council	Rushcliffe
Description	MOAT (Med, Medieval - 1066 AD to 1546 AD) Site of moat visible on aerial photography. Buildings destroyed - site now deeply excavated and within the bounds of Ratcliffe Power Station. Immediately N the land slopes uphill and has been ploughed and planted, partly with trees and partly grass. Very slight scarping suggests a N outer corner, but no other traces could be seen. RAF, undated, Air Photos (Aerial photograph). SNT1160. Other Refs: F22 58/151 0335-6

Site Number	20
Site Name	Holed axehead from the River Trent near Barton
Type of Site	Findspot
List Entry Number	
HER Number	ENT2439; L5239 - MNT5182
Status	Non-designated
Easting	450000
Northing	330000
Parish	Barton in Fabis, Rushcliffe
Council	Rushcliffe
Description	FINDSPOT (Neo-BA, Neolithic to Bronze Age - 4500 BC to 701 BC) A holed axehead was dredged from the River Trent near Barton. Siting and present location not established. Not drawn on map.

Site Number	21
Site Name	Stone quern from Thrumpton
Type of Site	Findspot
List Entry Number	
HER Number	ENT2440; L5240 - MNT5183
Status	Non-designated
Easting	451070

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Northing	331090
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	FINDSPOT (Ro, Roman - 43 AD to 409 AD) In 1955 Mr Roger Wilson found a stone quern, probably Ro, and retained it.

Site Number	22
Site Name	Roman pottery scatter, Ratcliffe on Soar
Type of Site	Findspot
List Entry Number	
HER Number	ENT 2443; L5244 - MNT5186
Status	Non-designated
Easting	450800
Northing	330300
Parish	Ratcliffe on Soar, Rushcliffe
Council	Rushcliffe
Description	ARTEFACT SCATTER (Ro, Roman - 43 AD to 409 AD) A scatter of Ro pottery was found by the corner of the road to Drypot Barn.

Site Number	24
Site Name	Pa handaxe, Ratcliffe-on-Soar
Type of Site	Findspot
List Entry Number	
HER Number	ENT3181; L7343 - MNT7275
Status	Non-designated
Easting	449500
Northing	329900
Parish	Ratcliffe on Soar, Rushcliffe
Council	Rushcliffe
Description	FINDSPOT (Lower Pa, (at some time) Palaeolithic - 700000 BC to 60001 BC) Lower Palaeolithic handaxe, from a mound of sand, gravel and clay. Would be c 13cm long complete, but has lost its tip. Made probably of andesite tuff.

Site Number	25
Site Name	Ridge and furrow near Redhill Farm, Ratcliffe on Soar
Type of Site	Monument

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List Entry Number	
HER Number	L8870 - MNT8781
Status	Non-designated
Easting	449500
Northing	330200
Parish	Ratcliffe on Soar, Rushcliffe
Council	Rushcliffe
Description	RIDGE AND FURROW (Med, Medieval - 1066 AD to 1546 AD) Rough pasture containing evidence of ridge and furrow. Grid ref approx.

Site Number	26
Site Name	Southern Red Hill Tunnel/Portal, Thrumpton
Type of Site	Structure
List Entry Number	
HER Number	L8871 - MNT8782
Status	Non-designated
Easting	449550
Northing	330700
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	STRUCTURE (1901, (throughout) Modern - 1901 AD) The (London-Derby) line was doubled in 1901 and another tunnel was made by the side. The original portal was copied but opposite hand so that the two are now a pair.

Site Number	27
Site Name	RED HILL: Ro cremation from Red Hill, Ratcliffe on
Type of Site	Monument
List Entry Number	
HER Number	ENT744; L8881 - MNT8792
Status	Non-designated
Easting	449500
Northing	330200
Parish	Ratcliffe on Soar, Rushcliffe
Council	Rushcliffe
Description	CREMATION (Ro, Roman - 150 AD to 249 AD) A fine Nene Valley beaker with associated burnt bone. The cremated bones were found within and lying on the potsherds, and are those of of a young child of 4 or 5 years. The beaker is of "Hunt Cup" type of late C2 to early C3. The girth of the vessel is decorated with a frieze of bird

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motifs, apparently ducks.

Site Number	28
Site Name	RED HILL: Finds from bulldozed topsoil, Ratcliffe on Soar
Type of Site	Monument
List Entry Number	
HER Number	ENT756; L8895 - MNT8806
Status	Non-designated
Easting	449400
Northing	330600
Parish	Ratcliffe on Soar, Rushcliffe
Council	Rushcliffe
Description	ARTEFACT SCATTER (Ro, Roman - 43 AD to 409 AD) Examination of the topsoil yielded animal bones, broken Romano-British roof tiles, unglazed grey, black and cream ware sherds, a clay marble, a bone gaming piece and a piece of puddled lead. NB Grid ref approx.

Site Number	29
Site Name	RED HILL: Roman finds scatter, Ratcliffe on Soar
Type of Site	Findspot
List Entry Number	
HER Number	ENT759; L8898 - MNT8809
Status	Non-designated
Easting	449400
Northing	330000
Parish	Ratcliffe on Soar, Rushcliffe
Council	Rushcliffe
Description	ARTEFACT SCATTER (Ro, Roman - 43 AD to 409 AD) The edges of the scatter were plotted after detailed discussion with a local fieldworker/detector user. The shape of the scatter is suggestive of ribbon development along a N-S road. Finds including pottery in great quantities (including samian and mortarium), iron slag (in quantity), galena, copper slag, lead steelyard weights, querns (8 or 9 fragments), hundreds of coins, brooches (c 12 fragments), 4 finger rings (one silver) and lead dice. Grid ref centred - scatter covers a large area.

Site Number	30
Site Name	RED HILL: Earthworks E of mine, Ratcliffe on Soar
Type of Site	Monument
List Entry Number	

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HER Number	L8904 - MNT8815
Status	Non-designated
Easting	449400
Northing	330600
Parish	Ratcliffe on Soar, Rushcliffe
Council	Rushcliffe
Description	EARTHWORK (U, Unknown date) Disturbance visible on APs E of mine, not able to classify. Location uncertain, but given the date this is pre excavation in this area and may well refer to mining remains. RAF, 1953 , Air photos (Aerial photograph). SNT1165. Other Refs: F22 58 0046-8

Site Number	31
Site Name	Bank at Thrumpton Churchyard
Type of Site	Monument
List Entry Number	
HER Number	L10077 - MNT9978
Status	Non-designated
Easting	450980
Northing	331150
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	BANK (EARTHWORK) (U, Unknown date) 0.5 to 1.0m high bank marking the former edge of the churchyard. TPAT, 1996, Village Earthwork Survey III (Published document).

Site Number	32
Site Name	Bank and terracing at Thrumpton
Type of Site	Monument
List Entry Number	
HER Number	L10078 - MNT9979
Status	Non-designated
Easting	450960
Northing	331210
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	BANK (EARTHWORK) (U, Unknown date), BUILDING PLATFORM (U, Unknown date), TERRACED GROUND (U, Unknown date)

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1.5m high bank dropping to road level, with signs of terracing marking possible building platforms.

TPAT, 1996, Village Earthwork Survey III (Published document).

Site Number	33
Site Name	Boundary Bank at Thrumpton
Type of Site	Monument
List Entry Number	
HER Number	L10080 - MNT9981
Status	Non-designated
Easting	450980
Northing	331410
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	BANK (EARTHWORK) (U, Unknown date), BOUNDARY (U, Unknown date), POND (U, Unknown date)

Boundary bank marking a drop to road level. It continues north to the pond.

TPAT, 1996, Village Earthwork Survey III (Published document).

Site Number	34
Site Name	Banks and hollows at Thrumpton
Type of Site	Monument
List Entry Number	
HER Number	L10081 - MNT9982
Status	Non-designated
Easting	451050
Northing	331380
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	BANK (EARTHWORK) (U, Unknown date), HOLLOW (U, Unknown date)

Assorted linear banks and hollows, many ill defined.

TPAT, 1996, Village Earthwork Survey III (Published document).

Site Number	35
Site Name	Bank at Thrumpton

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Type of Site	Monument
List Entry Number	
HER Number	L10082 - MNT9983
Status	Non-designated
Easting	450970
Northing	331310
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	BANK (EARTHWORK) (U, Unknown date) 5m wide, 0.5m high bank along the west side of the plot. TPAT, 1996, Village Earthwork Survey III (Published document).

Site Number	41
Site Name	Gypsum mine, Ratcliffe on Soar
Type of Site	Monument
List Entry Number	
HER Number	M45 - MNT12454
Status	Non-designated
Easting	451320
Northing	329850
Parish	Ratcliffe on Soar, Rushcliffe
Council	Rushcliffe
Description	GYPSUM MINE (pre 1921, Modern - 1780 AD to 1921 AD) Gypsum mine (disused), Disused mine visible on 1921 OS map. Now within arable field system.

