Rosefield Solar Farm

BESS Plume Assessment Summary

(Tracked)

EN010158/APP/7.13.2
Revision 2
Deadline 1
March~~September~~ 202~~5~~6
Rosefield Energyfarm Limited

APFP Regulation 5(2)(a)

Planning Act 2008

Infrastructure Planning
(Applications: Prescribed Forms
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1. Executive Summary

1.1.1. The plume assessment for the Rosefield Solar Farm Battery Energy Storage System (BESS) evaluates the potential air quality impacts and risks associated with thermal runaway incidents. The analysis was conducted to predict the potential extent of the harmful effects of a cell venting event which may include toxic release, thermal radiation from a fire and overpressure from an explosion.

1.1.2. The modelling undertaken demonstrates that a significant impact beyond the BESS Site is **unlikely**.

1.1.3. The SLOT (Significant Level of Toxicity) extent contour for a 4h exposure of Hydrogen Fluoride is **72m** from the source. Due to the low wind speed and lack of turbulence the cloud is anticipated to be less than 10m in width. It should also be noted that the modelled plume remained well formed and showed a gradual rise as it moves downwind, reducing the risk to people at ground level.

1.1.4. For Carbon monoxide, it is possible that members of the public could be harmfully impacted at less than **67m** (SLOT).

1.1.5. Clarendon Road runs approximately **35** m East of the site, and although it could experience harmful concentrations of toxic vent gas, the likelihood/risk of members of the public (road users) being present (stationary) for extended periods, when a release occurs under unfavourable wind conditions is less than the generally accepted threshold.

1.1.6. Although there is a public footpath approximately **55** m West of the site that might also be susceptible to harmful toxic gas exposure, the likelihood/risk of members of the public being present for extended periods, when a release occurs under unfavourable wind conditions is less than the generally accepted threshold.

1.1.7. The closest occupied residential dwelling (Borshaw Farm) is approximately **400** m from the South edge of the site and are **not** predicted to experience harmful conditions but may experience irritating concentrations in the unlikely event that the wind is blowing towards them when a cell venting occurs.

1.1.8. As part of the Emergency Response Plan (ERP) secured in the **O~~o~~utline Battery Safety Management Plan (~~o~~BSMP) [EN010158/APP/7.9.2]**, the duration of dwell will be controlled (minimized) to reduce the exposure time & concentration. This may include temporarily closing the nearby footpath or highway. The likelihood of members of the public remaining within a smoke plume is considered to be low as the plume will be very dense (and therefore obvious) under still wind conditions.

2. Introduction

2.1. Introduction

2.1.1. This BESS plume assessment has been prepared on behalf of Rosefield Energyfarm Limited ('the Applicant') to assess the possible impacts to receptors of the BESS (Battery Energy Storage System) in relation to the Development Consent Order (DCO) application for the construction, operation (including maintenance), and decommissioning of Rosefield Solar Farm (hereafter referred to as the 'Proposed Development').

~~2.1.1.~~2.1.2. This document has been updated at Deadline 1 to align with the updated Layer of Protection Analysis and to also add an Appendix to attach an Addendum document showing the Atmospheric Dispersion Modelling that has been undertaken to address the previous comments that have been received from the UKHSA. Please refer to the **Guide to the Application [EN010158/APP/1.2.6]** for the list of current versions of documents.

2.2. The Order Limits

2.2.1. The extent of the Order Limits are shown in **Location, Order Limits and Grid Coordinate Plans [EN010158/APP/2.1]** and the Proposed Development is described in full in **ES Volume 1, Chapter 3: Proposed Development Description [EN010158/APP/6.1]** and shown spatially on the **Works Plans [EN010158/APP/2.3].**

2.3. The Proposed Development

2.3.1. The Proposed Development comprises the construction, operation (including maintenance), and decommissioning of solar photovoltaic ('PV') development and energy storage, together with associated infrastructure and an underground cable connection to the National Grid East Claydon Substation.

2.3.2. The Proposed Development would include a generating station with a total exporting capacity exceeding 50 megawatts ('MW'). The agreed grid connection for the Proposed Development would allow the export and import of up to 500MW of electricity to the grid.

