BEACON FEN ENERGY PARK

Planning Inspectorate Reference: EN010151
Outline Battery Safety Management Plan
Document Reference: 7.2
April 2025

The Planning Act 2008
The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 - Regulation 5(2)(q)

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Abbreviations and Acronyms

TERM	Meaning
AC	Alternating Current
ADB	Approved Document B
ADR	European Agreement Concerning the International Carriage of Dangerous Goods by Road
AIS	Air Insulated Switchgear
Applicant	Beacon Fen Energy Park Ltd
BAT	Best Available Techniques
BESS	Battery Energy Storage System
BMS	Battery Management System
BS	British Standard
BSMP	Battery Safety Management Plan
CCTV	Closed Circuit Television
CE	Conformité Européenne (European Conformity)
DA	Data Analytics
DC	Direct Current
DCO	Development Consent Order
DSEAR	Dangerous Substances and Explosive Atmospheres Regulations 2002
EA	Environment Agency
EES	Electrical Energy Systems
EN	Europäische Norm (European Norm / Standard)
FAT	Factory Acceptance Testing
FMEA	Failure Mode and Effects Analysis
GIS	Gas Insulated Switchgear
HAZOP / HAZID	Hazard and Operability Analysis and Hazard Identification
HGV	Heavy Goods Vehicle
HSE	Health and Safety Executive
HV	High Voltage
IDB	Internal Drainage Board
IEC	International Electrochemical Commission
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Organization for Standardization
LCC	Lincolnshire County Council
LCRM	Land Contamination: Risk Management
LFP	Lithium Iron Phosphate ($LiFePO_4$)
Low Carbon	Low Carbon Ltd
MW	Megawatts
NFPA	National Fire Protection Agency
NGR	National Grid Reference
NKDC	North Kesteven District Council
NSIP	Nationally Significant Infrastructure Project
OBSMP	Outline Battery Safety Management Plan
OEM	Original Equipment Manufacturer

Order	The Beacon Fen Energy Park Order
PCU	Power Conversion Unit
PINS	Planning Inspectorate
Proposed Development	The entire development to be constructed and operated within the Site, as set out in Schedule 1 of the Order
PRoW	Public Right of Way
PV	Photovoltaic
SAT	Site Acceptance Testing
SIL	Safety Integrity Level
Site	The area within the Order Limits located approximately 6.5km northeast of the village of Sleaford and 2.5km north of Heckington, in which the Proposed Development will be constructed, operated/maintained and decommissioned.
SoS	Secretary of State
UL	Underwriters Laboratorie
UN	United Nations
VOC	Volatile Organic Compound
VESDA	Very Early Smoke Detection by Aspiration

Executive Summary

1. This Outline Battery Safety Management Plan (‘OBSMP’) sets out the key fire safety provisions proposed in relation to the Battery Energy Storage System (‘BESS’) associated with Beacon Fen Energy Park (‘the Proposed Development’). Prior to the commencement of construction of the BESS, Beacon Fen Energy Park Ltd (‘the Applicant’) will be required to prepare a detailed Battery Safety Management Plan (‘BSMP’), which will be substantially in accordance with this OBSMP. During the preparation of the detailed BSMP, the Applicant will take into account the prevailing legislation, guidance, and standards relating to battery fire detection and prevention, as such documentation continues to develop in the UK and around the world.

2. There are several battery storage technologies available to system designers, and while it is likely that the chosen BESS design will be based on a lithium-ion battery cell type, the exact technology and system will be determined at the detailed design stage. To support the preparation of this OBSMP, it has been assumed that Lithium Iron Phosphate (LFP) cells, a popular type of chemistry within the lithium-ion family used on other sites being developed in the UK market, will be utilised. This is considered to be a reasonable worst-case for the purposes of evaluating risk and outlining safety provisions.

3. The BESS will be designed in accordance with prevailing UK and internationally recognised good practice and will be informed by expert advice regarding the reduction of BESS-related risks.

4. The overall approach is to follow the Health and Safety Executive (HSE) hierarchy of controls – specifically, in order of priority:

    - Elimination;
    - Substitution;
    - Engineering controls;
    - Administrative controls; and
    - Personal protective equipment.

5. This OBSMP outlines the types of safety systems available on the market at present, along with the risk reduction barriers that are likely to be incorporated into the system to be installed. During the detailed design phase, however, it is possible that other battery technologies, e.g., all solid-state batteries, may be available. Should it be proposed that other such technologies be utilised, the relevant details and safety provisions will be reflected in the detailed BSMP, which is to be approved by the relevant planning authority in consultation with North Kesteven District Council and Lincolnshire Fire and Rescue (LFR).

6. The fire safety provisions anticipated to be adopted are summarised as follows:

    - The BESS will be designed, installed, operated, and decommissioned in accordance with prevailing international guidance, good practice, and related standards;
    - Risk assessments will be carried out to ensure the safety of personnel and equipment during all phases of the Proposed Development;

- The BESS will be located so as to minimise, as far as practicable, impacts on sensitive receptors;
- The separation distances between BESS components will reflect manufacturer recommendations and prevailing guidance, and, during an incident, will limit the spread of fire and facilitate access by LFR;
- The BESS will be designed so as to minimise the chance of a fire or thermal runaway event;
- All equipment will be monitored, maintained, and operated in accordance with manufacturer recommendations;
- The BESS will be monitored 24/7 by a control room, with experienced personnel on hand to alert necessary parties, including LFR and a subject matter expert;
- The firefighting strategy to be employed in the event of an incident will be recorded in the Emergency Response Plan, which is to be approved by the relevant planning authority in consultation with LFR; and
- LFR will continue to be engaged throughout the consenting and development process, particularly during the detailed design phase.

1. Introduction

1.1 Overview

1.1.1 This **Outline Battery Safety Management Plan ('OBSMP') (Document Ref: 7.2)** has been prepared on behalf of Beacon Fen Energy Park Ltd (the 'Applicant') in support of an application for a Development Consent Order ('DCO'), that has been submitted to the Secretary of State (the 'SoS') for the Department for Energy Security and Net Zero, under Section 37 of 'The Planning Act 2008' (the '2008 Act').

1.1.2 The Applicant is seeking development consent for a ground-mounted solar photovoltaic ('PV') electricity generation and battery energy storage system ('BESS'), together with associated grid connection infrastructure (the 'Proposed Development'), at an area sited approximately 6.5km northeast of the village of Sleaford and 2.5km north of Heckington (the 'Site'). The Proposed Development would have a generation capacity of approximately 400 megawatts ('MW') of electricity, with a 600MW BESS.

1.1.3 The Site corresponds to the entire draft Order Limits and represents the entire land area required for the construction, operation and decommissioning of the Proposed Development. It is made up of the Solar Array Area (comprising the solar PV and BESS infrastructure), the Cable Route Corridor (comprising an electrical connection from the Solar Array Area to the Bicker Fen National Grid 400kV substation), and the Bespoke Access Corridor (for a bespoke access from the A17 to the Solar Array Area, termed the Bespoke Access Road).

1.1.4 The Proposed Development falls within the definition of a 'Nationally Significant Infrastructure Project' ('NSIP') under Section 14(1)(a) and Sections 15(1) and (2) of the 2008 Act, as it is an onshore generating station in England that would have a generating capacity greater than 50MW electrical output. As such, a DCO application is required to authorise the Proposed Development in accordance with Section 31 of the 2008 Act.

1.1.5 The DCO, if made by the SoS, would be known as 'The Beacon Fen Energy Park Order' (the 'Order').

1.2 The Applicant

1.2.1 The Applicant is a subsidiary of Low Carbon Ltd ('Low Carbon'). Low Carbon is a privately-owned global renewable energy company.

1.3 The Site

1.3.1 The Site represents the entire proposed Order Limits and is located east of Sleaford in Lincolnshire. It extends to approximately 758ha and comprises three functional areas: the Solar Array Area, the Cable Route Corridor and the Bespoke Access Corridor.

Solar Array Area

1.3.2 The Solar Array Area is approximately 529ha in size and located to the north of Heckington, centred at the National Grid Reference ('NGR') 514682 347825. The Solar Array Area is located wholly within the administrative areas of North Kesteven District Council ('NKDC') and Lincolnshire County Council ('LCC').

1.3.3 The Solar Array Area predominantly comprises agricultural land in arable use, divided by ditches with sparse tree cover that is limited to small woodland blocks and scattered hedgerow trees. A small reservoir is located in the south-west of the Solar Array Area.

1.3.4 The Solar Array Area is bound to the south, west and north by local highways, and bound to the east by the Car Dyke. Public Right of Way ('PRoW') Ewer/12/1 extends across the north-eastern corner of the Site, close to the northern Site boundary. There are no other PRoW within the Solar Array Area.

1.3.5 Villages to the Solar Array Area include:

- Howell immediately to the south-west, with Heckington c. 1.7km beyond;
- Ewerby Thorpe immediately to the west, with Ewerby c. 1.1km beyond;
- Anwick c. 2.7km to the north-west;
- North Kyme c. 2.4km to the north; and
- South Kyme c. 1.5km to the east.

Cable Route Corridor

1.3.6 The Cable Route Corridor is approximately 183ha in size and extends c. 13km south-east from the Solar Array Area to Bicker Fen substation, at NGR TF 19684 38599. The Cable Route Corridor is located wholly within the administrative area of LCC. The majority of the Cable Route Corridor is located within the administrative area of NKDC, however the southern section is located within BBC's administrative area.

1.3.7 Land use within the Cable Route Corridor is predominantly agricultural. A number of local highways cross the Cable Route Corridor, and the A17 crosses east to west within the north-west section of the Corridor. The railway linking Heckington west to Sleaford and east to Swineshead intersects the mid-section of the Corridor. There are a number of PRoW within the Cable Route Corridor, including one alongside the South Forty Foot Drain which also crosses the Cable Route Corridor.

Bespoke Access Corridor

1.3.8 The Bespoke Access Corridor is approximately 45.4ha in size comprising predominantly agricultural land and extends approximately 3km south-west from the Solar Array Area to the A17. The Bespoke Access Corridor is located wholly within the administrative areas of LCC and NKDC.

1.3.9 Asgarby Road and Heckington Road cross the Bespoke Access Corridor, and there are four PRoW located within the route.

1.4 The Proposed Development

1.4.1 The main components of the Proposed Development are summarised below.

Solar Array Area

1.4.2 The Solar Array Area consists of solar PV panels and modular ground-mounting structures. The height of the panels considered will be up to 3.9m above ground level in fields to the east and 3.5m above ground level in fields to the west, south and an isolated field in the north. The proposal is for a fixed (i.e., static) panel orientation, facing due south, which is commonly seen on existing UK solar farms, and angled 10° to 45° from horizontal. Supporting infrastructure includes inverters, combiner boxes, transformers and switchgear converting the Direct Current ('DC') to Alternating Current ('AC') and stepping up the voltage so it can be exported to the National Grid. An inverter, transformer and switchgear comprised together is termed a Power Conversion Unit ('PCU').

1.4.3 A 600MW BESS adjacent to the Onsite Substation is included in the Proposed Development within the Solar Array Area. This will allow the electricity generated by the panels to be stored onsite at times when grid demand is low and then exported at times of higher demand. The BESS containers and switch rooms are anticipated to be up to 8m x 3m in size, with a height of up to 4.5m.

1.4.4 Low voltage onsite electrical cabling is required to connect the PV modules and BESS to the inverters, and the inverters to the onsite transformers. Higher voltage cables are required between the transformers and the switchgear and from switchgear to the Onsite Substation.

1.4.5 A new Onsite Substation is proposed and would have up to four High Voltage (HV) transformers with a maximum footprint of no more than 40,000m2 (e.g. 250m x 160m (or 200m x 200m)) and a height of up to 13m). The substation will include a 33kV switchroom, control and storage buildings that would house office space and welfare facilities, as well as operational monitoring and maintenance equipment and equipment for reactive compensation and/or harmonic filtering. The design control building and office/welfare will be defined as part of detailed design.

1.4.6 The perimeter fence would likely comprise a standard post and wire, deer fencing up to 3m tall around the Solar Array Area. Security fencing, up to 3.4m will be installed around the Onsite Substation compound and, possibly, other infrastructure / compounds. Acoustic fencing, up to 4m tall, may be required around the BESS, subject to the detailed design and layout.

1.4.7 Mounted internal-facing closed circuit television (CCTV) systems will likely be deployed around the perimeter of the operational areas of the Site; anticipated to be 5m high. The CCTV cameras would have fixed view sheds and will be aligned to face along the fence. Motion detection security lighting will be used around the electrical infrastructure and potentially at other pieces of critical infrastructure.

1.4.8 During construction, temporary construction compounds will be required, as well as temporary roadways, to enable access to all the land within the Site.

Localised earthworks to form suitable development platform for the substation and BESS will also be required.

1.4.9 There will be one primary access on the western edge of the Solar Array Area and a secondary access to the north, both of which will allow large vehicles (including first responder access to the BESS and Onsite Substation). Tertiary operational access primarily for smaller vehicles is provided to the north west and south.

1.4.10 PRoW Ewer/12/1 is being extended in a south and westerly direction as a permissive path terminating in the vicinity of Ewerby Thorpe, and will be in place for the operational duration of the Proposed Development. The exact route of the permissive path will be determined via the discharge of requirement in the DCO, but it is anticipated to run in a south easterly direction along Car Dyke and then heading south west on the north side of Hodge Dike. An undetermined number of footbridges (unlikely to be more than 8 in number) to cross existing watercourses will be required and will require the usual water course crossing agreements to be sought with the relevant Internal Drainage Board in parallel with the discharge of the requirement.

Cable Route

1.4.11 The Cable Route running between the Solar Array Area and the Bicker Fen 400kV Substation will be constructed through trenched methods and, where required, trenchless methods.

1.4.12 During construction, temporary construction compounds will be required approximately every 1-3km, as well as temporary roadways, to enable access to all land. It is anticipated that there will be 6 main compounds that are distributed at approximately equal distances along the cable route to facilitate proper construction management. Smaller temporary compounds may also be located anywhere within the final working area.

1.4.13 Vegetation and hedgerows lost during the construction of the Cable Route will be re-instated where possible in relation to easement restrictions.

Bespoke Access Road

1.4.14 A dedicated access from the A17 to the Solar Array Area is required. The Bespoke Access Road will be constructed in advance of material construction commencing on the Solar Array Area and will facilitate construction in that area. During construction, temporary construction compounds will be required which may be anywhere along the route.

1.4.15 The Bespoke Access Road will likely be the last component of the Proposed Development to be removed as it will be used to facilitate decommissioning of the Solar Array Area. Whilst it is assumed for this assessment that the road will be removed, it is possible that engagement with the landowners at that time will establish a preference for it to be retained. Optionality has been deliberately retained in the Application to facilitate such a scenario.

1.4.16 There will be no permanent lighting installed, and access will be controlled through gates at all stages.

1.4.17 Vegetation and hedgerows lost during the construction of the Bespoke Access Road will be re-instated.

In any or all of the above areas

1.4.18 Along with the above, in any or all of the three areas, the Proposed Development will include the following (subject to certain requirements):

- Access tracks of between 3.5m to 9m width for construction access and routine maintenance when operational. Access tracks located adjacent to drainage ditches will incorporate the necessary ecological, Environment Agency (EA) and/or Internal Drainage Board (IDB) buffers where required;
- Boundary treatments, means of enclosure, security measures, and paths;
- Landscaping and reinstatement planting and Biodiversity Net Gain related habitats;
- Flood resilience measures including swales and storm water attenuation, and works to existing irrigation systems;
- Utility diversions;
- Bunds, embankments, protective works to buildings, maintenance and improvement of streets; and
- Construction related (and decommissioning related) work sites.

Bicker Fen Substation Works

1.4.19 The extension of Bicker Fen substation will include a new generation bay, a new generation bay control room and a perimeter access road. A new generation bay will also include electrical equipment required for connection to the transmission system.

1.4.20 National Grid have requested that there be optionality within the design of the extension to Bicker Fen substation. The two design options that have been assessed in the Environmental Statement and included in the Application are: Air Insulated Switchgear ('AIS') and Gas Insulated Switchgear ('GIS').