Site Number	42
Site Name	RED HILL TUNNELS NORTH PORTAL
Type of Site	Listed Building
List Entry Number	1260025
HER Number	M390 - MNT12733
Status	Grade: II
Easting	449529
Northing	330757
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	RAILWAY TUNNEL (1840 & 1875, (throughout) Modern - 1840 AD to 2000 AD), RAILWAY TUNNEL PORTAL (1840 & 1875, (throughout) Modern - 1840 AD to 2000 AD)

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The northern portals of the main London - Derby railway tunnels are almost baronial castellated structures on Red Hill. The original built in 1839 was asymmetrical with a tower on one side only (with rooms). The line was doubled in 1901 and another tunnel was made by the side. The original portal was copied but opposite hand so that the two are now a pair. Red Hill Tunnel where the Midland Counties railway line (1840) cut through a hill. The earlier west tunnel was opened in 1840 and the east freight line tunnel in 1875.

Site Number	43
Site Name	Medieval well, Thrumpton
Type of Site	Monument
List Entry Number	
HER Number	M480 - MNT12788
Status	Non-designated
Easting	451000
Northing	331000
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	WELL? (Med, Medieval - 1066 AD to 1546 AD)

Coping stones of a Med well.

Site Number	44
Site Name	Roman site on Red Hill
Type of Site	Scheduled Monument
List Entry Number	1003667
HER Number	M501 - MNT12791; M541 - MNT12827
Status	Scheduled Monument
Easting	449436
Northing	330410
Parish	Thrumpton; Ratcliffe on Soar
Council	Rushcliffe (District Authority)
Description	Roman Site on Red Hill - Scheduled Monument

The building or site itself may lie within the boundary of more than one authority.

M501 - MNT12791
BUILDING? (Ro, Roman - 43 AD to 409 AD)

East of Red Hill, trial excavation. Remains of large building with several rooms. Debris indicated two periods, early C2 to late C3 and early C4. Another complex with flue tile, building stone, coin of Tetricus and pottery. Sherds of black Belgic ware. (1) Excavations 1956-60. Pottery ranges in date from C1 to C4, and seemed to be most plentiful close to the edge of the scarp to the E of Red Knob. It occurred down to a depth of c 20in, suggesting the Ro levels have been little disturbed by ploughing. One burial was found with a half pot in buff fabric, later C1. Near and below the skeleton was a hearth composed of waterworn pebbles. Pottery from this

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context includes some samian, grey and calcite-gritted wares and Derbys ware. A wall foundation was found on the edge of the scarp a few yards SW of the burial; the room to the N of it contained a burnt deposit 2ft thick. W of this room was a doorway and beyond it an area of stone paving. It appears that the Ro building is confined to the area on the top of Red Hill, and this is borne out by APs (taken 156 by RAF). Notes of these excavations and descriptions of the pottery have been deposited at NCM. (2) Excavator also mentioned"fluted columns of red sandstone". Pottery is at NCM but there are no records of the excavation.

M541 - MNT12827
BUILDING? (Ro, Roman - 43 AD to 409 AD)

Site 4 - (field 6, a mound with a possible building beneath it). Trial trenches located an occupational level beneath the mound of red clay. The level was Ro in date and appeared to be associated with timber structures. No solid stuctural evidence was found. A date between Flavian and Antonine was suggested by the pottery. Neither plans nor finds from this site are available now.

Site Number	45
Site Name	Church of All Saints, Thrumpton
Type of Site	Listed Building
List Entry Number	1242423
HER Number	M535 - MNT12821
Status	Grade: II*
Easting	450974
Northing	331162
Parish	Thrumpton
Council	Rushcliffe (District Authority)
Description	CHURCH (Med-Mod, Medieval to Modern - 1066 AD to 2000 AD) Evidence EXTANT BUILDING

GV II* Parish church. C13, C15, extensively restored 1871 by G.E. Street. Ashlar, some dressed coursed rubble. Plain tile roofs with decorative ridges. Coped gables with single ridge crosses to the east nave and east chancel. Single stack to vestry. Set on a chamfered plinth to all but the south west nave and buttressed apart from the tower. Tower, nave, north organ chamber and vestry and chancel.

C13 dressed coursed rubble embattled tower set on a low chamfered plinth, of two stages with bands and ashlar quoins. The west and south walls with single C13 lancets, the north wall with single smaller lancet. Four arched two-light bell chamber openings. The north nave wall, of dressed coursed rubble to the west, has a single restored C14 window with three arched and cusped lights under a flat arch. Below is an arched tomb recess commemorating those who died in the 1914-18 war, with a reclining effigy of a soldier. The memorial dates to 1924. It specifically commemorates three soldiers from the area who were killed in action although it is also a memorial to those killed in both the First and Second World Wars. It comprises a recessed sepulchre with a recumbent soldier in uniform lying within, holding a cross to his chest and with his head lying on a pillow and his feet resting on his cap. The arch of the recess is moulded and enriched with carved roses. In the left spandrel is a carved depiction of St George slaying a Dragon, which is itself carved in the right spandrel. There is an inscription carved on the left panel in the back of the recess which reads: IF YE SUFFER FOR/ RIGHTOUSNESS SAKE/ HAPPY ARE YE. The right hand panel contains the three names of the soldiers. The panels are flanked by carved foliate decoration and the regimental badges of the three soldiers which are affixed to the back of the memorial.

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To the left is a double chamfered arched doorway with hood mould and decorative label stops. Further left are two restored C15 windows each with two cinquefoil arched lights under a flat arch. Projecting from the north wall of the chancel is the gabled organ chamber set on a chamfered plinth. The west wall has a single cinquefoil arched light, below a single flight of steps leads to an arched doorway. The north wall has a single pair of trefoil arched lights and to the left a moulded arched doorway. To the left is the vestry with single pair of trefoil arched lights in the east wall.

The north wall of the C19 chancel has a continuous band forming a sill band to the east and south chancel windows. The east chancel with C19 arched three-light window with cusped flowing tracery, hood mould and decorative label stops. The south chancel has two C19 two-light windows both with cusped tracery under a flat arch, that on the left being larger. The south nave has three restored C15 windows each with two cinquefoil arched lights under a flat arch. To the right of the left window is a chamfered arched doorway with hood mould.

Interior: triple chamfered tower arch. Moulded chancel arch supported on quatrefoil responds with moulded capitals and fillets to the single central shafts. Decorative wrought iron screen under. Moulded organ chamber/chancel arch supported on engaged columns with fillets and moulded capitals. The north chancel wall with two bay aumbry with single central colonnette and two trefoil arches. The south wall has a low ashlar sill to the east window forming a sedilia. Reredos decorated with carved figures, this, the organ case, pulpit, decorated with blind tracery, and similar font are by Street. Remaining furniture C19. Projecting from the south wall of the nave is a stair turret with chamfered arched doorway.

On the north nave wall is a memorial to John Wescomb Emmerton Wescomb, 1838, this has a Gothick surround. That to John Emmerton Wescomb Emmerton, 1823, is set into an arched recess with marble surround and has a sarcophagus below the inscription and a crest over. The memorial to John and Thomas Emmerton, 1745, has an oval inscription tablet surrounded by a garland and with crest over, the apron has a further inscription and the crown a shield. The south nave wall has a bulbous oval alabaster tablet to Winifred Coppindale, 1648. In the south chancel is a good large memorial to Gervase Pigot, 1669, restored 1950. Large rectangular inscription tablet surmounted by a band of shields. Either side are single angels supported on corbels, these hold back curtains over the inscription. Apron decorated with a stylised tree and carved fruit.

Site Number	46
Site Name	Quarry, Thrumpton
Type of Site	Monument
List Entry Number	
HER Number	M664 - MNT12911
Status	Non-designated
Easting	450400
Northing	330900
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	QUARRY (U, Unknown date)

Quarry visible on 1914 OS map. No longer visible within wooded hill of Thrumpton Park conservation area.

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Site Number	47
Site Name	Quarry, Thrumpton
Type of Site	Monument
List Entry Number	
HER Number	M665 - MNT12912
Status	Non-designated
Easting	450600
Northing	331000
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	QUARRY (U, Unknown date) Quarry, visible on 1921 OS map. No longer visible within wooded hill of Thrumpton Park conservation area.

Site Number	48
Site Name	Quarry, Thrumpton
Type of Site	Monument
List Entry Number	
HER Number	M666 - MNT12913
Status	Non-designated
Easting	450700
Northing	330900
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	QUARRY (U, Unknown date) Quarry pit, visible on 1921 OS map. No longer visible within pasture hillside of Thrumpton Park conservation area.

Site Number	49
Site Name	Ice house, Thrumpton
Type of Site	Listed Building
List Entry Number	1242434
HER Number	M667 - MNT12914
Status	Grade: II
Easting	450648
Northing	331060
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe

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Description	THRUMPTON THRUMPTON HALL PARK SK 53 SW 2/134 Ice House II Ice house. Late C18. Red brick. Round arched entrance opening into a short passage which leads to the domed brick chamber.

Site Number	50
Site Name	Flood barrier, Thrumpton
Type of Site	Monument
List Entry Number	
HER Number	M668 - MNT12915
Status	Non-designated
Easting	450500
Northing	331400
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	FLOOD DEFENCES (by 1921, Post Medieval to Modern - 1547 AD to 2000 AD) Hachures form flood barrier visible on 1921 OS map. Slightly obscured but still present within the Thrumpton Park Conservation area.