2.3.3. The location of the Proposed Development is shown on **ES Volume 3, Figure 1.1: Location Plan [EN010158/APP/6.3]**. The Proposed Development would be located within the Order Limits (the land shown on the **Works Plans [EN010158/APP/2.3]** within which the Proposed Development can be carried out). The Order Limits plan is provided as **ES Volume 3, Figure 1.2: Order Limits [EN010158/APP/6.3]**. Land within the Order Limits is known as the 'Site'.

2.4. Purpose of the Document

2.4.1. This assessment acknowledges that there may be concern regarding the potential thermal runaway of the BESS (Battery Energy Storage System) and the possible impacts upon receptors. A thermal runaway event is where a battery cell enters an uncontrolled self-heating state

2.4.2. This assessment should be read in conjunction with the **Outline ~~o~~BSMP ~~(Outline Battery Safety Management Plan)~~ [EN010158/APP/7.9.2]** and provides an assessment of the possible impact of a thermal runaway event within the BESS battery components as well as the impact of a possible thermal runaway.

~~2.4.3. This document is the first submitted version. Please refer to the **Guide to the Application [EN010158/APP/1.2]** for the list of current versions of documents.~~

~~2.4.4.~~2.4.3. This document provides an assessment of the potential credible worst case air quality impacts of a thermal runaway incident at the BESS Compound forming part of the Proposed Development.

~~2.4.5.~~2.4.4. The aim of the plume assessment is to understand possible impacts of the BESS Compound on the nearby receptors in an emergency situation; primarily the emergency responders and those in the surrounding area such as workers or local residents.

~~2.4.6.~~2.4.5. The Applicant has consulted the UK Health Security Agency (UKHSA) as part of the DCO process. An introductory meeting was held with the UKHSA on 01 May 2025 to talk through the proposed Plume Study Methodology and share a draft **Statement of Common Ground – UK Health Security~~-~~ [EN010158/APP/5.11].** The Applicant and the UKHSA concur that at the detailed design stage (after battery system selection) a plume assessment would be commissioned based on atmospheric dispersion modelling; this would give an understanding of what would be emitted and the impact on Sensitive Receptors in comparison with air quality standards. This is secured through the **~~oBSMP~~ Outline BSMP ~~(Outline Battery Safety Management Plan)~~ [EN010158/APP/7.9.2]**.

3. Background

3.1. Proposed Development Overview

3.1.1. A summary of the description of the Proposed Development can be found in Section 3.1 of the **Environmental Statement (ES) Volume 1, Chapter 3: Proposed Development Description [EN010158/APP/6.1]**. The terminology used in this document is defined in the **Glossary [EN010158/APP/6.1]**.

3.2. Battery System Basic Architecture

3.2.1. The BESS parameters and therefore what is reflected in the **ES Volume 5, Appendix 5.9: Design Commitments [EN010158/APP/5.9]** for the BESS Compound have been selected based upon current technology market trends. Part of these trends is a move from Lithium-Nickel-Manganese-Cobalt-Oxide (NMC) to use Lithium Iron Phosphate (LFP) chemistries. The example design used to inform the ES uses LFP cells; a credible ~~worst case~~worst-case scenario based on these trends has been reflected in this plume assessment.

3.2.2. Irrespective of eventual technology choice, the BESS Compound, enclosures and auxiliary systems, such as cooling, UPS, fire detection and suppression systems, monitoring and control, will be designed in accordance with internationally recognised standards, best practice, and guidance available at the time.

3.3. Battery System Failures

3.3.1. There are four main ways in which a lithium-ion cell might fail: thermal, electrical, mechanical and chemical. The causes of failure could include issues such as: manufacturing defects, overcharging, over-discharging, mechanical damage, overheating, abuse, and short circuits (whether internal or external).

3.3.2. Regardless of the type of failure or the cause, the main potential hazard for consideration in this assessment is thermal runaway and ultimately, if not controlled, a significant flaming or explosive gas venting incident.