Draft Development Consent Order

1.4.21 The Proposed Development is described in detail in Schedule 1 of the **Draft Development Consent Order (Document Ref: 3.1)**, and the areas in which each component (the 'Work Numbers') may be constructed are shown on the **Works Plans (Document Ref: 2.4)**.

1.4.22 The Proposed Development is split into 10 Work Numbers as follows:

- Work No. 1 – a ground mounted solar photovoltaic generating station with a gross electrical output capacity of over 50 megawatts;
- Work No. 2 — a battery energy storage system compound and associated works (including fire safety infrastructure);
- Work No. 3 — development of an Onsite Substation and associated works;
- Work No. 4 — works in connection with electrical cabling and associated compounds;
- Work No. 5 — works to the existing Bicker Fen National Grid substation to create a new generation bay and substation extension;
- Work No. 6 — various ancillary works relating to the Solar Array Area, including cabling, fencing, security features, access tracks, watercourse crossings and landscaping and biodiversity mitigation measures;
- Work No. 7 — construction and decommissioning compounds in connection with Work Nos. 1, 2 and 3;

- Work No. 8 — works to create the Bespoke Access Road;
- Work No. 9 — areas of habitat management; and
- Work No. 10 — works to facilitate access to Work Nos. 1 to 9.

1.4.23 In addition, Schedule 1 to the Draft DCO lists other associated works (referred to as "further associated development") which may be carried out in connection with the construction of Work Nos. 1 to 10.

1.5 The Development Consent Order Process

1.5.1 As a NSIP, the Applicant is required to seek a DCO to obtain planning and other powers to construct, operate and maintain the generating station, in accordance with Section 31 of the 2008 Act. Sections 42 to 48 of the 2008 Act govern the consultation that an applicant must carry out before submitting an application for a DCO and Section 37 of the 2008 Act governs the form, content and accompanying documents that are required as part of a DCO application.

1.5.2 An application for development consent for the Proposed Development will then be submitted to the Planning Inspectorate ('PINS') acting on behalf of the SoS. Subject to the Application being accepted (which will be decided within a period of 28 days following receipt of the Application), PINS will then examine it and make a recommendation to the SoS, who will then decide whether or not to make (grant) the DCO.

2. Overview of Battery Safety Management

2.1 Purpose of this Document

2.1.1 This OBSMP outlines the key fire safety provisions for the BESS proposed to be installed at Beacon Fen Energy Park, including fire risk reduction and fire protection measures.

2.1.2 This document provides a summary of the safety-related information requirements, which will be provided in advance of the construction of the BESS. The purpose of this OBSMP is to identify how the Applicant will use advice from experts in the field and good industry practice to reduce risk to life, property, and the environment from the BESS.

2.1.3 References to current measures and guidelines are included in this OBSMP; however, the detailed BSMP will be prepared prior to the construction of the BESS to take account of prevailing guidance.

2.2 Structure of this Document

2.2.1 The structure of this OBSMP is set out below in Table 2.1 OBSMP structure.

Table 2.1 OBSMP structure

Section	Title
Section 1	Introduction
Section 2	Overview of Battery Safety Management
Section 3	Stakeholder Engagement
Section 4	Risk Management
Section 5	Pre-Construction Information Requirements
Section 6	Conclusion

2.3 Assumptions & Controls

2.3.1 As outlined in section 1.4, the Proposed Development includes a 600MW BESS, to be located within the BESS compound in the centre of the Site bound by the Hodge Dyke and Fox Covert wood, as shown on the **Works Plan (Document Ref: 2.4)** submitted with the Application (see the area marked as 'Work No. 2').

2.3.2 For the purposes of this document, it has been assumed that the BESS will utilise Lithium Iron Phosphate (‘LFP’) lithium-ion battery technology that is currently used on other sites being developed in the UK market. This is considered to be a reasonable worst-case for the purposes of evaluating risk and outlining safety provisions.

2.3.3 The design of the BESS and its impacts are controlled in several ways. Requirement 6 in Schedule 2 to the **Draft DCO (Document Ref: 3.1)** stipulates that prior to the commencement of construction of the BESS, a detailed BSMP (which must be substantially in accordance with this OBSMP) must be submitted to and, in consultation with North Kesteven District Council and Lincolnshire Fire and Rescue ('LFR'), approved by the relevant planning authority (this being LCC). The Applicant must operate the BESS in accordance with the approved BSMP.

2.3.4 As part of the preparation of the detailed BSMP, which will include an Emergency Response Plan ('ERP') and Risk Management Plan ('RMP'), the Applicant will take into account the latest good practices for battery fire detection and prevention as guidance continues to develop in the UK and around the world.

2.3.5 Further, pursuant to requirement 5 of the **Draft DCO (Document Ref: 3.1)**, the detailed design of the BESS must also be in accordance with the Outline Design Principles (Appendix A of the **Design and Access Approach Document (Document Ref: 5.6)**). The Outline Design Principles contain controls over the BESS, including dimensions and access requirements.

2.4 Potential for BESS Malfunction

2.4.1 Any high-voltage electrical equipment, if inadequately designed, protected and maintained, can give rise to malfunctions and, in turn, cause risks to property, the environment, and people.

2.4.2 Other electrical systems than the batteries which form part of the BESS can carry fire risks; however, due to the extensive historic long-term deployment of other technology such as transformers, inverters and switchgear, these risks are now better understood and regulated through longstanding industry guidance and codes. Therefore, only the battery component of the BESS is considered in this OBSMP.

2.4.3 Causes of BESS failure can include manufacturing defects (e.g., contaminants, imperfections), electrical abuse (e.g., overcharging, overdischarging), and physical or mechanical damage (e.g., puncture, crushing). Regardless of the type of failure and cause, if not detected and suppressed, the main potential hazard is thermal runaway and, ultimately, if not controlled, a fire or explosive gas venting incident. Thermal runaway refers to a self-reinforcing cycle in which an increase in temperature causes reactions that release energy, further increasing the temperature.

2.4.4 Though dependent on BESS design, in the unlikely event of a BESS failure and thermal runaway event, BESS hazards for first responders are typically categorised as fire hazards, explosion hazards, electrical hazards (e.g., shock, arc flash), and chemical hazards (e.g., the release of toxic gases). This OBSMP focuses on reducing fire and explosion risks associated with the BESS and managing the hazards in the unlikely event that they occur.

2.4.5 Potential failures associated with the BESS would be assessed through a Failure Modes and Effects Analysis ('FMEA') process, and mitigations established through a Hazard Mitigation Analysis ('HMA') process. As per the Health and Safety Executive's ('HSE') hierarchy of controls, where possible, all failure modes and hazards will be eliminated or substituted. Due to the nature of lithium-ion BESS equipment, however, it may not always be possible to eliminate and substitute all failure modes and hazards; therefore, engineering controls may be required instead.

2.5 Safety Objectives

2.5.1 The safety objectives for the design of the BESS are:

- To minimise the likelihood of a thermal runaway event (this is the overriding priority);
- To minimise the consequences to property, the environment and people, should an event occur;
- To restrict any event to the site and minimise any impact on the surrounding areas;
- To automatically detect and begin to fight an electrical fire as soon as possible and to alert LFR;
- To ensure any personnel on site are able to escape safely away from the site;
- To ensure that firefighters can operate in reasonable safety where necessary and have sufficient water resources;
- To ensure that fire, smoke, and the spread of toxic/explosive gases do not affect occupants in surrounding buildings and areas; and
- To ensure that firewater run-off is contained and treated.

2.5.2 Section 4 sets out the measures incorporated into the Proposed Development in order to achieve these objectives.

2.6 Legal Requirements & Relevant Guidance

2.6.1 The Applicant will develop the BESS in accordance with prevailing legislation and good practice, and following advice from subject matter experts. BESS are deployed globally, and the Applicant will look to incorporate good practice from around the world and not be restricted to UK guidance. Guidance documents and standards considered by the Applicant have been used to inform the design of the Proposed Development.

2.6.2 The primary guidance which has been used is the Planning Practice Guidance (‘PPG’). The PPG for renewable and low carbon energy[1] explains the roles of the local authority and the fire and rescue service and explains that where planning permission is being sought for the development of BESS with a capacity of 1MWh or over, applicants are encouraged to engage with the relevant local fire and rescue service before submitting an application to the local planning authority: *“so matters relating to the siting and location of battery energy storage systems, in particular in the event of an incident, prevention of the impact of thermal runway, and emergency services access can be considered before an application is made”*. The guidance is, therefore, clear that BESS siting, location, access, incident response, and prevention of thermal runaway impacts are relevant factors to consider at the planning stage.

[1] Ministry of Housing, Communities and Local Government and Department for Levelling Up, Housing and Communities, Planning Practice Guidance - Renewable and low carbon energy (2023). Available at https://www.gov.uk/guidance/renewable-and-low-carbon-energy (Accessed 02 April 2025).

2.6.3 The PPG explains that Applicants are also encouraged to consider the National Fire Chiefs Council ('NFCC') guidance "Grid Scale Battery Energy Storage System planning – Guidance for FRS[2] (2023)"[3].

2.6.4 In the summer of 2024, NFCC published a draft revision of the guidance for consultation. A high number of consultation responses were received and are under review; therefore, the publication of the new guidance has been delayed. The new guidance is due for publication in 2025, possibly during the examination of the Proposed Development. The 2023 guidance is not written or intended for use outside of fire and rescue services and is not planning guidance in itself, whereas the 2025 guidance is expected to have a wider readership.

2.6.5 As such, this OBSMP gives consideration to the current but outgoing 2022 guidance in a proportionate way, recognising that it may be updated in examination following the publication of the new 2025 guidance. Other guidance and good practice documentation has also been considered, including the following documentation, which is also not planning guidance but is used by the manufacturers of BESS technologies, by contractors, and by insurers, and therefore has relevance:

- National Fire Protection Agency ('NFPA') 855, Standard for the Installation of Stationary Energy Storage Systems (2023);
- NFPA 69, Standard on Explosion Prevention Systems (2024);
- Underwriters Laboratories ('UL') 9540A, Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems (2025);
- Factory Mutual Insurance Company ('FM'), FM Property Loss Prevention Data Sheets: 5-33 Lithium-Ion Battery Energy Storage Systems (2017, revised January 2024);
- DNV, Recommended Practice – DNV-RP-0043: Safety, operation and performance of grid-connected energy storage systems (2017, amended October 2021);
- BS 5839-1: 2017: Fire detection and fire alarm systems for buildings;
- BS EN IEC 61936: Power installations exceeding 1 kV AC and 1,5 kV DC – AC;
- The Regulatory Reform (Fire Safety) Order ('RRO') 2005;
- The Buildings Regulations 2010, Approved Document B (Fire Safety) – Volume 2 (specifically, Table 15.2: Typical fire and rescue service vehicle access route specification); and
- United Nations ('UN'), Manual of Tests and Criteria (eighth revised edition), Section 38.3 Lithium metal, lithium ion and sodium ion batteries (2023)[4].

2.6.6 The detailed BSMP, which must be submitted to, and approved by, the relevant planning authority (LCC) prior to construction of the BESS in accordance with Requirement 6 in Schedule 2 to the **Draft DCO (Document Ref: 3.1)**, will incorporate the prevailing legislative requirements, guidance, and standards,

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[2] Fire and Rescue Services.
[3] NFCC, Grid Scale Battery Energy Storage System planning – Guidance for FRS (2023) Available at https://nfcc.org.uk/consultation/draft-grid-scale-energy-storage-system-planning-guidance/ (Accessed 02 April 2025).
[4] The *Manual of Tests and Criteria* contains criteria, test methods and procedures to be used for the classification of dangerous goods according to the provisions of the *United Nations Recommendations on the Transport of Dangerous Goods, Model Regulations*.

including any relevant updates to the documentation above, at the time of drafting.

3. Stakeholder Engagement

3.1 Overview

3.1.1 This OBSMP has been developed in careful consultation with key stakeholders, as set out in the remainder of this section.

3.2 Lincolnshire Fire & Rescue

3.2.1 The Applicant and LFR first met on 16 November 2023. During the meeting, LFR was introduced to the Proposed Development, and both parties discussed the DCO process, the activities being undertaken by the Applicant, and working together going forward, including in relation to the drafting of a Statement of Common Ground.

3.2.2 LFR were also consulted during the Applicant's Section 42 Consultation between 18 January 2024 and 3 March 2024. LFR returned a Position Statement dated 31 January 2024 and sent it again on 08 March 2024.

3.2.3 In addition, LFR returned a more detailed response on 25 April 2024, after the statutory consultation had closed. However, this was received in time to be taken into account by the Applicant in the design of the Proposed Development. Further information on this can be found in the **Consultation Report Appendix 7.8 (Document Ref: 5.1.3)**.

3.2.4 A subsequent update meeting was held on 10 May 2024, which featured a deeper discussion on legislation and guidance and the specifics of the Proposed Development, such as access, layout and water supply. Following this, on 24 May 2024, the Applicant provided to LFR a written response to their 25 April 2024 comments. Key topics from the 24 May 2024 response are covered below in Table 3.1 LFR recommendations and Applicant response; however, the Applicant's response has, where helpful, been updated to reflect and reference the relevant application documents:

Table 3.1 LFR recommendations and Applicant response

Topic	LFR Recommendations	Applicant Response
Risk Reduction Strategy	According to LFR, the developer should produce a risk reduction strategy (Regs 38 of the Building Regulations) as the responsible person for the scheme as stated in the Regulatory Reform (Fire Safety) Order 2005.	This OBSMP sets out how the Applicant proposes to ensure risk reduction is central to the detailed design and subsequent construction, operation, and decommissioning of the BESS element of the Proposed Development. The adopted risk reduction measures will be captured within the detailed BSMP, submitted pursuant to a requirement in the **Draft DCO (Document Ref: 3.1)** (see below), and will reflect the prevailing legislation, guidance and standards at the time of its production. Further, in accordance with NFCC guidance, a RMP and ERP will form appendices to the detailed BSMP. The relevant planning authority must consult LFR when determining the application to discharge Requirement 6 in Schedule 2 to the **Draft DCO (Document Ref: 3.1)**.
Firefighting water	Where no piped water supply is available, or there is insufficient pressure and flow in the water main, or an alternative arrangement is proposed, the alternative source of supply should be provided in accordance with the following recommendations • a charged static water tank of at least 45,000 litres capacity; or • a spring, river, canal or pond capable of providing or storing at least 45,000 litres of water at all times of the year, to which access, space and a hard standing are available for a pumping appliance; or • any other means of providing a water supply for firefighting operations considered appropriate by the fire and rescue authority.	There is no piped water supply to the Proposed Development. The Applicant is therefore committing to provide 240,000 litres of water, split between up to 4 x 60,000 litre containers. Each of these will provide well in excess of the required 45,000-litre capacity. Furthermore, there is a small reservoir within the Site located approximately 540 metres south of the BESS area with a storage capacity of approximately 27,276,000 litres. While there is no permanent pump to this source proposed, it may be deemed suitable by LFR to use during an emergency using their own mobile high-volume pumps.

Site access	Access to buildings for fire appliances and fire fighters must meet with the requirements specified in Building Regulations 2010 Part B5. For small buildings (up to 2000m², with a top occupied storey that is a maximum of 11m above ground level), vehicle access for a pump appliance should be provided to whichever is the less onerous of the following: a) 15% of the perimeter; or b) Within 45m of every point of the footprint of the building. For all other buildings, provide vehicle access in accordance with Table 15.1 [sic: 15.2] of Approved Document [sic: B]. These requirements may be satisfied with other equivalent standards relating to access for firefighting. Lincolnshire Fire and Rescue requires a minimum carrying capacity for hard standing for pumping appliances of 18 tonnes, not 12.5 tonnes as detailed in the Building Regulations 2010 part B5. If it is not possible to provide access to the proposed development in accordance with the guidance details within Part B5 of Approved Document B, as compensation, Lincolnshire Fire and Rescue may accept the provision, at the developer's expense, of an automatic sprinkler system, designed, fitted and maintained in accordance with the relevant sections of BS5306/BSEN12845:2004. Should this option be considered, our Fire Safety advisers must be provided with detailed plans of the proposed sprinkler installation. Any scheme proposed should not be of a lesser standard than any provision as may be required by the Building Regulations.	The Applicant's proposals provide vehicular access to the relevant buildings for a pump appliance around 15% of the perimeter (see Environmental Statement Figure 1.4 Indicative Site Layout Plan **(Document Ref: 6.4 ES Vol.3, 6.4.4)**), and we will also endeavour to provide access within 45m of every point of the footprint of the building, although it is noted that the design of the Proposed Development only needs to meet one of these requirements. The Applicant also notes that there are no cul-de-sacs on Site. The Applicant notes that the requirement for the minimum carrying capacity for hard-standing for pumping appliances is 18 tonnes. The design of the Proposed Development will meet this requirement. An inbuilt gaseous or liquid suppression system may be part of the selected technology for the BESS. Should this option be taken forward, detailed plans will be submitted as part of the detailed BSMP.
Installation Standards	LFR recommend applying the National Fire Protection Association (NFPA) 855 Standard for the Installation of Stationary Energy Storage Systems.	This is noted and the Applicant intends to have regard to this guidance (or subsequent guidance in force at the time) in the preparation of the detailed BSMP, which must be submitted to and approved by the relevant planning authority (LCC) in accordance with Requirement 6 in Schedule 2 to the **Draft DCO (Document Ref. 3.1)**..