Site Number	51
Site Name	Fish ponds, Thrumpton
Type of Site	Monument
List Entry Number	
HER Number	M669 - MNT12916
Status	Non-designated
Easting	450810
Northing	331360
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	FISHPOND (U, Unknown date) Fish ponds visible on 1921 OS map and still present within the Thrumpton Park Conservation area.

Site Number	52
Site Name	Gravel pit, Thrumpton
Type of Site	Monument
List Entry Number	
HER Number	M671 - MNT12918

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Status	Non-designated
Easting	450500
Northing	331500
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	GRAVEL PIT (U, Unknown date) Gravel pit visible on 1914 OS map. Possibly visible as a slight hollow within the Thrumpton Park Conservation Area.

Site Number	53
Site Name	Moated manor site?, Ratcliffe on Soar
Type of Site	Monument
List Entry Number	
HER Number	M5237 - MNT15632
Status	Non-designated
Easting	450710
Northing	330330
Parish	Ratcliffe on Soar, Rushcliffe
Council	Rushcliffe
Description	MANOR HOUSE? (Med, Medieval - 1066 AD to 1546 AD) Evidence COMPROMISED MONUMENT MOAT? (Med, Medieval - 1066 AD to 1546 AD) Evidence COMPROMISED MONUMENT MOAT? (Med, Medieval - 1066 AD to 1546 AD) Evidence COMPROMISED MONUMENT Site of moat possibly visible in aerial photography. Buildings destroyed - site now deeply excavated and within the bounds of Ratcliffe Power Station. Immediately N the land slopes uphill and has been ploughed and planted, partly with trees and partly grass. Very slight scarping suggests a N outer corner, but no other traces could be seen. RAF, undated, Air Photos (Aerial photograph). SNT1160. Other Refs: F22 58/151 0335-6

Site Number	54
Site Name	Gypsum mine, Thrumpton
Type of Site	Monument
List Entry Number	
HER Number	M5249 - MNT15635
Status	Non-designated
Easting	450850
Northing	330650

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Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	GYPSUM MINE? (pre 1921, Post Medieval to Modern - 1547 AD to 1921 AD) Old shaft - presumably gypsum visible on 1921 OS map. Obscures and probably destroyed during landscaping associated with the Power Station.

Site Number	55
Site Name	Shallow surface quarries, Ratcliffe on Soar
Type of Site	Monument
List Entry Number	
HER Number	M8860 - MNT17178
Status	Non-designated
Easting	449500
Northing	330200
Parish	Ratcliffe on Soar, Rushcliffe
Council	Rushcliffe
Description	QUARRY? (U, Unknown date) Disused shallow surface quarries are common hereabouts. Grid ref approx. Colquhoun FD, 1975, Pers Comm (Personal comment).

Site Number	56
Site Name	Red Hill Iron Age Settlement, Ratcliffe on Soar
Type of Site	Monument
List Entry Number	
HER Number	M8869 - MNT17186
Status	Non-designated
Easting	449500
Northing	330400
Parish	Ratcliffe on Soar, Rushcliffe
Council	Rushcliffe
Description	SETTLEMENT? (IA, Iron Age - 700 BC to 42 AD) Detailed excavation revealed hitherto unsuspected Early IA occupation consisting of post holes and gullies. Late IA occupation was suggested by several sherds of pottery from the pipe-line trench. The Early IA finds are important because of the quality of the pottery. The small bird brooch is a unique and very important find. Could the Ro temple have been founded on the site of an earlier native shrine, as is so often the case. Thoroton Society, 1982, TTS, p 31 (Published document).

NCC received 16.07.2020

Site Number	57
Site Name	FONT IN CHURCHYARD OF CHURCH OF ALL SAINTS SINGLE METRE NORTH OF THE CHANCEL, CH
Type of Site	Listed Building
List Entry Number	1242426
HER Number	M10474 - MNT18647
Status	Grade: II
Easting	450970
Northing	331171
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	THRUMPTON CHURCH LANE SK 53 SW (east side) 2/116 Font in Churchyard of Church of All Saints single metre north of the chancel G.V. II Font. C13. Ashlar. Tapering octagonal pedestal supports the circular bowl decorated with blind arcading.

Site Number	58
Site Name	CHURCH HOUSE, CHURCH LANE
Type of Site	Listed Building
List Entry Number	1260040
HER Number	M10475 - MNT1864
Status	Grade: II
Easting	450961
Northing	331182
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	THRUMPTON CHURCH LANE SK 53 SW (east side) 2/117 Church House 13.10.66 G.V. II House. 1713 with C19 alterations. Red brick, blue brick, some ashlar. Plain tile roof. C19 external left gable red brick stack. Decorative bargeboards with pendant finials. Set on an ashlar and brick plinth with blue chamfered brick band over. Red brick stretchers and blue brick headers to all but the first floor left 2 bays. First floor band. 2 storey, 2 bay wing with 2 storey plus garret, single bay gabled wing to the right. Central doorway with studded plank door, to the left is a single cross casement and to the right a single 2 light ashlar mullion glazing bar casement. Above is a single similar ashlar cross casement with flush ashlar quoin surround and to the right a single similar ashlar mullion casement, extending over this opening is a brick band. Garret has a single glazing bar casement. Attached to the left is a red brick and slate lean-to with single small fixed light. South/church front with single central ridge red brick stack, first floor band and band over first floor lintels. Single central 2 light casement flanked by single 3 light ashlar mullion casements. Above are 2 similar 2 light ashlar mullion casements and over the band a single oeil de boeuf. All windows with glazing bars. In the right gable wall is a small ashlar plaque inscribed "J.E. 1713".

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Site Number	59
Site Name	THE COTTAGE YEW TREE COTTAGE
Type of Site	Listed Building
List Entry Number	1242427
HER Number	M10476 - MNT1864
Status	Grade: II
Easting	450979
Northing	331240
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	THRUMPTON CHURCH LANE SK 53 SW (east side) 2/118 Yew Tree Cottage and The Cottage G.V. II House, now 2 cottages. Early C18. Red brick with blue brick chequering. Ashlar plinth. Slate roof. Single ridge red brick stack. Brick coped gables with kneelers. Dentil eaves. First floor band. 2 storeys plus garret. Central doorway with plank door. Either side are single tripartite Yorkshire sashes. All ground floor openings with flush wedge brick lintels. Above is a single glazing bar Yorkshire sash, to the right is a single Yorkshire sash and to the left a single casement, all under segmental arches.

Site Number	60
Site Name	THE OLD POST OFFICE, CHURCH LANE
Type of Site	Listed Building
List Entry Number	1242428
HER Number	M10477 - MNT18650
Status	Grade: II
Easting	451009
Northing	331338
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	THRUMPTON CHURCH LANE SK 53 SW (east side) 2/120 The Old Post Office. GV II Cottage. 1731, with early C19 and C20 alterations. Red brick, some blue brick. Swithland slate roof to front of c1970 and plain-tile to rear. 2 red brick gable stacks, the left being external. Dentil eaves. First floor band of red brick stretchers and blue brick headers. Single storey plus attic, 3 bays. Central open trellis porch, inner panelled door. Either side are single casements each with 2 pointed arched lights under segmental brick arches. Attic has 2 C19 half dormers, gabled with bargeboards and single similar casements. Over the porch is a plaque inscribed "J.E. 1731". To rear are C18 wing probably raised early C19 and 2-storey extension of c1950. Interior: chamfered beams, plank doors, early and mid C19 fireplaces and grates, early C19 stairs and wooden frame in floor where original ladder stairs rose.

Site Number	61
Site Name	CHURCH FARMHOUSE, CHURCH LANE
Type of Site	Listed Building

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List Entry Number	1260042
HER Number	M10478 - MNT1865
Status	Grade: II
Easting	451050
Northing	331101
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	THRUMPTON CHURCH LANE SK 53 SW (south side) 2/121 Church Farmhouse G.V. II Farmhouse. Early C18 with some C19 alterations. Red brick and render. Plain tile roof. Single ridge red brick and render stack. Coped gables with kneelers. Dentil eaves. 2 toreys, 3 bays with projecting wing to the left. Rendered wing with doorway with panelled door and plain tile hood. To the right is a single tripartite casement with single similar glazing bar casement on the far right. Above are 2 similar smaller glazing bar casements. All casements under segmental arches. Projecting from the left is the 2 storey, single bay wing with rendered ground floor. The side wall with single segmental arched glazing bar sash on the first floor. Gable wall with single C20 glazing bar casement to the ground floor.

Site Number	62
Site Name	THE GARDEN HOUSE, CHURCH LANE
Type of Site	Listed Building
List Entry Number	1242429
HER Number	M10479 - MNT1865
Status	Grade: II
Easting	450966
Northing	331105
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	THRUMPTON CHURCH LANE SK 53 SW (south side) 2/122 The Garden House G.V. II House. Early C18 with C19 alterations and extensions. C18 build of red brick stretchers and blue brick headers. Ashlar plinth. Plain tile roof. Single ridge red brick stack. Raised eaves band. First floor band. Central closed wood and plain tile porch with plank door, the side walls with single fixed lights. Either side are single tripartite casements under segmental arches. Above are 2 tripartite casements. To the left under continuing roof with similar bands is the red brick C19 single bay range with left gable red brick stack. Single similar tripartite casement under segmental arch with single similar casement above.