3.3.3. Other electrical systems which form part of the BESS Compound can carry conventional fire risks, however due to the extensive historic long-term deployment of other technology such as transformers, inverters and switchgear, these risks are regulated through (and will be managed by the Applicant using) longstanding industry guidance and codes. Therefore, only the battery technology component of the BESS Compound is addressed in this report.

4. Incident Impacts

4.1. Overview

4.1.1. A consequence analysis of the potential immediate effects of a thermal runaway or other incident event has been undertaken. This process is undertaken for all EDF Power Solutions, BESS sites in the UK (EDF Power Solutions are a shareholder of the Applicant) and has been repeated for the example BESS design used to inform the ES. The aim of the assessment is to understand the envelope of possible impacts of a BESS thermal runaway event on the nearby receptors in an emergency situation; primarily the emergency responders and those in the surrounding area such as workers or local residents.

4.2. System Location

4.2.1. Within the Order Limits, the location of the BESS compound (Work No. 4 on the **Works Plans (EN010158/APP/2.3)**) has been determined with consideration of a number of factors. The most pertinent factor is that the selected site has tried to minimise the proximity to receptors of any nuisance, with the distance to properties maximised where possible. This has the benefit of reducing the visual and noise impact but also minimises any potential impacts on the local population should a thermal runaway event occur. As such the closest property to the BESS Compound is approximately 400m South of the site.

4.2.2. These considerations are fed back into the design, with intolerable outcomes being identified and design changes implemented for appropriate mitigation. The findings of this process will then also be incorporated into the Emergency Response Plan (ERP) secured in the ~~outline Battery Safety Management Plan (o~~**Outline BSMP**~~)~~ **[EN010158/APP/7.9.2].**

4.3. Example Design Used to Inform the ES

4.3.1. The electrochemistry for the example design used to inform the ES and oBSMP is LFP. These modules have been assessed to the UL9540A test protocol: Energy Storage Systems and Equipment. This determines the potential of a thermal runaway spreading within a battery system. The Concept Design satisfied the criteria at module level.

4.3.2. The module tests showed that during thermal runaway of 3x initiating cells there was no fire, and the thermal runaway did not propagate beyond the 2x adjacent cells (this is typical of the current UL9540A test protocol). Cell venting occurred leading to module venting. However for the purposes of this assessment it is conservatively assumed that the cells do ignite to understand the possible implications.

4.3.3. In the event of a thermal runaway, the battery system and the transformers serving the BESS Compound will be automatically electrically isolated when a thermal runaway is detected within a container. However, the batteries within the containers will still hold charge in the event of a thermal runaway even after the electrical system is isolated. As with any energy storage system, it will not be possible to immediately confirm that there is no residual risk from the energised batteries within the container. The Applicant are engaging with Buckinghamshire Fire Authority with regards to the Proposed Development and this engagement has led to a number of design improvements.

4.3.4. Spatial protections built into the example design via component grouping, means that in the very unlikely event that a thermal runaway event should occur and all of the system design mitigations and preventative measures fail, the thermal runaway should be limited to the part of the system that is on fire. In this, the overall size of the battery system is inconsequential to the outcome and an event should be limited in size to only that equipment within a group, whether there are one or any number of groups.

4.4. Methodology

4.4.1. To determine the impact of a thermal runaway event a number of credible worst case scenarios have been developed and modelled for the example design used to inform the ES.

4.4.2. The possible scenarios “credible worst cases” have been developed by the Applicant based upon a number factors including literature, empirical data from BESS Compounds, fires globally, risk assessment, previous studies and the experience of the Applicant’s global team. The Applicant has undertaken a number of BESS Compound end-to-end Risk Assessments / FMEA with a number of integrators across technologies allowing a deep understanding of BESS Compounds and their failure modes.

4.4.3. These scenarios are

- the release of toxic gas(es), without a fire event (as found during testing);
- a fire event;
- An explosion from the ignition of gasses.

4.4.4. The scope of the analysis is limited to evaluation of the worst credible toxic, flammable, thermal (radiant heat from a fire) and overpressure (from an explosion) effects of the most common chemicals released from cells inside a single container when venting under the most common weather conditions.