Risk Reduction and collaboration with LFR	We would expect that safety measures and risk mitigation is developed in collaboration with LFR. The strategy should cover the construction, operational and decommissioning phases of the project.	This Applicant's proposed safety and risk reduction measures are set out within the OBSMP, with consideration given to the construction, operational, and decommissioning phases. A RMP and ERP will be submitted as appendices to the detailed BSMP, which must be submitted to and approved by the relevant planning authority (LCC) in accordance with Requirement 6 in Schedule 2 to the **Draft DCO (Document Ref. 3.1).**.LFR will be consulted when the application to discharge Requirement 6 is being determined.
Road safety	During the construction phase the number of daily vehicle movements in the local area will significantly increase. The Service will want to view the transport strategy to minimise this impact and prevent an increase in the number of potential road traffic incidents. Any development should not negatively impact on the Service's ability to respond to an incident in the local area.	With regards to road safety, it is notable that the Applicant intends to include a Bespoke Access Road to improve safety and reduce traffic on rural roads. Further details on traffic and transport are set out in Environmental Statement Chapter 9: Access and Traffic **(Document Ref: 6.2.9)** and its Appendices 9.1: Transport Assessment **(Document Ref: 6.3.76)** and 9.3: Outline Construction Traffic Management Plan **(Document Ref: 6.3.78)**.
Lithium Battery	LFR would like to work with the developer to better understand any risks that may be posed and develop strategies to mitigate these risks.	The Applicant is committed to engaging with LFR as appropriate throughout the consenting and development process, in particular during the detailed design stage. The relevant planning authority must consult LFR when determining the application to discharge Requirement 6 in Schedule 2 to the **Draft DCO (Document Ref: 3.1)** (which relates to preparing for approval a detailed BSMP, substantially in accordance with this OBSMP).
Renewable Energy Guidance	LFR refer to the Department for Levelling Up, Housing and Communities revised policy guidance in reference to BESS and strongly recommend building in accordance with NPFA 855.	The Applicant is aware of and has taken account of this guidance in preparing this OBSMP, including the reference to the NFCC guidance, and is aware of the NPFA 855 guidance, which will inform the design.

3.3 Lincolnshire County Council

3.3.1 The Applicant discussed batteries and fire safety with LCC during a meeting on project updates on 10 August 2023. LCC raised concerns about the number of BESS developments in the area putting stress on the LFR and whether financial contributions should be made.

3.3.2 The Applicant has included protective provisions in Part 6 of Schedule 11 to the **Draft DCO (Document Ref. 3.1)** to allow financial contributions to be made to LFR. This follows a model adopted on other Lincolnshire solar and BESS DCOs, including the Gate Burton Energy Park Order 2024 and the Heckington Fen Solar Park Order 2025. This is considered to fully address LFR's concerns relating to the need for financial contributions from the Applicant.

LCC provided a response to the statutory consultation on 9 March 2024. Within their response, they directly refer to LFR’s response to the S42 letter to be adopted as their own opinion. They also stated it is *“disappointing to see that accidents and disasters have been scoped out of the ES due to the potential for battery fires from developments of this nature”*

The scope of the EIA was established via the formal EIA scoping process prior to statutory consultation, for which LCC was a consultee. Notwithstanding this Scoping Opinion, the Applicant has opted to consider the potential risks associated with BESS fires within the Environmental Statement. This assessment is presented in Environmental Statement **Chapter 17: Other Environmental Topics (Document Ref: 6.2 ES Vol.1, 6.2.17)**, specifically Section 17.5 Major Accidents and Disasters and Table 17.3 Major Accidents and Disasters associated with the Proposed Development.

4. Risk Management

4.1 BESS Units

Procurement

4.1.1 Beacon Fen Energy Park Ltd is the Applicant for the Proposed Development. Beacon Fen Energy Park Ltd is a subsidiary of Low Carbon, an experienced developer of electricity generation and storage projects. Low Carbon is an integrated renewables project development, investment and asset management company with an active interest in developing utility-scale wind, solar and storage across the UK, EU and the US. Low Carbon has been at the forefront of the storage market, having successfully deployed lithium-ion battery projects at scale in the UK and the Republic of Ireland.

4.1.2 The Applicant is therefore experienced in conducting thorough tendering processes for procuring battery storage equipment and services, working with Tier 1, bankable suppliers. In addition, the Applicant only works with leading battery integrators with a global presence, whose expertise in system integration – e.g., of battery cells and modules, inverters and transformers – in combination with intelligent software for management and optimisation of energy services from the battery, is critical for the successful operation of any battery project.

4.1.3 By only working with major global battery integrators, the Applicant gains access to the integrators' whole-system testing labs, which can simulate conditions at the Applicant's (as a subsidiary of Low Carbon) site locations, undergoing the full cycle of installation, commissioning, and operation under all required application modes, putting the hardware, controls, and software integration through a suite of tests. This helps reduce commissioning times and yields early identification of issues, allowing resolutions to be implemented prior to deployment at its sites.

4.1.4 The Applicant only considers and engages with battery storage integrators and component manufacturers that conform to ISO 9001[5], ISO 14001[6], CE[7], and local regulations, which are, therefore, audited on technical, environmental, and financial aspects.

4.1.5 The Applicant recognises that robust quality processes are essential within the development and procurement stages in terms of safe, continuous operation. As such, the Applicant has developed strong relationships with several suppliers and, in line with internal quality assurance processes, visited the factories of all key suppliers.

4.1.6 The Applicant's quality assurance processes require the inspection of manufacturing facilities and periodic monitoring of production lines. The inspections evaluate production quality documentation and production line process, against pre-defined documentation to verify that the quality

[5] ISO 9001:2015 Quality Management Systems – Requirements.
[6] ISO14001: 2015 Environmental management systems – Requirements with guidance for use.
[7] European Union, CE Marking. Available at https://europa.eu/youreurope/business/product-requirements/labels-markings/ce-marking/index_en.htm#inline-nav-1 (Accessed 02 April 2025).

requirement is correctly respected and implemented. The following aspects are specifically checked:

- Material management;
- Procurement and supplier management;
- Manufacturing processes;
- Quality system;
- Reliability program;
- Training;
- Corrective action and non-conformance process improvements; and
- Corporate social responsibility, environmental, health and safety.

4.1.7 The Applicant requires procured designs to incorporate the most advanced fire suppression systems and adhere to the UL9540A and NFPA 855 standards, as well as conforming with local and industry standards. A non-exhaustive list of standards applied in general for the equipment Low Carbon procures is set out below in Table 4.1 Procurement standards:

Table 4.1 Procurement standards

Standard	Description
IEEE 1547:2003	IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems
National Grid	Grid Code
IEC 61000-6-2	Electromagnetic compatibility ('EMC') - Part 6-2: Generic standards - Emission standard for industrial environments
IEC 61000-6-4	EMC Part 6-4 Generic Standards- Emission Standard for Industrial Environment
Directive 2006/66/EC	Directive of batteries and accumulators and waste batteries and accumulators
Directive 2014/35/EU	Low Voltage Directive
Directive 2014/30/EU	EMC Directive
IEC 60183	Guidance for the selection of HV AC cable systems
IEC EN 62477	Safety requirements for power electronic converter systems
IEC 62116 ed1.0	Test procedure of islanding prevention measures for utility-interconnected photovoltaic inverters
IEC EN 61727	PV – Characteristics of Utility Interface
IEC 61140	Electrical low voltage installations - Part 4-41: Protection measures - Protection against electrical shock
IEC 60076	Power Transformers
IEC 62933	Electrical energy storage ('EES') systems
IEC 62619	Secondary Cells and Batteries containing alkaline or other non-acid electrolytes
UL 9540A	Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems
NFPA 855	Standard for the installation of Energy Storage Systems
UN38.3	UN Manual of Tests and Criteria

Testing

4.1.8 The system selected will be tested in accordance with UL 9540A (2025) or its contemporary at the time of procurement. This will determine the propensity of the system to suffer from thermal propagation at cell, module, rack or container level. The results of all four tests at each level will be made available on request (note: if thermal propagation does not take place at module level, there is no need to proceed). Any actions taken, if necessary, to prevent thermal propagation will also be available, as will the results of the re-testing. A Low Carbon HSE expert will look at and interpret the results and, where needed, will consult a specialist third party.

BESS Enclosures

4.1.9 BESS enclosures will house the battery systems, electrochemical components and associated equipment. Multiple containers may be joined or close coupled to each other. They will be mounted on a concrete foundation, although other types of foundations (e.g., ground screws, metal piles, or compacted stone/gravel) may be used depending on the local geology or land quality.

4.1.10 The BESS enclosures will be designed and constructed by the manufacturer in accordance with the good practice available at the time, such as the current guidance outlined in the NFPA 855, Standard for the Installation of Stationary Energy Storage Systems. This will ensure the enclosures will be of robust construction and have suitably high ingress protection ratings. The BESS enclosures will be locked to prevent unauthorised access, and the BESS area will be surrounded by a perimeter security fence.

Fire Detection, Monitoring & Suppression

4.1.11 In order to achieve the safety objectives, the Applicant will employ monitoring systems that will help identify any abnormal operation and safely shut down the system before it develops. These systems will be independent of the control systems and equipment that can cause the abnormal event and avoid the use of Safety Integrity Level (‘SIL’) rated risk controls.

4.1.12 Data Analytics (‘DA’) will be employed to help minimise risks. The battery management system (‘BMS’) will routinely record a wide variety of data (including current, voltage and temperature), which can be exploited by DA. DA will automatically detect anomalous changes in temperature, cell resistance, and capacity at rack level (which could indicate lithium metal plating, corrosion, or failure of components and cables) and can monitor thousands of sensors such as smoke, gas, and ground fault detectors. Further, DA will routinely monitor the ageing of the cells and can be used to predict end-of-life, as well as alert the operator when modules need preventative maintenance.

4.1.13 The BESS will be monitored by the onsite control systems, which will be active at all times and feed cloud monitoring services, and a 24/7 remote control room that will monitor for critical health and safety faults. Control room personnel will be experienced in both emergency response and the management of renewables and battery sites, trained for the specific BESS system installed on the site, and made aware of key local points of contact. Control room personnel will be responsible for the implementation of the ERP, alerting LFR, facilitating collaboration with the subject matter expert (available 24/7), and, if necessary, remotely shutting down the BESS.

4.1.14 At the detailed design stage, once a BESS solution has been selected, a detailed BSMP will be developed in accordance with relevant standards and guidance to define measures applicable to the selected BESS enclosures. Such measures may include:

- Thermal monitoring of the BESS enclosures and automated cut-out beyond safe parameters;
- Battery cooling systems with automated fail-safe operation;
- Emergency stop capability, both remote and local;
- Fire and vapour cloud (immediate and delayed ignition) detection suitable to the architecture, such as:
  - Aspirated very early smoke detection apparatus ('VESDA');
  - Volatile organic compounds ('VOC') and carbon monoxide detection apparatus[8];
  - A standard heat and smoke detection system;
- Electrical fire suppression equipment such as thermally activated aerosol cannisters, or other contemporary system.

Deflagration / Explosion Detection & Protection

4.1.15 The Proposed Development will reflect the prevailing safety standards for deflagration protection at the point of procurement so as to manage and mitigate related risks effectively. Equipment and site design compliance is crucial for the protection of site personnel and property from incidents.

4.1.16 NFCC guidance states that BESS enclosures should be fitted with venting and explosion protection appropriate to the hazard, and, along with NFPA 855 and NFPA 69 guidelines, sets out that exhaust systems designed to prevent deflagration should prevent explosive gas concentration from reaching 25% of the Lower Explosion Limit ('LEL') (the LEL is determined from UL 9540A testing).

4.1.17 Such strategies will be built into the ERP so that first responders are aware and can consider the impact of their actions. For example, where emergency ventilation systems are implemented, first responders would be advised not to disconnect the relevant power supply during an evolving incident.

Cybersecurity

4.1.18 Cybersecurity will form a fundamental part of the system design and architecture of the BESS solution chosen for the Proposed Development. Standards such as IEC 62443[9] and guidance from sources such as the National Cybersecurity Centre will inform the implementation and protection measures, and reference shall be made in the detailed BSMP to the HSE Operational Guidance document OG86[10].

4.1.19 UL 2941[11] (2023) provides testable requirements for photovoltaic inverters, electric vehicle chargers, wind turbines, fuel cells and other resources

[8] VOC can be released prior to thermal runaway and hence give some warning of cell failure. The vapour cloud released in this way generally has both heavier than air and buoyant components, and the positioning of VOC sensors will reflect this. This will trigger gas venting in accordance with NFPA 855 (2023) and so avoid explosion.
[9] IEC 62443 – Industrial communication networks – Networks and system security.
[10] HSE, OG86 - Cyber Security for Industrial Automation and Control Systems (IACS) (2017).
[11] UL 2941 (2023) Outline of Investigation for Cybersecurity of Distributed Energy and Inverter-Based Resources.

essential to advancing grid operations. These new requirements prioritise cybersecurity enhancements for power systems that deal with high penetration inverter-based resources, including those interfacing with bulk power systems for periods of instantaneous high wind, solar and hybrid/storage generation. UL 2941 promotes the necessity to have cybersecurity designed into new inverter-based resources and distributed energy resource systems. The BESS supplier chosen at the detailed design stage will conform to these requirements.

4.1.20 The Applicant's dedicated technology team will review all cybersecurity provisions for the systems and services to be implemented as part of the Proposed Development.

Maintenance

4.1.21 The BESS will be maintained and operated by skilled personnel, ensuring that the system is in optimal condition and that all parts of the system are fully serviced and functional at all times.

4.1.22 As well as maintenance triggered by DA, routine maintenance will be undertaken on the BESS equipment, as specified in the equipment manuals, at least twice a year. This typically consists of a major maintenance period and a minor maintenance period. The major is relatively non-intrusive and involves checking connections and inspections from the transformer down to the module level. This will encompass all BESS equipment supplied by the original equipment manufacturer ('OEM'), including the fire system. The minor maintenance is typically a visual inspection and rectification of any accumulated non-critical defects.

4.1.23 During operation, all manufacturer instructions for maintenance will be followed, or safe variations agreed upon, and works on the site will be controlled under safe systems of work. This will mean all work is risk assessed to protect both personnel and equipment. Therefore, safety systems such as fire systems will not be stopped or taken out of service without appropriate mitigation, following the system being made safe so far reasonably practicable, and only for the minimum time required to undertake any specific maintenance tasks. Maintenance protocols will be outlined in the detailed BSMP.

4.2 Construction & Decommissioning

Construction

4.2.1 The BESS may be constructed in phases. Typically, the civil works and balance of plant equipment would be started; then, at a suitable point, the BESS equipment would be delivered to be installed on the foundations and connected up to the balance of plant.

4.2.2 The BESS installation will be subject to prerequisites such as the development of an ERP in consultation with LFR, as part of the approval of the detailed BSMP by LCC. In addition, the installation will not take place until practical provisions are completed, such as the installation and filling of water tanks for use in an emergency.