Site Number	63
Site Name	PAIR OF GATE PIERS AT ENTRANCE TO THRUMPTON HALL DRIVE 13 METRES SOUTH OF BARN A
Type of Site	Listed Building
List Entry Number	1242458
HER Number	M10480 - MNT1865

NCC received 16.07.2020

Status	Grade: II
Easting	450937
Northing	331160
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	THRUMPTON CHURCH LANE SK 53 SW (west side) 2/123 Pair of Gate Piers at entrance to Thrumpton Hall Drive 13M south of barn and outbuilding at Thrumpton House G.V. II Pair of gate piers. Late C18. Red brick and ashlar. Pair of red brick gate piers with ashlar quoins and moulded ashlar coping. Included for group value only. Thrumpton House not included in this list.

Site Number	64
Site Name	BARN AT THRUMPTON HOUSE, CHURCH LANE
Type of Site	Listed Building
List Entry Number	1242430
HER Number	M10481 - MNT1865
Status	Grade: II
Easting	450921
Northing	331185
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	THRUMPTON CHURCH LANE SK 53 SW (west side) 2/124 Barn at Thrumpton House G.V. II Barn. Early C19. Red brick, some ashlar. Plain tile roof. Brick coped gables with kneelers. 2 storeys, 6 bays. Large basket archway with ashlar hinge blocks, to the right are 2 lozenge shaped ventilators on each floor, further right is a similarly arched, part blocked doorway now with similarly arched smaller doorway with double plank doors and ashlar hinge blocks. On the far right are 2 similar ventilators on each floor. Included for group value only. Thrumpton House is not included in this list.

Site Number	65
Site Name	BARN AND ATTACHED OUTBUILDING AT THRUMPTON HOUSE, CHURCH LANE
Type of Site	Listed Building
List Entry Number	1260022
HER Number	M10482 - MNT18655
Status	Grade: II
Easting	450944
Northing	331187
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe

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Description	THRUMPTON CHURCH LANE SK 53 SW (west side) 2/125 Barn and attached outbuilding at Thrumpton House G.V. II Barn and attached outbuilding. Late C18 and early C19. Red brick. Plain tile roofs. Brick coped gables with kneelers. Dentil eaves. C18 barn. 1 and a half storeys, no openings. Attached to the left is the single storey, 2 bay outbuilding. single segmental arched opening with plank shutter, to the left is a blocked doorway. Included for group value only. Thrumpton House not included in this list.

Site Number	66
Site Name	HALL GATES AND ADJOINING WALL MANOR COTTAGE
Type of Site	Listed Building
List Entry Number	1260043
HER Number	M10483 - MNT1865
Status	Grade: II
Easting	450968
Northing	331344
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	THRUMPTON CHURCH LANE SK 53 SW (west side) 2/126 Manor Cottage, No.2 Hall Gates and adjoining wall G.V. II 2 cottages and adjoining wall. 1735, altered C20. Red brick with some blue brick chequering. Ashlar plinth. Plain tile roof. Single central large red brick ridge stack. Further single ridge and right gable red brick stacks. Brick coped gables with kneelers. Dentil eaves. First floor band of red brick stretchers and blue brick headers. Single storey plus attic, 6 bays. 2 doorways under segmental arches and with plank doors. Lean-to porch over extending to form the roof of the single C20 projecting bays each with single 2 light casement with glazing bars to the top and single, single lights in each side wall, ashlar sills. Either side are single Yorkshire sashes. Above are 4 gabled half dormers each with single bargeboard and single glazing bar casement under a segmental arch. Single central plaque inscribed "J. E. 1735". Attached to the right is a red brick wall with ashlar coping, this extends for about 4 metres terminating in the gatehouse, listed as a separate item.

Site Number	67
Site Name	THE MANOR HOUSE, SCHOOL LANE
Type of Site	Listed Building
List Entry Number	1260044
HER Number	M10484 - MNT18657
Status	Grade: II
Easting	450871
Northing	331304
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	THRUMPTON SCHOOL LANE SK 53 SW (south side) 2/129 The Manor House II House. Early C18 with early C19 and C20 alterations and extensions. Red brick, some blue brick and

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ashlar. Plain tile roof, some slate. Single red brick ridge stack. Brick coped gables with kneelers. 2 storeys plus garret, 7 bays, the right single bay is C19, projects slightly, is gabled and has dogtooth eaves. Left 6 bays with first floor band and first floor lintel band of red brick stretchers and blue brick headers. Having from left to right a single small casement, a single similar larger casement, a single round arched casement, a single small casement and a doorway with glazed and panelled door and in the gabled bay a single projecting bay window with slate roof and single tripartite cross casement. Above from left to right is a single oriel window, a single slightly projecting casement the sill supported on 2 brackets, a single small casement and in the gabled bay a single segmental arched cross casement. To the left is a lower single bay wing with single segmental arched tripartite casement. The left gable wall of the C18 build with ashlar plaque in the apex with illegible date and inscription. Under is a single casement now with foreshortened continuous hood mould of red brick stretchers and blue brick headers. Over the plaque is some blue brick diaper work. To the rear are later extensions.

Site Number	68
Site Name	EAST GATEWAY, THRUMPTON HALL DRIVE
Type of Site	Listed Building
List Entry Number	1242460
HER Number	M10485 - MNT18658
Status	Grade: II
Easting	450827
Northing	331328
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	THRUMPTON THRUMPTON HALL DRIVE SK 53 SW 2/130 East Gateway G.V. II Gateway. c.1830 for John Emerton Wescomb. Red brick with ashlar dressings. Set on a plinth. Moulded Tudor archway flanked by single sloping buttresses to the west side. East side with Tudor style raised brick and dogtooth hood mould over the arch. Ashlar coped parapet projecting over the buttresses and with mock machicolations under.

Site Number	69
Site Name	WEST GATEWAY, THRUMPTON HALL DRIVE
Type of Site	Listed Building
List Entry Number	1242433
HER Number	M10486 - MNT18659
Status	Grade: II
Easting	450759
Northing	331284
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	THRUMPTON THRUMPTON HALL DRIVE SK 53 SW 2/131 West Gateway G.V. II Gateway. c.1830 for John Emerton Wescomb. Red brick with ashlar dressings. Set on a plinth. Moulded Tudor archway with panelled spandrels. Either side are single sloping buttresses topped with

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large gabled finials decorated with blind trefoil arched panels. The ashlar coped parapet rises in the centre to accommodate an ashlar coat of arms. The west side with band of dogtooth under the parapet. To the south is a red brick wall which adjoins the Hall, listed as a separate item.

Site Number	70
Site Name	THRUMPTON HALL AND ATTACHED RANGE OF OUTBUILDINGS, THRUMPTON HALL DRIVE
Type of Site	Listed Building
List Entry Number	1242464
HER Number	M10487 - MNT18660
Status	Grade: I
Easting	450730
Northing	331259
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	THRUMPTON THRUMPTON HALL DRIVE SK 53 SW (south side) 2/132 Thrumpton Hall and attached range of outbuildings (formerly 14.5.52 and 13.10.66 listed as the Hall and Old Dairy, 2 separate items) G.V. I Small country house and attached outbuildings.

House completed by 1617 for Gervase Pigot. 1660s altered and improved by his son Gervase, late C18 further alterations made for John Wescomb Emerton, c.1830 alterations, extensions and restorations carried out for John Emerton Wescomb, restored mid C20. Red brick with ashlar dressings. House with flush ashlar quoins and set on a chamfered ashlar plinth. Plain tile roofs. H-plan with loggias and lower wing to the east which connects the house to the stable block. North/entrance front with single central stack with 5 tall shafts, the central 3 set diagonally. Single stack to the left with flush ashlar quoins and 4 shafts. Parapet with moulded ashlar coping and ashlar band extending under. 2 storeys plus cellar and attic, 7 bays. The outer 2 bays on each side project and are gabled with probably 1660s decorative ashlar crestings topped with broken horned pediments containing single orb finials. Cellar with 6 two light ashlr mullion openings. Central 3 bays with single storey loggia topped with balustraded parapet 3 round arches with ashlar impost bands and keystones. Central arch open forming a porch with inner late C18 window with 2 ogee arched lights with hexgonal glazing bars and single central quatrefoil. C17 dripmould over. In the right wall is a doorway with panelled door. The other arches each with single C19 fixed light with octagonal glazing bars. Further right and left are 2 similar 2 light windows with C17 drip moulds. Above are 6 similar windows and drip moulds. In each gable apex is a single similar window. The parapet to the central bays with 2 two light ashlar mullion casements each flanked by single ashlar strips. Single similar central strip. All other windows apart from those of the loggia with flush ashlar quoin surrounds. 2 decorative rainwater heads, one with the Pigot arms and crests, both with brackets to the downpipes dated 1662. Extending in front of the house is a terrace, balustraded to the west and north. Attached to the left of the house and set back slightly is a 2 storey, single bay C19 wing with dogtooth eaves. Single casement on each floor with hexgonal glazing bars. Behind this is a C17 wing, the side wall with single ashlar mullion casement and single ashlar cross casement above. Projecting from the side wall is a 2 storey plus attic, single bay wing with single 2 light ashlar mullion casement and single ashlar casement above, both with dripmoulds. The attic with single hipped roof dormer with single casement. Projecting from the left is a single bay two and a half storey wing each floor with single casement in ashlar surround. The ground and first floors with drip moulds. To the left and projecting is the 2 storey plus garret /C19 kitchen wing with Flemish gable. Single ridge glass and lead C19 cupola. Gable end of 2 bays with 2 casements on each floor in ashlar surrounds. Single ashlar clock face in the apex. To the left and set back is a 2 storey plus garret, 2 bay wing with similar gable. 2 casements with doorway to the left, 2 casements above. Most casements with hexgonal glazing bars. West front with 2 external stacks, each with 3 shafts and flush ashlar quoins. The parapet to the left as the entrance front and parapet to the right shaped with moulded ashlar coping.

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Reconstructed 1660s wall between the shafts, top floor with flush ashlar quoins with a balustraded parapet. Continuous ashlar lintel bands to all openings here apart from the top floor. Left stack with single ashlar mullion 2 light casement, blocked arch over. Blocked segmental arch in right stack. Central bays with doorway with glazed and panelled door. Over the band is a segmental arched ashlar pediment with imposts and pendant keystone and single small carved grotesque. Above are 2 ashlar cross casements with 2 similar casements above and single similar casement on the top floor to the right is a single ashlar mullion 2 light casement. The windows are staggered in order to light the stair. All openings with flush ashlar quoin surrounds. Garden/south front 2 storeys plus attic, 5 bays. The single outer bays project and have gables as the entrance front. Central parapet similar to the entrance front. The central 3 bays with slightly projecting single storey loggia topped with balustrade. The loggia was brought forward in the late C18 and enclosed c.1830. 3 bay ashlar arcade with Doric columns and responds and keystones, the single central bay with glazed and panelled door with fanlight. Either side are single sashes with balustrades under and single similar fanlights. Further left and right are single arched ashlar fixed lights with pendant keystones, single transoms and flush ashlar quoin surrounds. In each outer bay is a single C17 3 light ashlar cross sash. 2 similar smaller 3 light windows above, the central 3 bays with 3 similar 2 light windows. The garrets each with single 3 light ashlar mullion sash, all with moulded dripmoulds. The attic has 2 hipped roof dormers each with single glazing bar casement. All windows apart from the loggia sashes with decorative glazing bars. Most ashlar windows with flush ashlar quoin surrounds. Extending in front of the house is a formal garden enclosed by a low red brick wall with shaped ashlar coping and broken in parts. Wall with several small piers topped with decorative urns. Adjoining the right of the house and set back is an irregular 2 storey, 3 bay wing with some C17 ashlar and ashlar mullion windows. Projecting from the right is the rear of the c.1830 stable block with 4 ridge stacks. 5 bays. 5 half dormers with Flemish gables each with single fixed lights with hexgonal glazing bars, ashlar surround and drip mould. Projecting from the rear right of this wing is a further 9 bay stable block range. The outer single bays project and have Flemish gables. Single swimilarsmaller central bay with segmental arched doorway. Remaining bays with fixed lights in ashlar surrounds and with hexagonal glazing bars. Projecting from the rear right is a further stable range with brick coped right gable with kneelers. Tudor arched entrance into courtyard. Attached to the right is a red brick wall terminating in the early C17 Old Dairy. Single storey plus attic, 2 bays. Set on a rubble plinth. Left/south gable stack, this gable being brick coped with kneelers, right Flemish gable. 2 first floor raised brick and dogtooth bands. 2 casements with single half dormer above with Flemish gable and single casement. The right gable wall with single tripartite casement on each floor. Rear with doorway and plank door and single casement in the attic. All casements with hexgonal glazing bars and in ashlar surrounds. Projecting from the rear is a red brick wall termainting in the kitchen wing. Interior. Panelled library formed c.1830. Entrance hall probably panelled in the 1660s, further decorated with 2 pillars, pilasters abd shields. Arched doorways with keyblocks and panelled spandrels lead off. Ashlar fireplace with keystone flanked by single pilasters. Late C18 paved floor extending to the staircase hall. Fine 1660s open well staircase, the balustrade carved with foliate scrolls, similarly carved and decorated dados incorporating newels. Carved strings. Newels with foliate and grape carving topped with acanthus urns further decorated with carved fruit. Carved pendants to newels. Fireplace with eared architrave with decorative panelling to the sides and topped with urns. 8 mid C17 doorcases with eared architraves, the overdoors with carved swags and scrolls. Those on the ground floor topped with broken egg and dart pediments containing coats of arms. Each doorcase differing in decoration, some more elaborate. Some further decorated with carved heads and carved fruits. Single doorway with fine panelled door, panels containing single ovals, the spandrels with raised panelling. 1660s panelled saloon. The marble fireplace with decorative overmantel flanked by single foliate decorative strips topped with single brackets, further flanked by single decorative pilasters finely decorated with foliate and fruit drops. The cornice further decorated with lions' masks, c.1780 decorated ceiling. Mid C18 console-tables and mirrors in situ. Oak room with grained panelled walls. Pulvinated bay leaf brieze, egg and dart cornice. Fireplace with fluted surround, topped with scrolled broken pediment containing a single cartouche and a pair of cornucopias. Either side are single Ionic pilasters with arched blind panels with small impost and key blocks. Dining room with raised deep panelled late C17 ceiling. Late C18 fireplace removed from a house in Harley Street. Other rooms with Nottingham alabaster and Hopton marble fireplaces, panelling, decorative cornices and ceilings. The kitchen with large fireplace with keyblock. Centre of ceiling rising into the cupola. Stud partition to early C17 dogleg staircase with moulded rails, panelled newels, including a

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double newel topped with bulbous orbs. Newels incorporated into the wall. Single rail of plaster. Roof with stud partition retains much of its C17 structure.

Site Number	71
Site Name	PAIR OF GATE PIERS
Type of Site	Listed Building
List Entry Number	1260045
HER Number	M10488 - MNT1866
Status	Grade: II
Easting	450804
Northing	331160
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	THRUMPTON THRUMPTON HALL PARK SK 53 SW 2/133 Pair of Gate Piers 13.10.66 II Pair of gate piers. Late C18. Ashlar. Pair of gate piers with moulded coping and single orb finials.

Site Number	72
Site Name	GATEHOUSE, GATEHOUSE COTTAGE
Type of Site	Listed Building
List Entry Number	1242431
HER Number	M10596 - MNT1875
Status	Grade: II
Easting	450957
Northing	331345
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	THRUMPTON CHURCH LANE SK 53 SW (north side) 2/127 Gatehouse and Gatehouse Cottage G.V. II Gatehouse and adjoining cottage and wall. c.1830 for John Emerton Wescomb. Red brick, some blue brick. Gatehouse with 2 embattled and panelled octagonal turrets, being corbelled out at the top, set onto moulded plinths and of 2 stages with bands. Extending between the turrets and over the moulded Tudor arched gateway is an embattled parapet. Hood mould over gateway rises to accommodate a carved shield. Above and under the embattlements is a single 3 light ashlar mullion casement flanked by single flush blue brick lozeznge panels. Attached to the right is a red brick wall with ashlar coping and extending about 4 metres, terminating in Elm Cottage listed as a separate item. to the left of the gatehouse is the single storey, single bay cottage, with plain tile roof, hipped to the left, single ridge red brick stack and embattled parapet with band extending under. Set on a plinth. Single 4 light ashlar mullion casement.

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Site Number	73
Site Name	LABURNUM COTTAGE, CHURCH LANE
Type of Site	Listed Building
List Entry Number	1260041
HER Number	M11856 - MNT19711
Status	Grade: II
Easting	450977
Northing	331283
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	THRUMPTON CHURCH LANE SK 53 SW (east side) 2/119 Laburnum Cottage G.V. II Cottage. 1828. Red brick. Ashlar plinth. Slate roof. Single central ridge red brick stack. Decorative bargeboards with pendant finials. Dentil eaves. First floor band. 2 storeys, 3 bays. Doorway with plank door, to the left are 2 Yorkshire sashes. 2 similar smaller sashes above. The right gable has plaque inscribed "FEW 1828".

Site Number	74
Site Name	ELM COTTAGE, CHURCH LANE
Type of Site	Listed Building
List Entry Number	1242459
HER Number	M11857 - MNT19712
Status	Grade: II
Easting	450980
Northing	331345
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	THRUMPTON CHURCH LANE SK 53 SW (north side) 2/128 Elm Cottage G.V. II Cottage. 1735 with C20 alterations. Red brick, some blue brick. Plain tile roof. Single central red brick ridge stack. Brick coped gables with kneelers. Dentil eaves. SEt on a plinth. First floor band of red brick stretchers and blue brick headers. 2 storeys, 3 bays. Blocked doorway, to the right are 2 casements. Above are 2 Yorkshire sashes. The left gable wall has C20 projecting bay and above a C20 casement. In the apex is a plaque inscribed "J.E. 1735". Included for group value only.