4.2.3 The transportation of the BESS from the factory will involve a combination of sea and land freight. The BESS will be certified for transportation in all potential environmental conditions. The equipment will also be certified for transport to UN 38.3. Transportation will be managed in accordance with the "European Agreement Concerning the International Carriage of Dangerous Goods by Road ('ADR') 2019"[12] and the UK guidance on the transport of dangerous goods "Moving dangerous goods" webpage[13].

4.2.4 The equipment supplied will be fully tested, including Factory Acceptance Testing ('FAT'). By definition, the FAT will be undertaken away from the site, reducing the risks during on-site construction with visual inspections and functional testing undertaken before any Site Acceptance Testing ('SAT'). The Site installation will be supervised by the OEM and carried out hierarchically to ensure that all necessary systems are available before the next step is required. By following a logical sequence of works, with each step built upon the preceding one, the system can be safely assembled without risk, and all mitigations against issues are in place before the next step.

Augmentation

4.2.5 From time to time during the operational phase, there may be a requirement to replace or augment the battery system due to equipment failure or degradation of the system capacity[14]. Augmentation of the BESS system is most likely to comprise repowering, in which case all old containers are deemed to have reached end-of-life and will be replaced with new containers.

4.2.6 The indicative layout and overall area dedicated to the BESS compound provide adequate space for augmentation, including the use of lifting machinery.

4.2.7 The risks associated with any wholesale replacement with similar or any new technological developments will also be considered before any works commence. It is also possible that any replacement or augmentation of the system may use a contemporary equivalent of the original BESS system.

Decommissioning

4.2.8 With regards to the decommissioning of the BESS, the specific legislative and regulatory requirements will be determined at the procurement contract stage, with the contractor remaining clear that pursuant to the "Waste Batteries and Accumulators Regulations 2009"[15] (as amended) (or such equivalent regulations in force at the time of decommissioning), they are the producer of the battery components and the party placing the battery components on the UK market and, therefore, have certain obligations in respect of battery disposal.

4.2.9 All BESS decommissioning will be undertaken in a carefully controlled manner in accordance with the Decommissioning Environmental Management Plan (DEMP) that will be prepared and approved in accordance with Requirement

[12] United Nations Economic Commission for Europe (UNECE), European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) (2019).
[13] Department for Transport (DfT), Moving dangerous goods (2012). Available at https://www.gov.uk/guidance/moving-dangerous-goods (Accessed 02 April 2025).
[14] The planned design life may require replacement or augmentation of the battery systems on more than one occasion depending on use case.
[15] Waste Batteries and Accumulators Regulations 2009 (SI 2009/890).

18 of the **Draft DCO (Document Ref: 3.1)**. The detailed DEMP(s) must be substantially in accordance with the Outline Decommissioning Environmental Management Plan (ODEMP) **(Document Ref: 6.3 ES Vol.2, 6.3.8)**.

4.2.10 All components replaced during the defects notification and warranty period will be taken back and recycled.

4.2.11 The Applicant will follow the hierarchy of waste management throughout the life of the Proposed Development.

4.3 Layout, Access & Emergencies

BESS Location

4.3.1 Within the Proposed Development, the selection of the location of the BESS has been based on a number of factors. The most pertinent factor is the proximity of the BESS location to sensitive receptors of any nuisance, with the distance to properties maximised where possible. Distancing the BESS location from sensitive receptors not only has the benefit of reducing the visual and noise impact but also minimises any potential impacts on the local population should an event occur. The location of the proposed BESS is more than 800m from any residential properties and is centrally located within the Proposed Development.

BESS Layout

4.3.2 Batteries will be placed within individual enclosures arranged regularly within a compound with vehicular access available to each unit. The precise number will depend upon the power capacity and duration of energy storage that the Proposed Development requires. An element of flexibility in approach is, therefore, adopted at this stage as technology, business models, and relevant policy all evolve.

4.3.3 The dimensions of the BESS enclosure (and switch rooms) are anticipated to be up to 12.5m x 3m, with a height of up to 4.5m. The BESS enclosures will be arrayed in discrete groups, along with inverters and transformers. Each group will be separated from the rest.

4.3.4 The separation distances between the following key BESS components or groups of components will reflect manufacturer recommendations and the prevailing guidance during the detailed design phase but will, in any case, serve to limit the spread of fire to initially unaffected parts of the BESS and facilitate access by LFR during an incident:

- The separate BESS groups;
- The BESS enclosures and transformers;
- The BESS enclosures and the BESS area perimeter fence;
- The BESS enclosures and adjacent uses (i.e., the Order Limits)[16][17]; and
- The inverters and transformers[18].

[16] NFCC (2023) guidance, for example, states 25m from adjoining uses or occupied buildings as a starting point, with the potential to reduce in rural areas. The separation distance between the BESS enclosures and the Order Limits in the assessed design exceeds this.
[17] The permissive path is not yet designed in detail, and its routeing would be defined at the requirement discharge stage; however, the separation distance would likely exceed 10m. This exceeds the 3m set out in NFPA 855 (2023) guidance.
[18] A skid-mounted inverter and transformer could be utilised, in which case the separation of the group from the BESS would be considered.

4.3.5 The areas between and around the equipment within the BESS area will be finished with gravel and kept free of combustible vegetation.

4.3.6 In the unlikely event that a fire should occur, it should be limited to the part of the system that is on fire, i.e., the overall size of the battery system is inconsequential to the outcome; an event should be limited in size to only that equipment within a group, whether there are one or any number of groups.

Fire Service Access

4.3.7 Access has been designed such that emergency services are able to access the site easily, with site roads clearly laid out and signed in line with relevant guidance.

4.3.8 Firefighting access will be designed in accordance with the guidance of Approved Document B ('ADB'), approved for the purposes of the Building Regulations 2010. Although the Proposed Development is not covered under the Building Regulations, and, therefore, ADB is not directly applicable, it is nonetheless useful to consider the access road specifications set out in ADB and reproduced below in Table 4.2: Typical fire and rescue service vehicle access route specification. It should be noted, however, that fire and rescue vehicles differ across the UK, and access route specifications should, therefore, be considered on a site-by-site basis.

Table 4.2: Typical fire and rescue service vehicle access route specification

Appliance type	Min. width of road between kerbs (m)	Min. width of gateways (m)	Min. turning circle between kerbs (m)	Min. turning circle between walls (m)	Min. clearance height (m)	Min. carrying capacity (tonnes)
Pump	3.7	3.1	16.8	19.2	3.7	12.5
High Reach	3.7	3.1	26.0	29.0	4.0	17.0

4.3.9 Vehicular access / circulation will be provided around the perimeter of the BESS.

4.3.10 The design used to inform the Environmental Statement uses a minimum proposed access road width to reach the BESS area of 4m, i.e., in excess of the minimum values in Table 4.2: Typical fire and rescue service vehicle access route specification.

4.3.11 As required by NFCC (2023), twin accesses are provided from differing compass directions. The principal access is from a west-south-west direction off Heckington Road, while the second access is from the north-east off Halfpenny Toll Lane. Each is provided with a setup/staging area near the perimeter of the BESS site[19]. As such, the BESS area can be reached without first responders having to drive through a smoke or gas plume in the event of an incident.

4.3.12 The retention of the Bespoke Access Road during the operational phase of the Proposed Development, while intended for the overall purpose of maintenance and renewal of the operational solar and BESS development, could be made available to LFR (e.g., keys or other controls to gates) to allow

[19] All necessary information regarding the BESS will be made available at each staging area.

usage by Sleaford based crews and reduce the distance travelled on rural roads. Even if this is not appropriate for the first attending crew, it could be opened for subsequent crews or larger vehicles. Detailed management and response arrangements would be agreed upon and recorded within the detailed BSMP.

Firefighting Water

4.3.13 In the event of an incident, it is anticipated that LFR will likely adopt a defensive firefighting strategy whereby water is used to cool adjacent areas, e.g., neighbouring BESS enclosures and structures, so as to prevent further fire spread. This approach reflects the NFCC guidance, which recognises that such measures will be the focus in the majority of cases. The Proposed Development, therefore, incorporates the provision of sufficient firefighting water.

4.3.14 As there is not currently a piped water supply to the Proposed Development, onsite water storage is proposed in the form of rigid aerial tanks within the BESS area. The number of tanks is to be determined as part of detailed design; however, it is likely to be either two 120m^3 tanks or four 60m^3 tanks with a total capacity of 240m^3 or 240,000 litres. In a four-container design, the 60,000 litres of water contained in each remains well in excess of the recommended 45,000-litre capacity, as set out in Table 3.1 LFR recommendations and Applicant response. This would also provide amounts of water which are in excess of the recommended minimum set out in the NFCC guidance of 1,900 litres per minute for two hours.

4.3.15 Furthermore, there is a small reservoir within the Site located approximately 540 metres south of the BESS area with a storage capacity of approximately 27,276,000 litres. While there is no permanent pump to this source, it may be deemed suitable by LFR to use during an emergency using their own mobile high-volume pumps.

4.3.16 The primary and secondary water sources have been discussed with LFR and will be finalised when the ERP appended to the detailed BSMP is, in consultation with LFR, approved by the relevant planning authority during the discharge of Requirement 6 in Schedule 2 to the Draft DCO **(Document Ref:3.1)**.

Firefighting Equipment

4.3.17 Additional firefighting equipment will also be provided on the site for use by LFR. Weather stations will be installed to identify the weather conditions in an emergency situation. This will allow the fire service to approach from a safe direction.

4.3.18 Prior to the commencement of construction of the BESS, LFR will be consulted regarding the provision of other firefighting or emergency equipment, such as additional fire hoses to be stored onsite, as part of the approval of the detailed BSMP by LCC.

4.3.19 The Applicant will continue to engage LFR throughout the design, construction, and commissioning phases of the Proposed Development.

Protection of Environmental Receptors

4.3.20 As the BESS would have only occasional and limited personnel access into the battery enclosures (for maintenance), there is unlikely to be any immediate threat to life or safety, only to property that forms part of the Proposed Development.

4.3.21 Reflecting the likely adoption of a defensive firefighting strategy, it is not anticipated that firefighting techniques will involve direct jets of water onto equipment and will be limited to containment and cooling of adjacent units to prevent the fire from spreading. This strategy will be finalised with LFR prior to construction and will be clearly set out in the ERP, which will be developed as part of the detailed BSMP.

4.3.22 In the unlikely event of a fire within the BESS area, fire water can be contained within a lined lagoon at the centre of the BESS platform if necessary, e.g., in the further unlikely event that water is deployed directly onto the fire (as opposed to the more likely scenario of being used solely for the cooling of adjacent units), or heavy rainfall coinciding. Shutoff valves could be used by firecrews to contain and reuse water or to prevent potentially contaminated water from being discharged to the watercourse. After the fire has been managed, such contained firewater will be tested and either released to the watercourse or removed from the Site for treatment and off-site disposal.

4.3.23 After an incident, any necessary immediate and follow-up actions will be determined, including an assessment in general accordance with land contamination risk management ('LCRM') guidance[20] and BS 10175:2011+A2:2017[21].

4.3.24 Many factors, which ultimately account for the volume and concentration of the loss, would inform the design of an investigation following an incident. In the case of a BESS fire, factors to be considered include:

- Extent of the fire, e.g., number of BESS units impacted, number of adjacent assets impacted;
- Firefighting method, e.g., whilst defensive techniques are anticipated, larger volumes of water may be required to prevent spread to adjacent assets, and alternative techniques may be required to fight adjacent fires;
- Location of fire, e.g., adjacent to drainage or close to soft ground; and
- Existing site conditions, e.g., recent weather and precipitation levels.

4.3.25 Detailed air dispersion modelling of unplanned emissions from BESS modules during a thermal runaway event has been undertaken to assess the impact on sensitive receptors, such as residents of nearby properties. The assessment, included as Appendix 1 to this OBSMP, predicts that the overall impact of such emissions on existing sensitive human receptors would not be significant.

Emergency Planning

4.3.26 A RMP and ERP will form appendices to the detailed BSMP submitted for approval to the relevant planning authority in accordance with Requirement 6 in Schedule 2 to the **Draft DCO (Document Ref: 3.1)**. The RMP and ERP will

[20] Environment Agency, Land contamination risk management (LCRM) (2023). Available at https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm (Accessed 02 April 2025).
[21] BS 10175:2011+A2:2017 Investigation of potentially contaminated sites. Code of practice - Code of practice.

be developed in consultation with LFR, as part of the approval of the detailed BSMP by LCC.

4.3.27 The RMP and ERP will be developed in accordance with NFCC guidance and will incorporate the prevailing legislative requirements, wider guidance, and standards at the time of drafting. They will also be maintained and reviewed regularly throughout the operating life of the BESS.

4.3.28 The RMP will, as a minimum, provide advice in relation to potential emergency response implications, including:

- The hazards and risks at and to the facility and their proposed management;
- Any safety issues for firefighters responding to emergencies at the facility;
- Safe access to and within the facility for emergency vehicles and responders, including to key site infrastructure and fire protection systems;
- The adequacy of proposed fire detection and suppression systems (e.g., water supply) on-site; and
- Natural and built infrastructure and on-site processes that may impact or delay effective emergency response.

4.3.29 The ERP will be developed to facilitate effective and safe emergency response, and will, as a minimum, include:

- How the fire service will be alerted to an emergency event;
- A facility description, including infrastructure details, operations, number of personnel, and operating hours;
- A site plan depicting key infrastructure, e.g., site access points and internal roads, firefighting water and equipment, drainage, and neighbouring properties;
- Details of emergency resources, e.g., fire detection and suppression systems and equipment, gas detection, emergency eye-wash and shower facilities, spill containment systems and equipment, emergency warning systems, communication systems, personal protective equipment, and first aid;
- Up-to-date contact details for facility personnel, and any relevant off-site personnel that could provide technical support during an emergency;
- A list of dangerous goods stored on site;
- Site evacuation procedures; and
- Emergency procedures for all credible hazards and risks, including building, infrastructure and vehicle fire, grassfire and bushfire.

4.3.30 In the unlikely event of an incident, an executive stakeholder steering committee comprising key organisations will be set up within 24 hours. Multiple parties involved in the emergency response will actively participate in the steering committee, ensuring accurate and effective communication.

4.3.31 Furthermore, a post-incident recovery plan will address the potential for reignition of the BESS and de-energising the system, as well as the removal and disposal of the damaged equipment.

Site Security

4.3.32 The site security profile will be assessed by the Applicant's dedicated security team, and the output from this assessment will inform the level of security measures used.

4.3.33 As a minimum, the BESS will have security fencing clearly signed identifying the dangers within the site and the Control Room freephone telephone number for use in case of an emergency.

4.3.34 The site will also have high quality CCTV with video analytics to identify and prevent unauthorised access to enable the correct security response to be undertaken by the control room.

5. Pre-construction information requirements

5.1 Summary

5.1.1 The lifecycle of the BESS from installation to decommissioning will be considered in greater depth at the detailed design stage. Fire risk-focussed studies will be undertaken to inform the overall design solution, including but not limited to, studies in line with analysis and management tools, e.g., Hazard and Operability Analysis and Hazard Identification ('HAZOP' / 'HAZID'), FMEA, and Bowtie risk assessments, as well as the "Dangerous Substances and Explosive Atmospheres Regulations 2002 ('DSEAR')"[22].

5.1.2 An agile approach to fire safety analysis will be applied, whereby analyses will be updated based on any changes in context or deviation from the initial set of technical requirements. These will be finalised before the commencement of construction of the BESS.

5.1.3 The detailed design phase will determine the approach to addressing the following specific requirements, which will be updated prior to construction of the BESS and submitted to the relevant planning authority as a detailed BSMP prior to the commencement of construction. The detailed BSMP must include:

- The detailed design, including drawings of the BESS;
- A statement on the battery system specifications, including fire detection and suppression systems;
- A statement on operational procedures and training requirements, including emergency operations;
- A statement on the overall compliance of the system with applicable legislation, standards, and manufacturer recommendations; and
- An ERP covering construction (specifically installation) and operation, developed in consultation with LFR, as part of the approval of the detailed BSMP by LCC, which is to include the adequate provision of firefighting equipment on-site, signage and access, and an environmental component (an environmental risk assessment to ensure that the potential for indirect risks from the implementation of the ERP, e.g., through leakage, runoff or other emissions, is understood and mitigated).