Site Number	77
Site Name	ELTON COTTAGE
Type of Site	Building
List Entry Number	
HER Number	M15944 - MNT2366
Status	Non-designated

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Easting	451065
Northing	331107
Parish	Orston, Rushcliffe
Council	Rushcliffe
Description	HOUSE (Modern - 1780 AD to 2000 AD) No description

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Site Number	78
Site Name	THRUMPTON HOUSE
Type of Site	Building
List Entry Number	
HER Number	M16050 - MNT23764
Status	Non-designated
Easting	450936
Northing	331216
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	HOUSE (Modern - 1780 AD to 2000 AD) No description

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Site Number	79
Site Name	CHURCH FARM COTTAGE - PARTIALLY
Type of Site	Building
List Entry Number	
HER Number	M16051 - MNT23765
Status	Non-designated
Easting	451037
Northing	331084
Parish	Orston, Rushcliffe
Council	Rushcliffe
Description	HOUSE (Modern - 1780 AD to 2000 AD) No description

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Site Number	80
Site Name	BARNS AT CHURCH FARM
Type of Site	Building

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List Entry Number	
HER Number	M16106 - MNT23820
Status	Non-designated
Easting	451020
Northing	331080
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	HOUSE (Modern - 1780 AD to 2000 AD)
	No description

Site Number	81
Site Name	STABLES AT THE GRANGE
Type of Site	Building
List Entry Number	
HER Number	M16107 - MNT23821
Status	Non-designated
Easting	450936
Northing	331270
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	HOUSE (Modern - 1780 AD to 2000 AD)
	No description

Site Number	82
Site Name	OUTBUILDING TO MANOR HOUSE
Type of Site	Building
List Entry Number	
HER Number	M16923 - MNT24630
Status	Non-designated
Easting	450862
Northing	331287
Parish	Orston, Rushcliffe
Council	Rushcliffe
Description	HOUSE (Modern - 1780 AD to 2000 AD)
	No description

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Site Number	83
Site Name	CREST COTTAGE
Type of Site	Building
List Entry Number	
HER Number	M17012 - MNT24718
Status	Non-designated
Easting	451225
Northing	331114
Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	HOUSE (Modern - 1780 AD to 2000 AD) No description

Site Number	84
Site Name	Winking Hill Farm
Type of Site	Building
List Entry Number	
HER Number	M17534 - MNT25219
Status	Non-designated
Easting	450986
Northing	329732
Parish	Ratcliffe on Soar, Rushcliffe
Council	Rushcliffe
Description	COUNTRY HOUSE (By 1835, Modern - 1780 AD to 2000 AD) No description

Site Number	87
Site Name	Red Hill Tunnel South Portals (West SPC6 28 and East
Type of Site	Listed Building
List Entry Number	1417715
HER Number	M18828 - MNT2647
Status	Grade: II
Easting	449597
Northing	330621
Parish	Ratcliffe on Soar, Rushcliffe
Council	Rushcliffe
Description	Summary Two portals forming the southern entrance of Redhill Tunnel, the west portal (SPC6 28) built

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1838-40 for the Midland Counties Railway to the designs of Charles Vignoles, and the east portal (SPC6 28a) built 1892-93 for the Midland Railway probably to the designs of J. A. MacDonald.

Reasons for Designation
The west (SPC6 28) and east (SPC6 28a), south portals of the Redhill Tunnel, constructed in 1838-40 and 1892-3, respectively, are listed at Grade II for the following principal reasons: * Architectural interest: the west portal has a quiet classical composition, delicately defined by pilasters and an entablature. It demonstrates a high standard of design and masonry detailing resulting in an aesthetic quality that far exceeds its functional and structural requirements. Whilst the east portal is less refined, its construction in engineering brick demonstrates the important development in the use of building materials along the line; * Historic interest: they form part of a series of railway structures along the line of the Midland Counties Railway designed by Charles Blacker Vignoles between 1837 and 1840, and later widened by J. A. McDonald, the Midland Railway's chief engineer. The portals are important examples of both the pioneering phase of railway development in England and its subsequent evolution; * Group value: the portals at each end of a tunnel form an architectural and engineering entity. The south portals have strong group value with the listed north portals which are seen in combination with one another as elements of a railway transport landscape of great interest and quality.

History
The Midland Main Line is the outcome of a number of historic construction phases undertaken by different railway companies. The first two phases were carried out simultaneously between 1836 and 1840 by the North Midland Railway and the Midland Counties Railway. The North Midland Railway, which operated between Derby and Chesterfield and onwards to Rotherham and Leeds, was pre-eminently the work of George (1781-1848) and Robert Stephenson (1803-1859) who, along with Isambard Kingdom Brunel, are the most renowned engineers of this pioneering phase of railway development. They worked closely with the Assistant Engineer, Frederick Swanwick (1810-1885). The railway's architect Francis Thompson (1808-1895) designed stations and other railway buildings along the line. The less demanding route for the Midland Counties Railway, which ran between Derby and Nottingham to Leicester and on to Rugby, was surveyed by Charles Blacker Vignoles (1793-1875) who was engineer to a large number of railway projects. These two companies (along with the Birmingham & Derby Junction Railway) did not yield the expected profits, partly because of the fierce competition between them. This led to the three companies merging into the Midland Railway in 1844 which constituted the first large scale railway amalgamation. The next part of the line from Leicester to Bedford and on to Hitchin was constructed between 1853 and 1857 by the engineer Charles Liddell (c.1813-1894) and specialist railway architect Charles Henry Driver (1832-1900). In 1862 the decision was made to extend the line from Bedford to London which was again the responsibility of Liddell, except for the final fourteen miles into London and the design of the terminus at St Pancras (listed at Grade I) which was undertaken by William Barlow (1812-1902). Additional routes were then added from Chesterfield to Sheffield in 1870, and from Kettering to Corby in 1879. The most important changes to the infrastructure of the Midland Railway were the rebuilding of its principal stations and the increasing of the line's capacity, involving the quadrupling of some stretches of the route south of the Trent from the early 1870s to the 1890s.

Redhill Tunnel was built as part of the Midland Counties Railway. The line connecting Derby and Nottingham to Leicester and Rugby originated in a proposal to supply Leicester with coal from the Nottinghamshire coalfield but it was extended to Rugby in order to become a major component in the strategy to link London to the North. The routes were surveyed by Charles Vignoles in 1835 and an Act of Parliament for the construction of the line was obtained in 1836. The sixty mile line was opened in three stages between 1839 and 1840. Built largely across the Trent, Derwent and Soar valleys, the engineering of this line was in most respects less demanding than the North Midland. At Derby the company shared a station provided by the North Midland but built its own principal stations at Nottingham and Leicester together with an increasing number of intermediate stations. The character of the line owes almost as much however to the alterations that were made over the next thirty-five years. The modernisations carried out by the General Manager James Allport and his successors were crucial to securing the reputation of the Midland Railway. Extra capacity was needed because

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of the huge expansion of the company's coal traffic to London. The procession of slow-moving coal trains from the East Midland and Yorkshire coalfields created havoc in the punctuality of passenger services and the only solution was to segregate them on several tracks. This was achieved by means of a complex series of projects, requiring in some places the quadrupling of the tracks and in others the construction of entirely separate relief lines.

Redhill Tunnel was designed by Charles Vignoles and constructed by William Mackenzie under Contract no. 3, dated 23 June 1838. The 154-yard long tunnel was completed by the opening of the line in May 1840. The surviving contract drawings show classical designs for both the north and south portals, neither of which was executed. The decision (recorded in minute books on 30 July 1838) to adopt a grand castellated Gothic structure for the Grade II listed north portal was probably taken because of its public aspect facing the River Trent and Vignoles' iron viaduct. By contrast, the south portal (of the west tunnel) is largely obscured in a deep cutting and for this a modified classical scheme was executed. The east tunnel dates to 1892-93 when the line from Redhill Tunnel to Trent Junction was quadrupled by the Midland Railway's engineer J. A. MacDonald. Whereas the Grade II listed 1890s north portal of the east tunnel copies the Gothic style of the original, the new south portal is a simpler, classically-derived composition in engineering brick. Neither the east nor the west portal appears to have been altered since construction.

Details
Two portals forming the southern entrance of Redhill Tunnel, the west portal (SPC6 28) built 1838-40 for the Midland Counties Railway to the designs of Charles Vignoles, and the east portal (SPC6 28a) built 1892-93 for the Midland Railway probably to the designs of J. A. MacDonald.

MATERIALS: the west portal is faced in coursed quarry-faced sandstone with ashlar dressings, and the east portal is constructed of blue engineering brick laid in English bond with ashlar dressings.

EXTERIOR: the west portal is situated at the end of a steep earth cutting, and is expressed architecturally as a classical frame applied to a retaining wall of coursed quarry-faced stone. The semi-circular arch has ashlar voussoirs that return as quoins on the soffit of the tunnel. The arch springs from a moulded impost band which extends across the abutments to form the cornice of flanking pedestals. These support pilasters with plain, squared capitals, which have a picked dressing with tooled margins. Above is a square-profiled string course with the same dressings which forms the architrave of an entablature. The frieze consists of three courses of quarry-faced stone and the cornice has a cyma reversa moulding. This is surmounted by a low, recessed ashlar parapet.

The east portal has a horseshoe arch with four courses of headers stepped in two parts and an outer stone roll moulding. The innermost course of bricks is also rounded as it returns to the soffit. The arch is flanked by two pairs of broad raked piers, the outer piers terminating the wing walls, where they meet the rising sides of the cutting. The portal has a bold ashlar stone roll moulding and a parapet consisting of a single course of ashlar stone.

Site Number	88
Site Name	Park at Thrumpton Hall
Type of Site	Park
List Entry Number	
HER Number	MNT26809
Status	Non-designated
Easting	450500
Northing	331200

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Parish	Thrumpton, Rushcliffe
Council	Rushcliffe
Description	LANDSCAPE PARK (C18 onwards, Post Medieval to Modern - 1547 AD to 2000 AD)

The site passed to Gervase Pigot, a High Sheriff of Nottingham, who began building the present hall in 1609. In 1720 the estate only totalled 12 acres accompanied by the manor house. It would, however, increase in a piecemeal fashion throughout the eighteenth century. In 1754 it passed to John Emerton Wescomb Emerton. The ice house and the ashlar gate piers date from his ownership. He was also responsible for planting the parkland and the original pleasure ground as described in Throsby. In 1810 he planted the cedars to commemorate the Jubilee of King George III which have survived to the present. In 1820 Laird describes the gardens as 'extremely neat and agreeable; and the surrounding scenery is picturesque in almost every point of view'.
In 1823 the estate passed to John Emerton Wescomb who constructed a new drive to the north of the house along which he built the east and west gateways and the turreted Gatehouse at the end. It is most likely that he was also responsible for the layout of the Secret garden and the Rose Garden. On the 5th May 1840 the Midland Counties Railway opened which passed through the western end of the park. This necessitated the construction of the Red Hill tunnels. The ornamental portals would appear to have been inspired by the Gatehouse. In the early period of her ownership (from 1844) Lady Byron was responsible for the formation of the present lake known as the Fish Pond. This had previously been a swampy backwater of the Trent which had been prone to flooding and so it was remodelled providing water via a pipeline from Thrumpton Weir, a stone bridge and a channel back to the river. Later on in the 1880s she carried out improvements to the 3.5 acre walled kitchen garden which included much replanting. In 1944 the estate then passed to George Fitzroy Seymour. He began a comprehensive programme of restoration to the Hall, park and gardens which has continued to the present under the
guidance of his widow, the Honourable Mrs. George Seymour.

Notts Historic Gardens Trust, 1995-1997, Notts Historic Parks and Gardens Files (Unpublished document).

Site Number	90
Site Name	Field Observation at enclosure, Red Hill, Ratcliffe on Soar
Type of Site	Event - Survey
List Entry Number	
HER Number	ENT3226
Status	Event
Easting	449500
Northing	330200
Parish	Ratcliffe on Soar, Rushcliffe
Council	Rushcliffe
Description	No description

Site Number	91
Site Name	Historical Report: Machine-made lace in Beeston
Type of Site	Event - Interpretation

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List Entry Number	
HER Number	ENT1014
Status	Event
Easting	450000
Northing	330000
Parish	Beeston, Broxtowe
Council	Broxtowe
Description	No description

Site Number	93
Site Name	Watching brief on service trench at Red Hill, Ratcliffe on
Type of Site	Event - Intervention
List Entry Number	
HER Number	ENT3856
Status	Event
Easting	449390
Northing	330050
Parish	Ratcliffe on Soar, Rushcliffe
Council	Rushcliffe
Description	An archaeological watching brief on the groundworks in the field S of Redhill Farm, during the excavation of a service cable for the present marina. 64m long by 0.3m wide excavated to a depth of 0.68m. The trench was too narrow to allow full recording or for the stratigraphy to be properly identified. Grid ref for E end of trench. Unpublished document: Birmingham Archaeology. 2006. Red Hill Marina, Ratcliffe on Soar. An Archaeological Watching Brief. p 4

Site Number	96
Site Name	Historical report: Beeston Then and Now by Mellors
Type of Site	Event - Interpretation
List Entry Number	
HER Number	ENT819
Status	Event
Easting	450000
Northing	330000
Parish	Beeston, Broxtowe
Council	Broxtowe
Description	No description Monograph: Mellors R. 1916. Beeston Then and Now.

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Site Number	97
Site Name	Field Observation by Woodhouse, Ratcliffe on Soar
Type of Site	Event - Survey
List Entry Number	
HER Number	ENT933
Status	Event
Easting	449750
Northing	330680
Parish	Ratcliffe on Soar, Rushcliffe
Council	Rushcliffe
Description	No description

Site Number	98
Site Name	CHURCH OF ST WINIFRED, THE GREEN
Type of Site	Listed Building
List Entry Number	1242066
HER Number	
Status	Grade: I
Easting	450184
Northing	327742
Parish	Kingston on Soar
Council	Rushcliffe
Description	KINGSTON ON SOAR THE GREEN SK 52 NW (north side) 4/38 Church of St. Winifred 13.10.66 G.V. Parish church.

Chancel and chancel aisle c.1540, remainder and restorations 1900 by R. Creed. Ashlar. Plain tile roofs. Parapets to porch, chancel and chancel aisle. Single ridge crosses to porch, east and west nave, east aisle and east chancel. Buttressed and set on a moulded plinth with moulded band extending over, apart from the tower and stair turret which are not buttressed and have a splayed plinth with moulded band over, the vestry lacks the band. South west tower with stair turret to the north east, south aisle, south porch, nave, north vestry, chancel and chancel aisole. Tower of 2 stages with bands. The embattlements are decorated with blind tracery with single large similarly decorated corner crocketed pinnacles to all but the north east and single similar smaller pinnacles to the centre of each side. The west side with single arched light with cusped panel tracery, hood mould and label stops. Above to west, north and south sides are single arched and cusped lights with hood moulds and label stops. 4 bell chamber openings each with 2 arched and cusped lights under a flat arch with hood moulds and label stops. Under the south side is a single clock face. Projecting from the north east corner is the embattled stair turret of 3 stages with bands with chamfered arched doorway, 2 small rectangular lights and 2 quatrefoils. The west wall of the nave has a single arched 2 light window with reticulated tracery, hood mould and label stops. The north wall has a single arched 2 light window with cusped panel tracery, to the left is a single arched 3 light window with cusped panel tracery and on the far left a single arched 2 ight window with flowing tracery. All with hood moulds and label stops. To the left is the gabled vestry with chamfered arched doorway, hood mould and label stops in the west wall. The north wall has a single window with 2 arched and cusped lights under a flat arch with hood mould and label stops. To

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the left in the north chancel are 2 windows each with 2 arched lights under a flat arch, the continuous hood mould extends to the east chancel and the continuous sill band to the east chancel, east and south chancel aisle walls, being broken by the east chancel window. Over the windows are 4 decorative heraldic plaques. The single central buttress is topped with a damaged decorative finial. Rainwater head here inscribed "1900 B". The east chancel has a single arched window with 5 arched and cusped lights, each cusp terminating in a single orb, the window further decorated with carved.shields. To the right and left are single panels containing decorative shields. Above is a single similar smaller panel. To the left and slightly porjecting is the chancel aisle, the diagonal buttresses terminating in crocketed pinnacles below the parapet. Single central canted bay with single arched window with 3 arched and cusped lights, each cusp terminating in a single orb, the window further decorated with carved quatrefoils. In each side wall are single similar lights. Continuous hood mould. Over the central window is a carved lion flanked by single smaller carved figures of beasts. Over the lion in the parapet is a single panel with decorative carved heraldic shield. Either side of the canted bay are single panels with decorative carved heraldic shields. Hood moulds and label stops over each. The south chancel aisle wall has 2 arched 2 light windows treated in a similar manner to those of the east wall. Continuous hood mould over. Over each is a single panel with carved lion. The single central buttress is topped with an heraldic carving. Rainwater head here inscribed "1900 B". The south aisle wall has a single arched 2 light window with flowing tracery, to the left is a single arched 3 light window with cusped panel tracery, both with hood moulds and label stops. To the left is the porch with moulded arched entrance hood mould and human head label stops. Over is a single niche with cusped canopy containing a single carved figure. Inner moulded arched doorway with hood mould and label stops. Interior. 3 bay nave arcade. Piers and responds consist of 4 colonnettes alternating with 4 engaged octagonal piers. Moulded arches. Moulded tower arch. Moulded aisle/chancel aisle arch with similar responds to the nave arcade. Similar chancel arch, responds however with stiff-leaf capitals, hood mould and human head label stops. Between chancel and chancel aisle is the extraordinary and elaborate Babington monument. 4 piers, the bases and shafts decorated with blind tracery, carved heads, figures and figures set into hexagonals, capitals decorated with babes and tons and open tracery, support a large and elaborate arched canopy with single corner crocketed pinnacles further decorated with blind tracery. The canopy decorated with angels holding shields, foliate, babes and tons and blind and open tracery. The vaulted roof with blind tracery and pendant bosses. The east side decorated with a representation of The Last Judgement. To the left, linking the monument to the east wall of the nave is a depressed arch supported on moulded corbels. The soffits decorated with foliate. Cornice surmounted by large panel decorated with a coat of arms. Mounted on to the west wall is a carved panel decorated with lions holding a shield with carvings of children and tons, further decorated with fleur de lys and Tudor roses. Above is a single panel decorated with blind shields and blind tracery. The north wall of the chancel has a tripartite sedilia consisting of moulded arches supported on 2 colonnettes with continuous hood mould and 2 human head label stops. To the left is a moulded arched doorway with hood mould. Alabaster reredos with blind tracery, alabaster font. The east windows of chancel and chancel aisle are treated in a similar mode to their exteriors. Reveal of chancel aisle window further decorated with elaborate blind tracery. The chancel and chancel aisle roofs with C16 moulded beams and carved bosses, further decorated with blind tracery and carved angels. The tower has 3 C19 monuments. In the chancel aisle is a copper plaque inscribed "The nave, aisle and tower of this church were erected and the chancel and chancel aisle restored A.D.1900 by Henry Lord Belper in memory of his son William Strutt born Feb.8th. 1875, died Oct.5th 1898".