5.1.4 The provision of the above information would demonstrate prior to construction that all of the considerations and requirements in this document have been addressed and the BESS installation is safe.

5.1.5 All BESS decommissioning will be undertaken in a carefully controlled manner in accordance with the Decommissioning Environmental Management Plan (DEMP) that will be prepared and approved in accordance with Requirement 18 of the **Draft DCO (Document Ref: 3.1)**. The detailed DEMP(s) must be substantially in accordance with the Outline Decommissioning Environmental Management Plan (ODEMP) **(Document Ref: 6.3 ES Vol.2, 6.3.8)**.

[22] The Dangerous Substances and Explosive Atmosphere Regulations 2002 (SI 2002/2776).

6. Conclusion

6.1 Summary

6.1.1 The Applicant is committed to developing a safe BESS that will provide long, dependable operation. As such, the Applicant has examined available guidance and standards and has considered safety throughout each phase of the Proposed Development, from the design and construction of the BESS, through to its safe operation and decommissioning. It is in the interest of all stakeholders that the chosen BESS solution is robust, particularly with regard to safe operation.

6.1.2 This OBSMP demonstrates that the Applicant has significant internal expertise and robust processes concerning BESS development. Further, it evidences that LFR and LCC have been consulted, and their responses have been used to inform the design of the Proposed Development and management of the BESS. Safety will, therefore, be inherent in the overall design, minimising the risk of a fire or explosion event occurring and reducing the impact of such an event should it occur.

6.1.3 The implementation of this OBSMP is secured by Requirement 6 of Schedule 2 to the **Draft DCO (Document Ref: 3.1)**, which stipulates that, prior to the commencement of construction of the BESS, a detailed BSMP must be submitted to and, in consultation with North Kesteven District Council and LFR, approved by the relevant planning authority (LCC). The detailed BSMP must be substantially in accordance with this OBSMP and must be implemented as approved and maintained throughout the construction, operation and decommissioning of the Proposed Development.

Appendices

Appendix 1: Assessment of Unplanned Atmospheric Emissions from Battery Energy Storage Systems (BESS)

Assessment of Unplanned Atmospheric Emissions from Battery Energy Storage Systems (BESS)

For: Beacon Fen Energy Park Ltd

Site: Sleaford, Lincolnshire

Date: 28/03/2025

Document Ref: 314012

Issue 1.0

Quality Assurance

Issue Record

Revision	Description	Date	Author	Reviewer	Approver
1.0	First Issue	28/03/2025	SC	JJ	JJ

Limitations

The recommendations contained in this Report represent Arthian Ltd's professional opinions, based upon the information listed in the Report, exercising the duty of care reasonably expected of an experienced Consultant of the appropriate discipline of this report.

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Table of Contents

Section 1.0: Introduction

1.1 Background

Beacon Fen Energy Park Ltd intend to submit a planning application for a new solar and batter storage park (hereafter referred to as the 'proposed development') on land to the east of Sleaford, Lincolnshire.

Part of the proposed development will include a Battery Energy Storage System (BESS). The batteries to be used in the BESS will be based on established lithium-ion technologies (Lithium Iron Phosphate (LFP)). If the battery cells become damaged by heat or are burnt within a fire, then combustible material consumed in the fire may give rise to a range of fugitive organic and inorganic air pollutants.

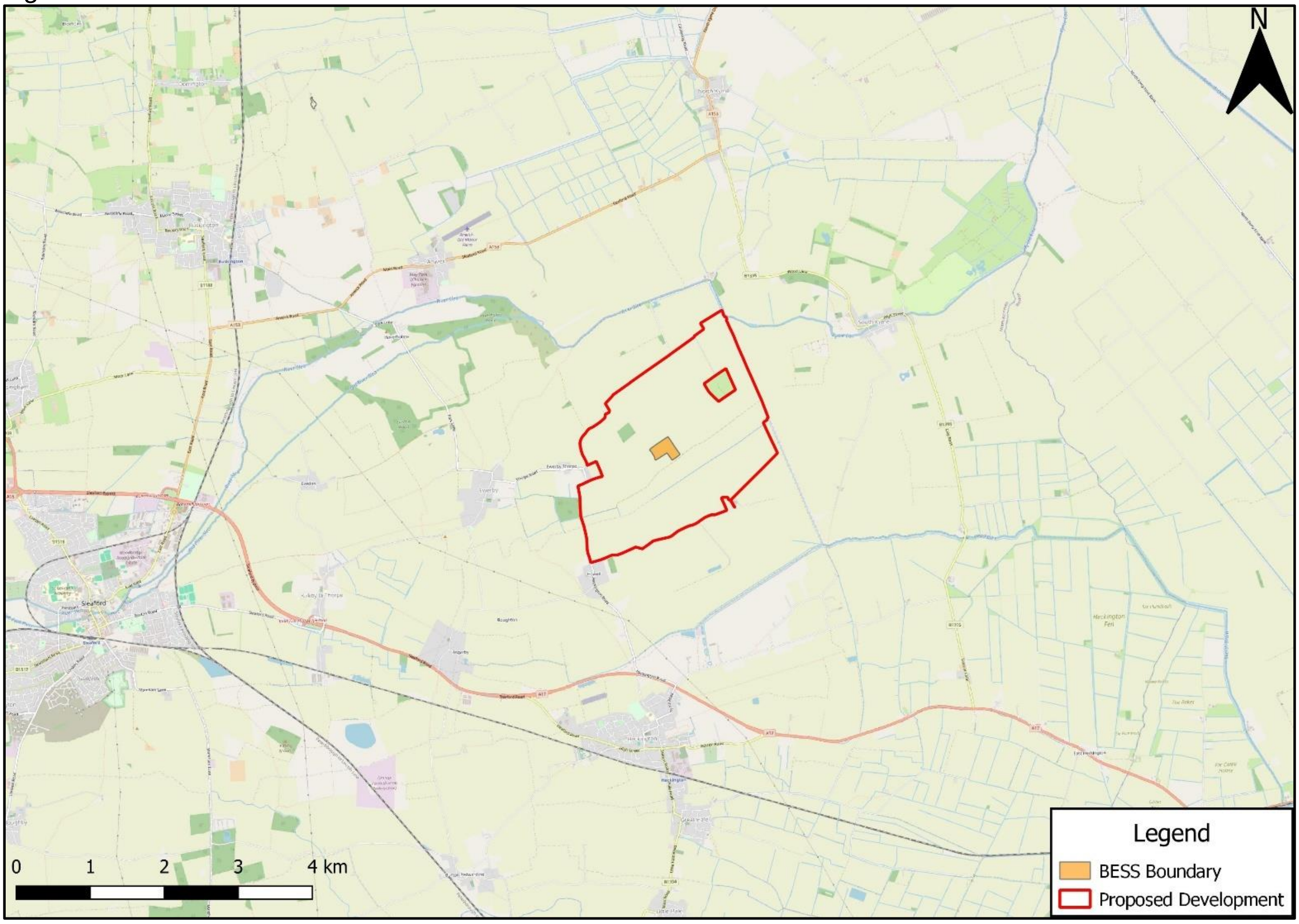
Arthain has been commissioned by Beacon Fen Energy Park Ltd to provide an air quality assessment of unplanned atmospheric emissions from the proposed development.

1.2 Site

The site is located on vacant land located approximately 6km east of the town of Sleaford. The proposed development is bounded on all sides by open fields and farmland. The proposed development is located entirely within the boundaries of North Kesteven District Council (NKDC).

A site location plan is shown in Figure 1.1 with the location of the BESS marked up in orange.

Figure 1.1: Site Location



Contains OpenStreetMap Data © 2024

1.3 Understanding of Requirements

Arthain has reviewed correspondence with the UK Health Security Agency (UK HAS) for other BESS schemes associated with large-scale solar projects. The UK HSA acknowledges that there is currently no policy, legislation, or guidance which provides clarity on the methodology for undertaking a BESS Fire Risk Assessment.

Arthian note that the following approach has been agreed as an appropriate method:

- Undertake a BESS Fire Risk Assessment using dispersion model software (such as ADMS or AERMOD) to determine pollutant levels of. The report will include details of the justification of the assessment methodologies. The predicted pollutant concentrations at receptor locations will be assessed and compared against UK Air Quality Standards.

Testing of LFP battery modules has been undertaken[1], which has indicated that the pollutants to consider are Nitrogen Dioxide (NO_2), Carbon Monoxide (CO), Hydrogen Fluoride (HF) and Methane (CH_4).

[1] Island Green Power Limited. Cottam Solar Project, Air Quality Assessment of Battery Energy Storage Systems (BESS) Fire. November 2023

Section 2.0: Legislation, Policy & Assessment Criteria

2.1 National Legislation and Policy

2.1.1 National Policy Statement for Renewable Energy Infrastructure

The National Policy Statement for Renewable Energy Infrastructure (EN-3)[2] sets out the primary policy for decisions by the Secretary of State for nationally significant renewable energy infrastructure.

The above policy is applicable to significant renewable energy infrastructure (i.e. solar photovoltaic >50 MW in England, where MW is measured as alternating current). However, the principles should be extended to infrastructure <50MW.

2.1.2 National Planning Policy Framework (NPPF)

The latest guidance published in December 2023, the National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how these are expected to be applied. At the heart of the NPPF is a presumption in favour of sustainable development. It provides a framework within which locally prepared plans for housing and other development can be produced. It requires Local Plans to be consistent with the principles and policies set out in the Framework with the objective of contributing to the achievement of sustainable development. Current planning law requires that application for planning permissions must be determined in accordance with the relevant development plan (i.e. Local Plan or Neighbourhood Plan). The NPPF should be taken into account in the preparation of development plans and therefore the policies set out within the Framework are a material consideration in planning decisions.

Under paragraph 109, it states that:
"The planning system should actively manage patterns of growth in support of these objectives. Significant development should be focused on locations which are or can be made sustainable, through limiting the need to travel and offering a genuine choice of transport modes. This can help to reduce congestion and emissions and improve air quality and public health. However, opportunities to maximise sustainable transport solutions will vary between urban and rural areas, and this should be taken into account in both plan-making and decision-making."

Under paragraph 180(e), it states that:
"Planning policies and decisions should contribute to and enhance the natural and local environment by preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans."

Under paragraph 192, it states that:
"Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan."

2.1.3 UK Clean Air Strategy 2019

The Defra Clean Air Strategy 2019 aims to show how the UK will tackle all sources of air pollution, make air healthier to breathe, protect nature and boost the economy.

The strategy builds on an extensive consultation process which indicated broad-based support for many of the actions Defra were proposing. There was also a range of constructive feedback and challenge that

[2] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1147382/NPS_EN-3.pdf

has enabled Defra to improve and extend its ambition even further in certain key areas. A document summarising the responses to the consultation is published alongside the strategy. The strategy sets out these proposals in detail and indicates how devolved administrations intend to make their share of emissions reductions.

2.1.4 Environmental Protection Act 1990

The Environmental Protection Act 1990 (EPA 1990) defines a statutory nuisance as a problem that affects another property and is prejudicial to health or enjoyment of property. Statutory nuisance includes air pollutants emitted through smoke, fumes/gases, dust, steam or smell.

As part of the EPA, Local Authorities are required to investigate any complaints from the public regarding air quality. If Local Authorities are satisfied that a statutory nuisance exists, or may occur, they must serve an abatement notice.

2.2 Local Planning Policy

2.2.1 Central Lincolnshire Local Plan

The Local Plan is the councils primary planning document which sets out the policies used for determining planning applications within North Kesteven. The Local Plan contains the following policies related to air quality:

"Policy 14: Renewable Energy

The Central Lincolnshire Joint Strategic Planning Committee is committed to supporting the transition to a net zero carbon future and will seek to maximise appropriately located renewable energy generated in Central Lincolnshire (such energy likely being wind and solar based). Proposals for renewable energy schemes, including ancillary development, will be supported where the direct, indirect, individual and cumulative impacts on the following considerations are, or will be made, acceptable. To determine whether it is acceptable, the following tests will have to be met: […]

iii. The impacts are acceptable on the amenity of sensitive neighbouring uses (including local residents) by virtue of matters such as noise, dust, odour, shadow flicker, air quality and traffic."

"Policy S53: Design and Amenity

All development, including extensions and alterations to existing buildings, must achieve high quality sustainable design that contributes positively to local character, landscape and townscape, and supports diversity, equality and access for all.

Good design will be at the centre of every development proposal, and this will be required to be demonstrated through evidence supporting planning applications to a degree proportionate to the proposal. Design Codes may be produced for parts of Central Lincolnshire or in support of specific developments. The approach taken in these Design Codes should be informed by the National Model Design Code and where these codes have been adopted, developments will be expected to adhere to the Code.

Proposals for new buildings should incorporate the Design Principles for Efficient Buildings in Policy S6 at the centre of design.

All development proposals will be assessed against and will be expected to meet the following relevant design and amenity criteria. All development proposals will: […]

7. c) Not result in adverse noise and vibration taking into account surrounding uses nor result in adverse impacts upon air quality from odour, fumes, smoke, dust and other sources."

2.3 Guidance

A summary of some of the key guidance documents referred to in the undertaking of this assessment is provided below. Others which have been used are referenced throughout the report, as appropriate.

2.3.1 Local Air Quality Management Review and Assessment Technical Guidance

Defra has published technical guidance for use by local authorities in their review and assessment work. This guidance, referred to in this document as LAQM.TG22, has been used where appropriate in the assessment presented herein.

2.3.2 Land-Use Planning & Development Control: Planning for Air Quality

Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM) have published guidance that offers comprehensive advice on: when an air quality assessment may be required; what should be included in an assessment; how to determine the significance of any air quality impacts associated with a development; and, the possible mitigation measures that may be implemented to minimise these impacts.

2.3.3 EA Air Emissions Risk Assessment

The EA's Air Emissions Risk Assessment (AERA) Guidance for environmental permitting provides guidance on evaluating the impacts of emissions to air and the standards that are required to be met. The AERA guidance provides information on Environmental Assessment Levels (EALs) against which the impacts of emissions to air can be assessed to evaluate whether 'further action to reduce your impact on the environment is required'.

2.4 Assessment Levels

2.4.1 Air Quality Strategy

The Air Quality Strategy for England, Scotland, Wales and Northern Ireland Volume 1 (Air Quality Strategy) establishes the policy for ambient air quality in the UK. It includes the National Air Quality Objectives (NAQOs) for the protection of human health and vegetation for 11 pollutants.

The Air Quality Strategy contains NAQOs for NO_2 and CO as detailed in Table 2.1 below. Given the assessment considers potential emissions from a fire, the annual mean NO_2 objective is not applicable. The Air Quality Strategy does not contain any NAQOs for HF or CH_4.

Table 2.1: NAQOs

Pollutant	Objective	Reference	Additional Information
NO_2	200 µg/m^3	1-hour Mean	Maximum 18 exceedances a year
	40 µg/m^3	Annual Mean	-
CO	10,000 µg/m^3	8 Hour Mean	Running mean

2.4.2 British Occupational Exposure Limits

The HSE document 'EH40/2005' defines Workplace Exposure Limits (WEL) as *"British occupational exposure limits and are set in order to help protect the health of workers. WELs are concentrations of hazardous substances in the air, averaged over a specified period of time, referred to as a time-weighted average (TWA). Two time periods are generally used:*

- *Long-term (8 hours); and*
- *Short-term (15 minutes)."*

The relevant WELs for CO and HF, as detailed within the HSE document, are detailed in Table 2.2 below. The HSE document does not contain any WELs for CH_4.

Table 2.2: WELs

Pollutant	WEL (mg/m^3)	
	Long-Term Exposure Limit (8 Hours)	Short-Term Exposure Limit (15 Minutes)
CO	23	117

HF	1.5	2.5

2.4.3 Acute Exposure Guideline Levels (AEGLs) and Emergency Response Planning Guidelines (ERPGs)

Public Health England (PHE) publish Incident Management guidance for specific air pollutants including HF[3] and CH_4[4]. These guidance's summarise the physical and chemical properties of substance and the hazard they pose to human health.

The Incident Management guidance's also provide AEGLs for pollutant which estimate the concentrations at which most people will begin to experience health effects if they are exposed to a hazardous chemical for a specific length of time. For a given duration, a chemical may have up to three AEGL values as detailed below:

- AEGL-3 – Airborne concentration of a substance above which it is predicted that the general population could experience life-threatening health effects or death.
- AEGL-2 – Airborne concentration of a substance above which it is predicted that the general population could experience long-lasting adverse health effects.
- AEGL-1 – Airborne concentration of a substance above which it is predicted that the general population could experience notable discomfort, irritation or certain asymptomatic non-sensory effects.

As well as AEGLs, the PHE guidance provides details on ERPGs which estimate the concentrations at which most people will begin to experience health effects if exposed to a hazardous airborne substance for 1 hour. A substance may have up to three ERPG values are detailed below:

- ERPG3 – Maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour, without experiencing or developing life-threatening health effects.
- ERPG2– Maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour, without developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action.
- ERPG1– Maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour, without experiencing more than mild, transient adverse health effects.

The relevant AEGLs and EPRGs for HF are listed in Table 2.3 below.

Table 2.3: HF AEGL and EPRG Values

Pollutant	AEGL-1	Time Period for AEGL	EPRG-1	Time Period for EPRG
HF	1 ppm	10 minutes and up to 1 hour	2 ppm	10 minutes and up to 1 hour
	0.82 mg/m^3		1.64 mg/m^3	

For the purposes of this assessment, they represent a maximum concentration value in a 10-minute period. These values are also valid at an averaging time of 1 hour, which is the resolution of the meteorological data used in this assessment.

CH_4 does not have an AEGL or EPRG, however, the PHE guidance does provide explosive limits for CH_4 as detailed below:

- Lower Explosive Limit – 5.53%
- Upper Explosive Limit - 15%.

This equates to approximately 50,000ppm and 32,801.8 mg/m^3.

[3] Public Health England. Hydrogen Fluoride and Hydrofluoric Acid Incident Management - https://assets.publishing.service.gov.uk/media/5a82f35ee5274a2e8ab5a2f1/Hydrogen_fluoride_incident_management.pdf
[4] Public Health England. Methane Incident Management - https://assets.publishing.service.gov.uk/media/5a815e6340f0b62305b8e93f/methane_incident_management.pdf

2.4.4 Summary

Given the above, and following a literature review, the following assessment levels have been utilised in this assessment as detailed in Table 2.4. Given the nature of the emissions (i.e. short-term emissions from fire) only short-term assessment levels have been considered in the assessment.

Table 2.4: Assessment Level Summary

Pollutant	Reference	Assessment Level ($\mu g/m^3$)	Additional Information
NO_2	99.79th Percentile 1-Hour Mean	200	NAQO
CO	100th Percentile 8-Hour Running Mean	10,000	NAQO
HF	100th Percentile 8-Hour Mean	1,500	WEL
	100th Percentile 15-Minute Mean	2,500	WEL
	100th Percentile 15-Minute Mean	820	AEGL-1
CH_4	100th Percentile 15-Minute Mean	32,801,800	Lower Explosive Limit

Section 3.0: Baseline Air Quality

3.1 Local Air Quality Management

The UK Air Quality Strategy establishes a framework for the improvement of air quality and focusses on measures agreed at a national and international level. However, it was recognised, that despite such strategic measures, areas of poor air quality would likely remain, and that these will best be dealt with using local measures implemented through the LAQM regime. Part IV of The Environment Act 1995 sets provisions for protecting air quality in the UK and for local air quality management.

The LAQM regime has been in place in the UK since 1997. The role of the regime is to review local air quality and identify all relevant locations where the air quality objectives are being or are likely to be exceeded. Where an area of exceedance is identified, the local authority is required to declare an Air Quality Management Area (AQMA) and implement an Air Quality Action Plan to improve air quality within the areas. As part of this process, the authority is required to regularly review and assess air quality within its boundary.

NKDC has not declared any AMQAs within its jurisdiction. As such, potential impacts of the proposed development on AQMAs are considered negligible and have not been considered in this assessment.

3.2 Air Quality Monitoring Data

A review of the available local monitoring data has been undertaken. During 2022 NKDC operated no automatic monitoring sites and monitored NO_2 concentrations at twenty-two diffusion tubes sites. Of these monitors, none are located within 2.5km of the proposed development and none are considered to be representative of air quality conditions at the site. Background concentration maps are considered to provide the most representative data for the site and have thus been utilised for modelling background pollutant concentrations.

3.3 Background Pollutant Data

3.3.1 NO_2

Defra background concentration data was obtained for the human health sensitive receptors. The highest background concentration from the site was selected for use within the assessment as a conservative approach. The annual mean data is provided (and presented below) in Table 3.1.)

Table 3.1: NO_2 Background Concentration Data for Gridded Receptors (513500, 3465500)

Year	NO_2 (µg/m^3) Annual Mean
2018	8.0
2019	7.6
2020	7.2

The Defra estimated background concentrations of NO_2 are below their respective air quality objectives and are predicted to decrease in future years. Defra has predicted background pollutant decreases in future years due to future developments in vehicle technology and changes to national and local policy.

3.3.2 CO

For CO, Defra 2001 data were used, as this was the last year such emissions were mapped.

The highest background concentration from the site was selected for use within the assessment as a conservative approach. The annual mean data is provided (and presented below) in Table 3.2.

Table 3.2: CO Background Concentration Data (513500, 346500)

Year	CO (µg/m^3) Annual Mean
2001	233

3.3.3 HF

HF is not routinely monitored within the UK; however, the Expert Panel on Air Quality Standards (EPAQS) suggest that background levels have been in the range of 0.035 µg/m^3 to 2.35 µg/m^3. As a conservative approach, the upper limit of this range has been used to represent background concentrations.

3.3.4 CH_4

CH_4 is not monitored within the UK and no background estimates are available.

3.3.5 Summary

The background concentrations considered within this assessment are summarised in Table 3.3 below. The short-term background concentrations are taken as twice the (non-rounded) annual mean concentrations as per modelling good practice.

Table 3.3: Summary of Background Concentrations for Human Health Receptors

Pollutant	Background Concentration (µg/m^3)	
	Long Term	Short Term
NO_2	8.0	16.0
CO	233	466
HF	2.35	4.7

Section 4.0: Dispersion Modelling Methodology

4.1 Model Choice

ADMS 6.0, the model used to undertake this exercise, is a new generation Gaussian plume air dispersion model, which means that the atmospheric boundary layer properties are characterised by two parameters (the boundary layer depth and the Monin-Obukhov length) rather than in terms of the single parameter Pasquill-Gifford class. Dispersion under convective meteorological conditions uses a skewed Gaussian concentration distribution (shown by validation studies to be a better representation than a symmetrical Gaussian expression).

4.2 Emission Parameters

There is limited information on BESS fires and their associated pollutant emissions data. Furthermore, no standardised set of emissions factors for BESS is currently available from the Environmental Agency (EA). Emissions data has therefore been sourced from a literature review.

A literature review has identified fire test emissions data[1] from LFP battery modules that are typically used in BESS systems. As summarised in Section 2.4, NO_2, CO, HF and CH_4 were identified to be the main pollutants of concern. Emissions were based on a runaway fire taking place inside 1 BESS container (which consists of 2 racks of battery modules), which would generally burn out in 2 to 8 hours. This is the standard assessment approach taking into account the standard safety considerations for BESS design.

Two temperatures were considered for the dispersion modelling assessment: 800°C and 1,000°C. Initial modelling results indicated that the highest pollutant concentrations were produced at a temperature of 1,000°C. As such, only emissions from the 1,000°C scenario have been presented in this report. This is considered to be a conservative assumption.

The modelled emissions parameters for the proposed development are summarised in Table 4.1.

Table 4.1: Proposed Development Modelled Emission Parameters

Parameter	Inputs	Notes
Source Type	Point	Represents location of one BESS container
Source Central Point Location X(m), Y(m)	514542, 347952	Central point of BESS area
Modelled Height (m)	4.5	Max height of BESS container
Emissions Temperature (°C)	1,000	From literature review[1]
Fire Gas Upward Velocity (m/s)	2.5	
NO_x Emission Rate (g/s) – 1,000°C	0.0313	
CO Emissions Rate (g/s) – 1,000°C	0.342	
HF Emission Rate (g/s) – 1,000°C	0.055	
CH_4 Emission Rate (g/s) – 1,000°C	0.0313	

4.3 Modelled Receptors

4.3.1 Sensitive Human Health Receptors

A review of the surrounding area was undertaken to identify potentially sensitive receptors. This focused on identifying those high sensitive receptors nearest to the site in all directions.

In order to adequately assess nearby high sensitive receptors, and receptors within the site itself, a grid was included in the dispersion modelling assessment.

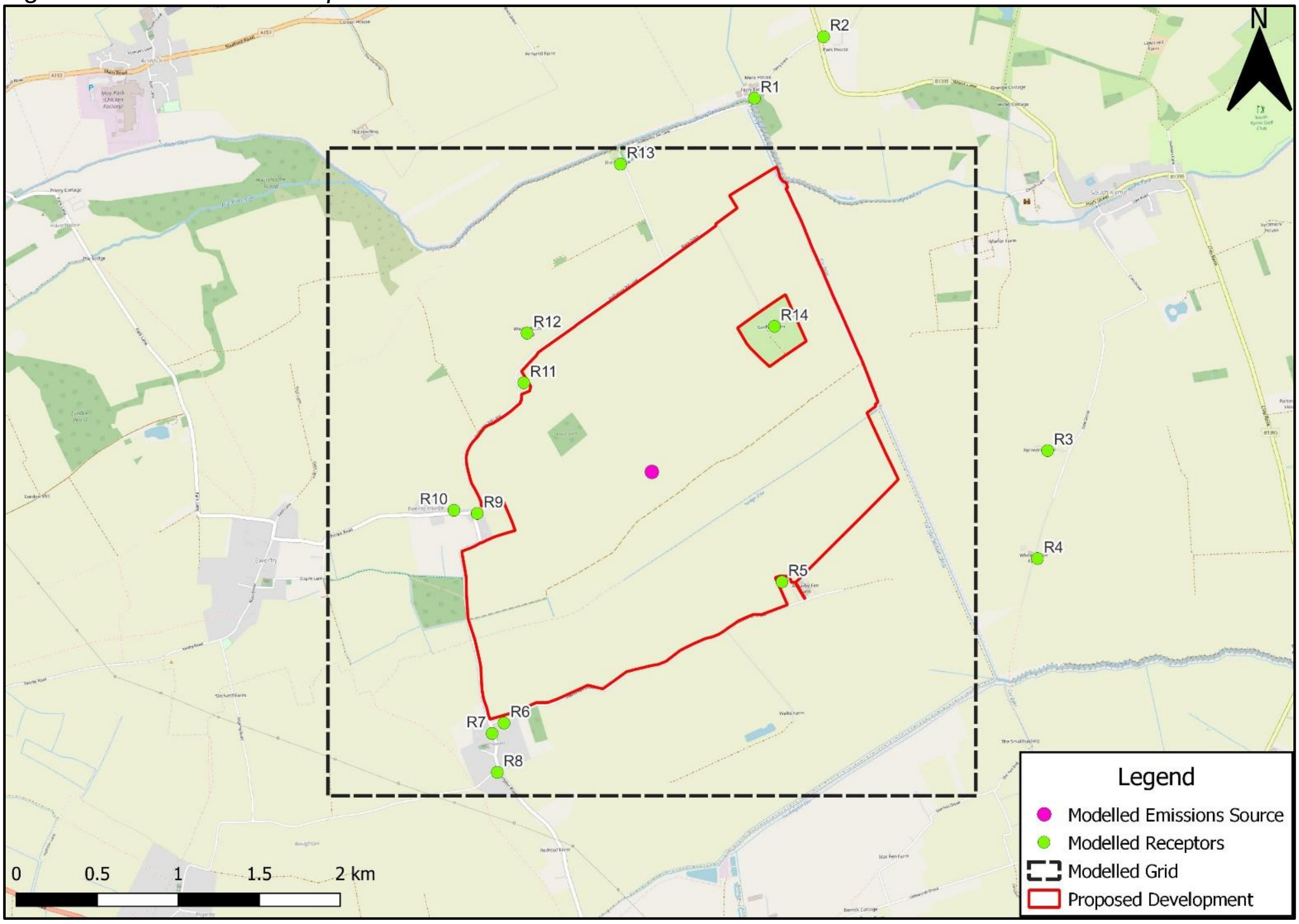
The modelled grid domain was from easting 512542 and northing 345952 (with a grid spacing of 10 m. The grid was modelled at a breathable height of 1.5m. The extent of the grid is shown in Figure 4.1.

In addition to the modelled gird, discrete receptors were included in the model. The discrete receptors represent the nearest sensitive receptors (e.g. residential dwellings) to the site. Table 4.2 and Figure 4.1 summarises the discrete sensitive receptors which were modelled. All receptors were modelled at a breathable height of 1.5m (ground floor) and 4.5m (first floor).

Table 4.2: Modelled Human Health Sensitive Receptor Locations

Ref.	Receptor	X Coordinate (m)	Y Coordinate (m)	Z Coordinate (m)
R1	Ferry Lane - Residential	515176	350259	1.5, 4.5
R2	Wood Lane - Residential	515603	350639	1.5, 4.5
R3	Fenmore Farm - Residential	516986	348084	1.5, 4.5
R4	White House Farm - Residential	516923	347417	1.5, 4.5
R5	Howell Fen Drove - Residential	515346	347273	1.5, 4.5
R6	Howell Fen Drove - Residential 2	513629	346401	1.5, 4.5
R7	Howell - Residential	513557	346337	1.5, 4.5
R8	Heckington Road - Residential	513588	346097	1.5, 4.5
R9	Ewerby Thorpe - Residential	513464	347696	1.5, 4.5
R10	Ewerby Thrope - Residential 2	513321	347715	1.5, 4.5
R11	Halfpenny Toll Lane - Residential	513752	348502	1.5, 4.5
R12	Halfpenny Toll Lane - Residential 2	513772	348809	1.5, 4.5
R13	Ferry Lane - Residential 2	514348	349852	1.5, 4.5
R14	Gashes Barn - Residential	515299	348851	1.5, 4.5

Figure 4.1: Modelled Receptors



Contains OpenStreetMap Data © 2024

4.3.2 Sensitive Ecological Receptors

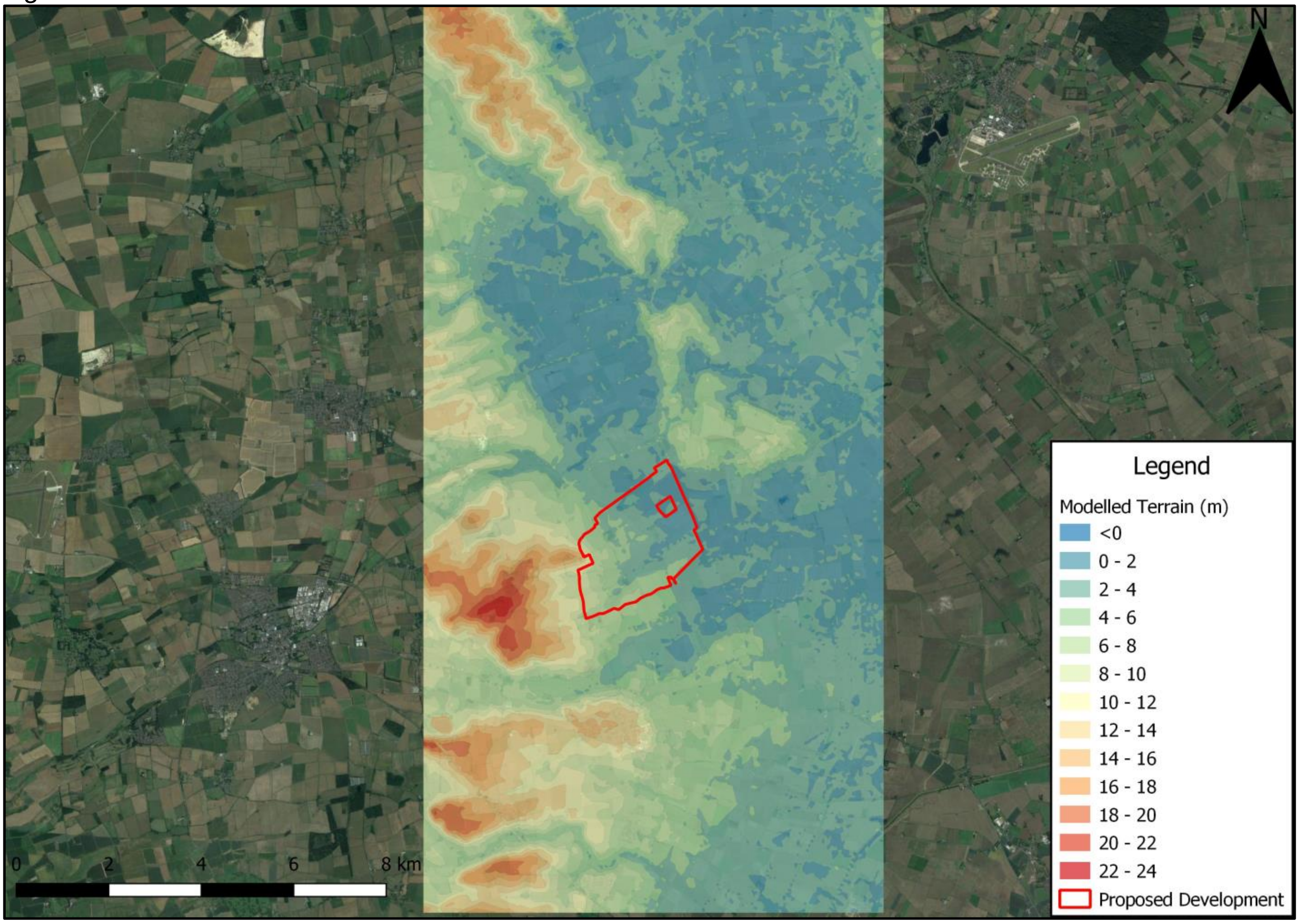
A review of Defra Magic Map online tool[5] identified that there are no designated ecological sites within 10km of the proposed development. As such, potential impacts on designated sites are considered to be not significant and have been screening out of further assessment.