Site Number	99
Site Name	CHURCH OF HOLY TRINITY, CHURCH LANE
Type of Site	Listed Building
List Entry Number	1242163
HER Number	
Status	Grade: I

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Site Gazetteer

Easting	449483
Northing	328898
Parish	Ratcliffe on Soar
Council	Rushcliffe
Description	RATCLIFFE ON SOAR CHURCH LANE SK 42 NE (north side) 3/52 Church of Holy Trinity 13.10.66 G.V. I Parish church.

C13, C14, C15, C18, restored 1891. Ashlar, dressed coursed rubble, some red brick. Lead and slate roofs. Parapets to nave, chancel and north aisle. Coped gables, single ridge cross to east chancel. Buttressed, apart from the tower. Tower with spire, nave, aisles, south porch, north chapel and chancel. C13 dressed coursed rubble tower with ashlar quoins, set on a splayed plinth with band over, of 3 stages with bands, corbel table and single corner pinnacles. Topped with early C14 broach spire with 2 tiers of 4 lucarnes. West side of the tower has a single C13 lancet with single similar smaller lancet above and 2 tie plates. North, south and west sides each with single C13 arched bell chamber openings, each opening with 2 pointed arched lights and hood mould. East bell chamber with single pointed arched light and hood mould, evidence of former nave roof. North aisle is on a low chamfered plinth with further chamfer extending under the sills. Projecting from the west wall is a single large stepped buttress. In the north wall is a blocked round arched doorway. To the left are 2 C18 round arched windows. Clerestory with 2 rectangular lights. The north wall of the chapel has a single small lancet with single smaller lancet in the east wall. The chancel is set on a low chamfered plinth and has in the east wall a single large C14 arched 4 light window with geometric tracery, hood mould and continuous sill band. The south wall has 3 pairs of C13 lancets. To the right of the left pair is a blocked chamfered arched doorway with hood mould and decorative label stops. The south aisle is set on a chamfered plinth with moulded band extending over. The east wall has a single 3 light arched window with hood mould. The south wall has 2 C14 arched 3 light windows with cusped tracery, hood moulds and label stops. There are 2 'S' tie plates. To the left is the gabled porch, set on a similar plinth, with double chamfered arched entrance and 2 'S' tie plates. Inner C14 moulded arched doorway with hood mould and C17 stud door. Sides of the porch with brick benches. The west wall of the aisle has a single pair of arched and cusped lights. Interior. 3 bay C14 nave arcades, hexgonal columns with moulded capitals, wide plinths, chamfered and moulded arches, hood mould with single label stop to south side. Responds consist of moulded capitals, that to the south east decorated with nail head and further supported on a carved human head. Double chamfered C13 tower arch, the outer order supported on colonnettes with shaft rings. Hood mould and single blocked opening over. Double chamfered chancel arch, the inner order supported on octagonal responds with moulded capitals. North aisle/north chapel double chamfered arch, the north side fore-shortened, the south side supported on an octagonal respond with moulded capital. 2 bay chancel/chapel arcade with single circular column and octagonal responds with moulded capitals, double chamfered arches. South chancel with C14 tripartite arched and cusped sedilia arches supported on colonnettes with fillets. To the left is a single arched and cusped piscina. North chancel wall has a C14 moulded arched tomb recess arch supported on single colonnettes with fillets. Under the south west window of the chancel is an ashlar bench. South aisle, south wall has a pointed arched piscina. Chancel with C13 ashlar altar piece, altar rails with C17 turned balusters. South aisle with C17 carved altar table. Oak chest with some C17 carving. C14 octagonal ashlar font with C17 cover. Furthr C19 font, remaining furniture C19. The C15 nave, chancel and aisle roofs with chamfered beams, nave roof also with carved bosses. In the tower are the remains of 2 C13 ashlar coffins. In the nace, chancel and south aisle are a number of C18, C19 floor slabs. The south aisle also with worn C13 floor slab with incised carved figures. North aisle has 2 similar slabs, one of a C15 priest, the other of C16 male and female figures. The north chapel with several similar C15 and C16 slabs including one of a female figure. C13 floor slab in the chancel and further floor slab to Ann Darly, 1667. Against the south chancel wall is the alabaster monument to Henrie Sacheverell, d.l625. There is a recumbant figure of a kniight with head on a visor, the sides of the tomb decorated with shields and front with 3 figures of children flanked by inscriptions and decorative strips. Set into the wall above are the kneeling figures of his 3 wives, flanked by Corinthian columns supporting cornice. Over are 2 small panelled pilasters supporting a round arch with keystone, containing a shield of arms. Pilasters are flanked by decorative strapwork. Between chancel and chapel is the alabaster monument to Henrie and Jane Sacheverell, c.1590, the sides of the tomb are decorated with figures, shields

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and strapwork, and it is surmounted by 2 recumbant figures, he in the attire of a knight. The alabaster monument to Henry Sacheverell and his wife, 1558, is decorated around the sides with 17 figures holding blind shields. The tomb is surmounted by 2 recumbant figures, he in attire of a knight with feet on a dog. Set into the north wall of the chapel is an alabaster monument to Ralph Sacheverell and his wife, 1539, the sides of the tomb decorated with cusped lozenges containing blind shields, 2 recumbant figures and niche over. Reveal of niche decorated with carved figures set into cusped arches, further decorated with cusped blind tracery. Soffits also decorated with blind tracery.

Site Number	100
Site Name	CHURCH OF ST GEORGE, CHURCH LANE
Type of Site	Listed Building
List Entry Number	1248685
HER Number	
Status	Grade: I
Easting	452245
Northing	332758
Parish	Barton in Fabis
Council	Rushcliffe
Description	BARTON IN FABIS CHURCH LANE SK 53 SW (north side) Church of 4/2 St. George 13.10.66 G.V. I Parish church.

C14, C15, C17, 1693, restored 1855 and 1877 probably by T. C. Hine and 1886. Tower restored 1892. Dressed coursed rubble and ashlar. Slate roofs. Single red brick stack to north nave. Parapets. Coped gables. Single ridge crosses to east nave and east chancel. Buttressed and set on a plinth. Tower with spire, nave, south aisle, south porch and chancel. Embattled angle buttressed C14 single stage tower with attached circular embattled stair turret to the north east. Early C15 spire with 4 lucarnes. The west side has a C19 doorway with 2 rectangular lights above. The north side has a single and the stair turret 4 rectangular lights. The south side has a single rectangular light. The 4 C14 bell chamber openings each have 2 trefoil arched lights and 2 mouchettes under a flat arch. The north nave with continuous sill band forming a hood mould over the doorway and extending to the chancel, has a single C14 window with 2 trefoil arched lights and tracery under a flat arch. To the left is a moulded arched doorway with C17 door and further left 2 similar windows with 2 similar windows in the north chancel. The east chancel has a single arched 3 light C15 window with cusped panel tracery, hood mould and label stops. The south chancel has 2 similar C14 windows, below that on the left is a C14 moulded arched doorway with remains of 3 attached colonnettes with fillets and moulded capitals. The single buttress to the right with sundial. To the left is a single restored C15 window with 2 cinquefoil arched lights under a flat arch, the band forming a hood mould. The east wall of the south aisle has a single C17 3 light window under a flat arch. The south wall has 2 similar C14 windows. To the left is the 1693 porch with parapet and clasping pilaster buttresses. Capitals support an entablature. Arched entrance with imposts and panelled spandrel. Keystone inscribed: "RS:HP HW 1693". Inner moulded arched doorway. to the left is a single similar C14 window. C15 clerestory has 6 windows each with 3 arched lights under a flat arch. Interior. 4 bay C14 nave arcade with octagonal piers, double chamfered arches, hood moulds and label stops. Moulded, pointed arched doorway to the tower. Double chamfered chancel arch, the inner chamfer supported on 2 corbels. Glazed screen being constructed from C16 rood screen with cinquefoil arched panels, each cusp terminating in 3 small orbs. Trefoil panels over surmounted by crocketed finials. In the chancel is a restored C14 sedilia with cinquefoil arches and crocketed ogee hood moulds with finials. Trefoil arched piscina, flanking the top are single small ogee arched recesses for cruets. Similar piscina in the south wall of the south aisle, the north wall of the south aisle has a trefoil arched piscina, and flanking the west window are single corbels. East chancel wall with remains of C14 arched and cusped canopy.