4.4 Modelled Terrain

The terrain around the site is variable in all directions and has the potential to impact dispersion and requires inclusion in the model as it may impact dispersion of pollutants. Terrain data was obtained from Ordnance Survey in 'OS Terrain 50, ASCII Grid and GML' format. The terrain grid is necessarily larger than the modelled domain. The terrain grid was modelled at a resolution of 50m. The terrain data is visualised in Figure 4.2.

[5] https://magic.defra.gov.uk/MagicMap.aspx

Figure 4.2: Modelled Terrain



Contains Google Satellite Data © 2023

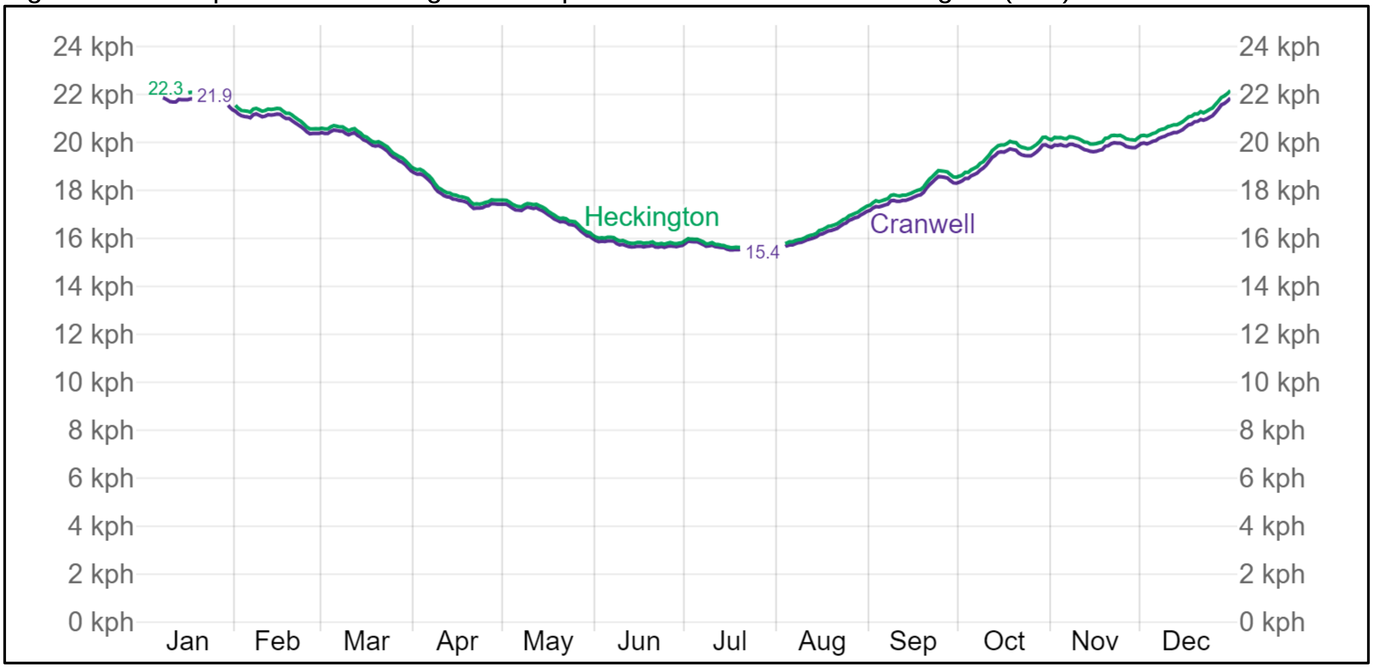
4.5 Meteorology

Cranwell weather station (around 11 km to the west of the site) was used to provide hourly sequential meteorological data for the dispersion model.

A study by the UK Atmospheric Dispersion Modelling Liaison Committee (ADMLC) into the portability of weather data for dispersion calculations[6] found that the most important factor in the selection of a meteorological station was the annual mean wind speed. A desk study was undertaken to compare the wind speeds from Cranwell with the closest estimate for the site (Heckington) as shown in Figure 4.3. The results showed that average wind speeds are very similar. As such, data from Cranwell weather station is considered to be appropriate for use in this assessment.

6 https://admlc.files.wordpress.com/2014/09/r316.pdf

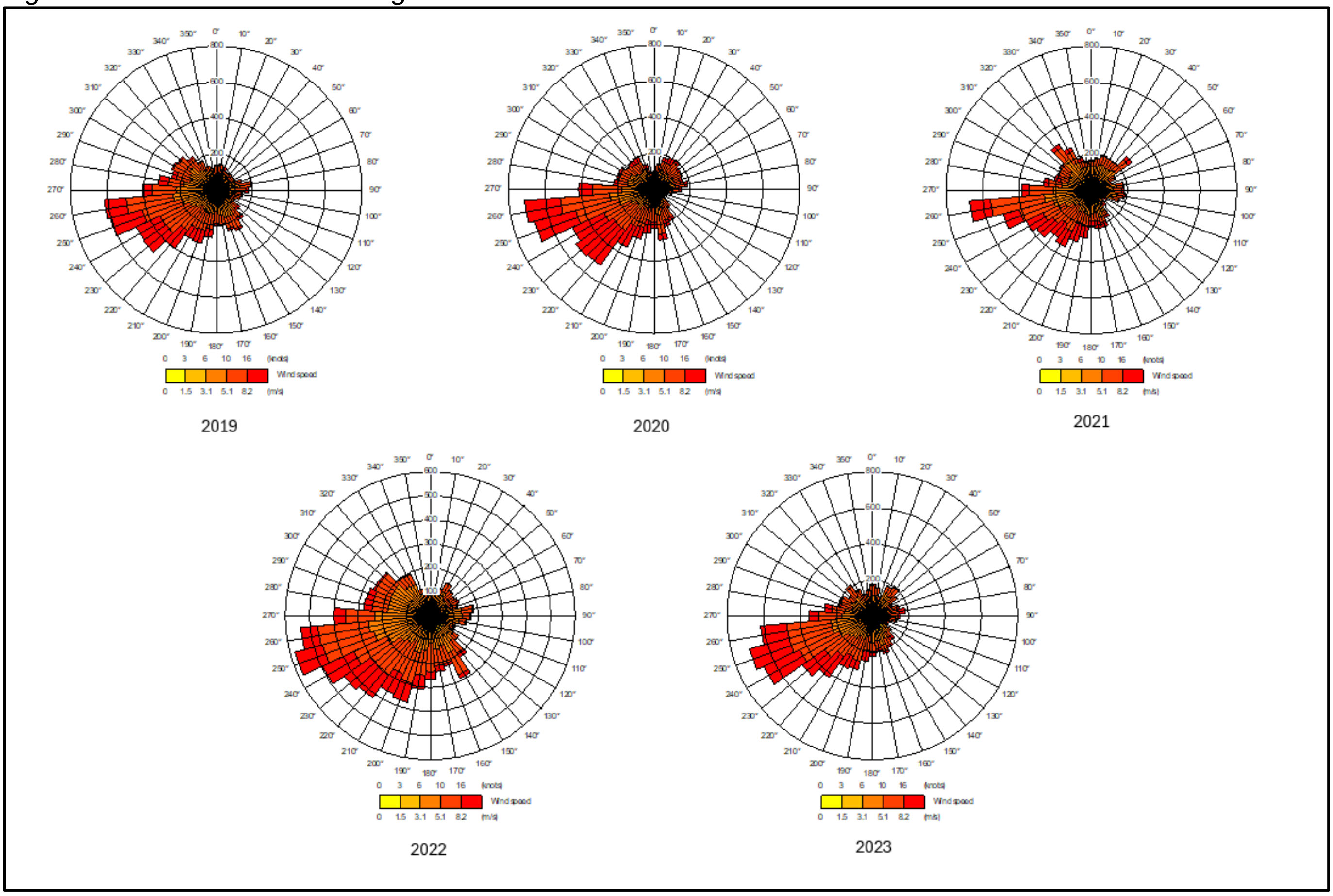
Figure 4.3: Comparison of Average Wind Speed at Cranwell and Heckington (Site)



Contains Weatherspark.com Data © 2024

Five full years of Cranwell meteorological data from years 2019-2023 were used in the dispersion modelling; the wind rose for each year is shown in Figure 4.4

Figure 4.4: Cranwell Meteorological Station 2019-2023 Wind Rose Data



4.6 Surface Characteristics

A surface roughness length is used to characterise the texture of land as this can impact dispersion of pollutants. A length of 0.2 m (agricultural areas (min)) has been used for the site and a length of 0.3 m (agricultural areas (max)) has been used for the meteorological site.

4.7 Minimum Monin-Obukhov Length

A minimum Monin-Obukhov length of 10 m was used for the development site and weather station (small towns) to account for the effects of buoyancy on turbulent flows.

4.8 Special Treatments

No special treatment (such as: dry or wet deposition; short-term releases; fluctuations; or chemistry) were deemed appropriate or used within the dispersion model.

4.9 Modelling Uncertainty

There are a variety of factors which can lead to potential uncertainty in dispersion modelling predictions. Arthian aimed to control these uncertainties by following relevant modelling good practice, and where unknowns exist to use suitably conservative assumptions/estimates. It is noted:

- The atmospheric dispersion model ADMS-6.0 has been verified by CERC through a number of studies to ensure predictions are suitably robust;
- Emission rates were derived from a literature review of similar size facilities[1];
- Background pollutant concentrations were obtained from the Defra website to provide an estimate of baseline conditions at human health receptors;
- To help account for inter-year variability in meteorological conditions, five years of meteorological data was used in the assessment, with the maximum (worst case year) concentration at each receptor considered/reported; and,
- Surface roughness and the Monin-Obukhov length for the dispersion site and meteorological site were defined based on the land use guidance provided by CERC.

4.10 Model Output

Predicted pollutant concentrations were summarised in the following formats:

- Process contribution (PC) - Predicted pollutant level due to emissions from the facility only; and,
- Predicted environmental concentration (PEC) - Total predicted pollutant level due to emissions from the facility and existing baseline conditions.

4.11 NO_X to NO_2 Conversion

Combustion emissions of NO_X are mainly in the form of nitric oxide (NO). NO_2 forms where the NO is oxidised due to excess oxygen in the combustion gases or other atmospheric reactions. In accordance with EA guidance, the NO_X to NO_2 conversions were assumed to be 70% for long-term average concentrations and 35% for short-term average concentrations.

4.12 Impact Significance

4.12.1 AERA Guidance

In accordance with the EA's AERA guidance, a PC for any substance can be considered 'insignificant' if the PC meets the following criteria:

- The long term PC is less than 1% of the long-term environmental standard.
- The short-term PC is less than 10% of the short-term environmental standard.

Initially, the maximum predicted PC across the modelled grid has been assessed against these criteria. If the above criteria are achieved at the point of maximum impact, then it can be concluded that impacts are 'insignificant' at all locations and that no further assessment is required.

If these criteria are exceeded, the predicted environmental concentration (PEC - defined as the PC plus the background concentration) is then calculated and consideration given to predicted impacts at discrete receptor locations.

Further action is not required, and impacts are considered to be acceptable and not to constitute 'significant pollution' if both of the following criteria are met:

- The proposed emissions comply with Best Available Techniques Associated Emission Levels (BAT AEL) or equivalent where there is no BAT AEL; and
- The resulting PECs are predicted to not exceed environmental standards.

Section 5.0: Dispersion Model Results

5.1 Introduction

Table 5.1 summarises the impact assessments which were undertaken.

Table 5.1: Impact Assessment Summary

Assessment Type	Section	Relevant Tables	Comment
Prediction of maximum concentrations (µg/m^3) across the modelled grid[7]	5.2	5.2 – 5.5	Assessment of pollutant impact relative to the assessment levels outlined in Section 2.3
Prediction of maximum concentrations (µg/m^3) at discrete sensitive human receptors	5.3	5.6 – 5.9	

In each instance a screening exercise using only the PC value relative to the applicable environmental standard was undertaken i.e. not considering background concentrations. Where screening occurs, the associated impact is considered negligible. The screening criteria are as follows:

- For long term (annual mean) assessment, screening occurred where the PC value was <1% of the relevant environmental standard, and
- For short term (1-hour mean and 8-hour mean) assessment, screening occurred where the PC value was <10% of the relevant environmental standard.

Given the nature of the emissions (i.e. short-term emissions from fire) only the 10% screening criteria has been applied to model results.

As detailed in Section 2.4, various sources have been used to derive assessment levels for the modelled pollutants. The short-term NAQO for NO_2 and CO have been considered for the modelled grid and at all discrete sensitive receptors. The WELs for HF have only been considered at the discrete sensitive receptors. Given the nature of the AEGL and the CH_4 explosive limits, these have only been considered in the modelled grid.

5.2 Gridded Human Receptors

As summarised in Section 4.5, five years of weather data have been run to help account for the variation in weather conditions which will be experienced at site. The results presented below represent the maximum predicted concentrations from these five modelled years.

5.2.1 1-Hour Mean NO_2

As shown in Table 5.2, 1-hour mean NO_2 PCs are above 10% of the assessment level at worst case locations across the modelled grid. However, this exceedance is contained to a small area around the modelled emission point. Concentrations are predicted to drop below 10% of the assessment level approximately 15m from the emissions point.

The corresponding PECs are below the 200 µg/m^3 assessment level across the modelled grid with a maximum concentration of 48.1 µg/m^3 predicted which is below the annual mean assessment level value by 76%. As such, predicted effects of 1-hour mean NO_2 concentrations across the modelled grid are considered to be insignificant.

5.2.2 8-Hour Rolling Mean CO

As shown in Table 5.3, 8-hour rolling mean CO PCs are above 10% of the assessment level at worst case locations across the modelled grid. However, this exceedance is contained to a small area around the modelled emission point. Concentrations are predicted to drop below 10% of the assessment level approximately 10m from the emissions point.

[7] The grid is modelled at 1.5m representative of human breathing height at ground level but the point of maximum impact which is reported will, where applicable, include any sensitive receptors which have been modelled at height.

The corresponding PECs are below the 10,000 µg/m^3 assessment level across the modelled grid with a maximum concentration of 1,478 µg/m^3 predicted which is below the annual mean assessment level value by 85%. As such, predicted effects of 8-hour rolling mean CO concentrations across the modelled grid are considered to be insignificant.

5.2.3 15-Minute Mean HF

As shown in Table 5.4Table 5.2, 15-minute mean HF PCs are above 10% of the assessment level at worst case locations across the modelled grid. However, this exceedance is contained to a small area around the modelled emission point. Concentrations are predicted to drop below 10% of the limit value approximately 20m from the emissions point.

The corresponding PECs are below the 820 µg/m^3 assessment level across the modelled grid with a maximum concentration of 171.7 µg/m^3 predicted which is below the 15-minute mean assessment level value by 79%. As such, predicted effects of 15-minute mean HF concentrations across the modelled grid are considered to be insignificant.

5.2.4 15-Minute Mean CH_4

As shown in Table 5.5, the 15-minute mean HF PCs are below 10% of the assessment level at worst case locations across the modelled grid. As such, predicted effects of 15-minute mean HF concentrations across the modelled grid are considered to be insignificant.

5.3 Assessment Across Modelled Grid

5.3.1 1-Hour Mean NO_2

Table 5.2: Maximum Predicted Concentration of 99.79th Percentile 1-Hour Mean NO_2 Across Modelled Grid

Year	Reference Period	Assessment Level - NAQO (µg/m³)	PC (µg/m³)	PC: % of Limit	BC (µg/m³)	PEC (µg/m³)	PEC: % of Limit	Location (x, y, z)		
2018	1-hour Mean	200	32.0	16%	16.0	48.0	24%	514552	347952	1.5
2019			32.1	16%		48.1	24%	514542	347962	1.5
2020			31.9	16%		47.9	24%	514542	347962	1.5
2021			31.9	16%		47.9	24%	514552	347952	1.5
2022			31.9	16%		47.9	24%	514552	347952	1.5

5.3.2 8-Hour Rolling Mean CO

Table 5.3: Maximum Predicted Concentration of 100th Percentile 8-Hour Rolling Mean CO Across Modelled Grid

Year	Reference Period	Assessment Level - NAQO (µg/m³)	PC (µg/m³)	PC: % of Limit	BC (µg/m³)	PEC (µg/m³)	PEC: % of Limit	Location (x, y, z)		
2018	8-Hour Rolling Mean	10,000	1,009	10%	466	1,475	15%	514532	347952	1.5
2019			1,012	10%		1,478	15%	514542	347962	1.5
2020			968	<10%		SCREENED		514542	514542	347962
2021			985	<10%		SCREENED		514542	514542	347962
2022			974	<10%		SCREENED		514542	514532	347952

5.3.3 15-Minute Mean HF

Table 5.4: Maximum Predicted Concentration of 100th Percentile 15-Minute Mean HF Across Modelled Grid

Year	Reference Period	Assessment Level – AEGL-1 (µg/m³)	PC (µg/m³)	PC: % of Limit	BC (µg/m³)	PEC (µg/m³)	PEC: % of Limit	Location (x, y, z)		
2018	15-Minute Mean	820	166.8	20%	4.7	171.5	21%	514542	347962	1.5
2019			166.8	20%		171.5	21%	514552	347952	1.5
2020			166.8	20%		171.5	21%	514542	347962	1.5
2021			167.0	20%		171.7	21%	514542	347962	1.5
2022			166.3	20%		171.0	21%	514552	347952	1.5

5.3.4 15-Minute Mean CH4

Table 5.5: Maximum Predicted Concentration of 100th Percentile 15-Minute Mean CH_4 Across Modelled Grid

Year	Reference Period	Assessment Level – Lower Explosive Limit (µg/m³)	PC (µg/m³)	PC: % of Limit	BC (µg/m³)	PEC (µg/m³)	PEC: % of Limit	Location (x, y, z)		
2018	15-Minute Mean	32,801,800	94.9	<1%	N/A	N/A		514542	347962	1.5
2019			94.9	<1%				514552	347952	1.5
2020			94.9	<1%				514542	347962	1.5
2021			95.1	<1%				514542	347962	1.5
2022			94.7	<1%				514552	347952	1.5

5.4 Discrete Human Receptors

5.4.1 1-Hour Mean NO_2

The maximum predicted 99.79th percentile 1-hour mean NO_2 concentrations at the receptor locations are summarised in Table 5.6.

Table 5.6: Maximum Predicted 99.79th Percentile 1-hour Mean NO_2 Impacts at Discrete Human Receptors

Receptor	PC (µg/m^3)	PC % of Limit	PEC	PEC % of Limit
R1-GF	0.1	<0.1%	SCREENED	
R2-GF	<0.1	<0.1%	SCREENED	
R3-GF	<0.1	<0.1%	SCREENED	
R4-GF	<0.1	<0.1%	SCREENED	
R5-GF	0.1	0.1%	SCREENED	
R6-GF	0.1	<0.1%	SCREENED	
R7-GF	0.1	<0.1%	SCREENED	
R8-GF	0.1	<0.1%	SCREENED	
R9-GF	0.1	0.1%	SCREENED	
R10-GF	0.1	0.1%	SCREENED	
R11-GF	0.1	0.1%	SCREENED	
R12-GF	0.1	0.1%	SCREENED	
R13-GF	0.1	<0.1%	SCREENED	
R14-GF	0.1	<0.1%	SCREENED	
R1-1F	0.1	<0.1%	SCREENED	
R2-1F	<0.1	<0.1%	SCREENED	
R3-1F	<0.1	<0.1%	SCREENED	
R4-1F	<0.1	<0.1%	SCREENED	
R5-1F	0.1	0.1%	SCREENED	
R6-1F	0.1	<0.1%	SCREENED	
R7-1F	0.1	<0.1%	SCREENED	
R8-1F	0.1	<0.1%	SCREENED	
R9-1F	0.1	0.1%	SCREENED	
R10-1F	0.1	0.1%	SCREENED	
R11-1F	0.1	0.1%	SCREENED	
R12-1F	0.1	0.1%	SCREENED	
R13-1F	0.1	<0.1%	SCREENED	
R14-1F	0.1	<0.1%		
Assessment Level - NAQO (µg/m^3)	**200**			

The 99.79th percentile 1-hour mean NO_2 PCs are below 10% of the limit value at all modelled receptors. As such, predicted effects of 1-hour mean NO_2 concentrations on sensitive human receptors are considered to be insignificant in accordance with the stated criteria.

5.4.2 8-Hour Rolling Mean CO

The maximum 100th percentile 8-hour rolling mean CO concentrations at the receptor locations are summarised in Table 5.7.

Table 5.7: Maximum Predicted 100th Percentile 8-Hour Rolling Mean CO Impacts at Discrete Human Receptors

Receptor	PC (µg/m^3)	PC % of Limit	PEC	PEC % of Limit
R1-GF	1.0	<0.1%	SCREENED	

Receptor	PC (µg/m³)	PC % of Limit	PEC	PEC % of Limit
R2-GF	0.8	<0.1%	SCREENED	
R3-GF	1.0	<0.1%	SCREENED	
R4-GF	1.1	<0.1%	SCREENED	
R5-GF	2.9	<0.1%	SCREENED	
R6-GF	1.3	<0.1%	SCREENED	
R7-GF	1.3	<0.1%	SCREENED	
R8-GF	1.2	<0.1%	SCREENED	
R9-GF	2.4	<0.1%	SCREENED	
R10-GF	2.1	<0.1%	SCREENED	
R11-GF	2.2	<0.1%	SCREENED	
R12-GF	2.0	<0.1%	SCREENED	
R13-GF	1.5	<0.1%	SCREENED	
R14-GF	2.0	<0.1%	SCREENED	
R1-1F	1.0	<0.1%	SCREENED	
R2-1F	0.8	<0.1%	SCREENED	
R3-1F	1.0	<0.1%	SCREENED	
R4-1F	1.1	<0.1%	SCREENED	
R5-1F	3.0	<0.1%	SCREENED	
R6-1F	1.3	<0.1%	SCREENED	
R7-1F	1.3	<0.1%	SCREENED	
R8-1F	1.2	<0.1%	SCREENED	
R9-1F	2.5	<0.1%	SCREENED	
R10-1F	2.1	<0.1%	SCREENED	
R11-1F	2.2	<0.1%	SCREENED	
R12-1F	2.0	<0.1%	SCREENED	
R13-1F	1.5	<0.1%	SCREENED	
R14-1F	2.0	<0.1%		
Assessment Level - NAQO (µg/m³)	**10,000**			

The 8-hour rolling mean CO PCs are below 10% of the limit value at all modelled receptors. As such, predicted effects of 8-hour rolling mean CO concentrations on sensitive human receptors are considered to be insignificant in accordance with the stated criteria.

5.4.3 8-Hour Mean HF

The maximum 100th percentile 8-hour mean HF concentrations at the receptor locations are summarised in Table 5.8.

Table 5.8: Maximum Predicted 100th Percentile 8-Hour Mean HF Impacts at Discrete Human Receptors

Receptor	PC (µg/m³)	PC % of Limit	PEC	PEC % of Limit
R1-GF	0.1	<0.1%	SCREENED	
R2-GF	0.1	<0.1%	SCREENED	
R3-GF	0.1	<0.1%	SCREENED	
R4-GF	0.1	<0.1%	SCREENED	
R5-GF	0.5	<0.1%	SCREENED	
R6-GF	0.2	<0.1%	SCREENED	
R7-GF	0.2	<0.1%	SCREENED	
R8-GF	0.2	<0.1%	SCREENED	
R9-GF	0.3	<0.1%	SCREENED	

Receptor	PC (µg/m^3)	PC % of Limit	PEC	PEC % of Limit
R10-GF	0.3	<0.1%	SCREENED	
R11-GF	0.3	<0.1%	SCREENED	
R12-GF	0.3	<0.1%	SCREENED	
R13-GF	0.2	<0.1%	SCREENED	
R14-GF	0.3	<0.1%	SCREENED	
R1-1F	0.1	<0.1%	SCREENED	
R2-1F	0.1	<0.1%	SCREENED	
R3-1F	0.1	<0.1%	SCREENED	
R4-1F	0.1	<0.1%	SCREENED	
R5-1F	0.5	<0.1%	SCREENED	
R6-1F	0.2	<0.1%	SCREENED	
R7-1F	0.2	<0.1%	SCREENED	
R8-1F	0.2	<0.1%	SCREENED	
R9-1F	0.3	<0.1%	SCREENED	
R10-1F	0.3	<0.1%	SCREENED	
R11-1F	0.3	<0.1%	SCREENED	
R12-1F	0.3	<0.1%	SCREENED	
R13-1F	0.2	<0.1%	SCREENED	
R14-1F	0.3	<0.1%		
Assessment Level - WEL (µg/m^3)	**1,500**			

The 8-hour mean HF PCs are below 10% of the limit value at all modelled receptors. As such, predicted effects of 8-hour mean HF concentrations on sensitive human receptors are considered to be insignificant in accordance with the stated criteria.

5.4.4 15-Minute Mean HF

The maximum 100th percentile 15-minute mean HF concentrations at the receptor locations are summarised in Table 5.9.

Table 5.9: Maximum Predicted 100th Percentile 15-Minute Mean HF Impacts at Discrete Human Receptors

Receptor	PC (µg/m^3)	PC % of Limit	PEC	PEC % of Limit
R1-GF	0.8	<0.1%	SCREENED	
R2-GF	0.6	<0.1%	SCREENED	
R3-GF	0.7	<0.1%	SCREENED	
R4-GF	0.7	<0.1%	SCREENED	
R5-GF	1.5	0.1%	SCREENED	
R6-GF	1.0	<0.1%	SCREENED	
R7-GF	0.9	<0.1%	SCREENED	
R8-GF	0.9	<0.1%	SCREENED	
R9-GF	1.6	0.1%	SCREENED	
R10-GF	1.3	0.1%	SCREENED	
R11-GF	1.5	0.1%	SCREENED	
R12-GF	1.4	0.1%	SCREENED	
R13-GF	0.9	<0.1%	SCREENED	
R14-GF	1.4	0.1%	SCREENED	
R1-1F	0.8	<0.1%	SCREENED	
R2-1F	0.6	<0.1%	SCREENED	
R3-1F	0.7	<0.1%	SCREENED	

Receptor	PC (µg/m³)	PC % of Limit	PEC	PEC % of Limit
R4-1F	0.7	<0.1%	SCREENED	
R5-1F	1.5	0.1%	SCREENED	
R6-1F	1.0	<0.1%	SCREENED	
R7-1F	0.9	<0.1%	SCREENED	
R8-1F	0.9	<0.1%	SCREENED	
R9-1F	1.6	0.1%	SCREENED	
R10-1F	1.3	0.1%	SCREENED	
R11-1F	1.5	0.1%	SCREENED	
R12-1F	1.4	0.1%	SCREENED	
R13-1F	0.9	<0.1%	SCREENED	
R14-1F	1.4	0.1%		
Assessment Level - WEL (µg/m³)	**2,500**			

The 15-minute mean HF PCs are below 10% of the limit value at all modelled receptors. As such, predicted effects of 15-minute mean HF concentrations on sensitive human receptors are considered to be insignificant in accordance with the stated criteria.

Section 6.0: Conclusion

Arthain were appointed to undertake detailed air dispersion modelling of unplanned atmospheric emissions from a potential fire at a proposed solar and battery storage park.

Dispersion modelling was undertaken using ADMS-6. For the purposes of assessing impacts on sensitive human receptors, short term emissions from NO_2, CO, HF and CH_4 were included in the dispersion modelling.

The dispersion model results were compared against the relevant assessment levels, as summarised below:

- The 1-hour mean NO_2 PCs are below 10% of the NAQO at all discrete modelled receptors but above 10% of the limit value at the worst case grid locations. However, the corresponding NO_2 PECs are below the 200 µg/m^3 limit value at all modelled receptors and grid locations. As such, predicted effects of 1-hour mean NO_2 concentrations on sensitive human receptors is considered insignificant.
- The 8-hour running mean CO PCs are below 10% of the NAQO at all discrete modelled receptors but above 10% of the limit value at the worst case grid locations. However, the corresponding CO PECs are below the 10,000 µg/m^3 limit value at all modelled receptors and grid locations. As such, predicted effects of 8-hour running mean CO concentrations on sensitive human receptors is considered insignificant.
- The 8-hour mean HF PCs are below 10% of the WEL at all discrete modelled receptors. As such, predicted effects of 8-hour mean HF concentrations on sensitive human receptors is considered insignificant.
- The 15-minute mean HF PCs are below 10% of the WEL at all discrete modelled receptors but above 10% of the AEGL at the worst case grid locations. However, the corresponding HF PECs are below the 820 µg/m^3 AEGL limit value at all grid locations. As such, predicted effects of 15-minute mean HF concentrations on sensitive human receptors is considered insignificant.
- The 15-minute mean CH_4 PCs are below 10% of the lower explosive limit value at all grid locations. As such, predicted effects of 15-minute mean CH_4 concentrations on sensitive human receptors is considered insignificant.

The overall impacts of emissions from the proposed development on existing sensitive human receptors is predicted to be insignificant.

Appendix A: Examples of Where Environmental Standards Apply

Averaging Period	Objectives should apply at:	Objectives should generally not apply at:
Annual Mean	▪ All locations where members of the public might be regularly exposed. ▪ Building façades of residential properties, schools, hospitals, care homes, etc.	▪ Building façades of offices or other places of work where members of the public do not have regular access. ▪ Hotels, unless people live there as their permanent residence. ▪ Gardens of residential properties. ▪ Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.
24 Hour Mean and 8 Hour Mean	▪ All locations where the annual mean objectives would apply, together with hotels. ▪ Gardens of residential properties.	▪ Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.
1 Hour Mean	▪ All locations where the annual mean and 24 and 8 hour mean objectives would apply. ▪ Kerbside sites (e.g. pavements of busy shopping streets). ▪ Those parts of car parks, bus stations and railway stations, etc. which are not fully enclosed, where the public might reasonably be expected to spend one hour or more. ▪ Any outdoor locations at which the public may be expected to spend an hour or longer.	▪ Kerbside sites where the public would not be expected to have regular access.
15 Minute Mean	▪ All locations where members of the public might reasonably be expected to spend a period of 15 minutes or longer.	