4.4.5. The analysis does not consider electrical system risks, other than as instigators for a BESS Compound event, as these risks are generally well known with longstanding industry guidance and codes.

4.4.6. The analysis does not consider the effects of smoke or particles created by a fire, nor does it consider the effects of projectiles or other debris released by an explosion. At the detailed design stage (after battery system selection) a plume assessment would be commissioned based on atmospheric dispersion modelling; this would give an understanding of what chemicals would be emitted and the impact on Sensitive Receptors in comparison with air quality standards.

4.4.7. The BESS design would be capable of preventing / mitigating any deflagration events, which could be demonstrated through full scale destruction testing and rigorous consequence modelling as per - typical reports are listed below:

- NFPA 69 Explosion Prevention Compliance report
- Deflagration analysis report
- FDS gas ventilation analysis report
- Full scale fire testing report

4.4.8. The analysis does not consider all weather conditions (wind speed & direction and ambient temperature). Wind speeds of 2 m/s & 5m/s have been used for analysis which is consistent with HSE guidance for consequence modelling as calm wind conditions generally produce the greatest hazard range, i.e. distance from source. Further wind data can be seen in “4.7~~3.7~~ Scenarios”.

4.4.9. The analysis does not consider the effects of obstacles (man-made or natural) in the path of the releases, nor does it consider the height of the toxic or flammable clouds as the effects are predicted at ground level.

4.5. Definitions

4.5.1. **Credible** would be an event which although it will have mitigations to prevent occurrence could feasibly occur if the mitigations were to fail. For example several failures would have to occur for a bank to overcharge; these failures are deemed to be extremely unlikely. But we assume, to enable us to model the failure, that an overcharge situation of a bank to an extreme State of Charge (SOC) is credible, which in turn could lead to a thermal runaway.

4.5.2. It is deemed extremely unlikely to occur in the first instance with all of the protections in place. Therefore that this failure could happen on a number of banks simultaneously is not considered credible even with a failure of multiple protections, as if this were to happen, the whole system cannot fail simultaneously i.e. one part of the system will fail first, causing the rest of the system to shut down. i.e. at some point a protection will activate.

4.5.3. **Worst case** would be dependent on the assessment being made.

4.5.4. In the event of an explosion; the total free volume of the enclosure would be considered to be filled with off-gas. i.e. it has displaced the normal atmosphere completely.

4.5.5. Even though the example cells passed the UL9450a assessment at module level without igniting, to understand the possible worst case, it is assumed that the cells ignite and all are consumed in a thermal runaway event. It is clear that this is an extremely conservative and almost incredible occurrence even without all of the other safety considerations but allows the worst case envelope to be defined.

4.6. Parameters

Gas release

4.6.1. To determine vent concentrations for an example cell, laboratory off-gas measurements are extrapolated to predict system-level emissions. Precise calculations are possible when detailed reports on the specific cell technology are available. The manufacturer of the Concept Design cell has supplied gas analyses from UL9540A testing. In the event of a venting incident, the gases listed in **section 3.6.3** may be released either fully or partially.

4.6.2. Data from cell provider indicates that the volume of HF released based on a 5 cell cluster release during rack-level UL9540A testing was 82.56 litres. The volume of vent gas from these 5 cells has been used to scale up to a 3 or 6 compartment (i.e. 50% or 100% of the container, respectively) scenario.

4.6.3. This example cell manufacturer data suggests a wide range of hydrocarbons are released during venting. However, only the most significant were evaluated (those with a predicted composition of more than 1% by volume) including:

- Hydrogen (H2);
- Carbon Monoxide (CO);
- Carbon Dioxide (CO2);
- Hydrogen Fluoride (HF);
- Methane (CH4);
- Ethylene (C2H4);
- Ethane (C2H6);

- Propylene (C3H6).

4.6.4. Note that Carbon Dioxide (CO2) was not evaluated as it is not considered harmful in an open environment. <1%

4.6.5. After initial analysis of these chemicals under different wind conditions and release volumes & durations, analysis focused on the following materials under F2 wind conditions:

- Hydrogen Fluoride;
- Carbon Monoxide;
- Methane.

4.6.6. The design of the BESS and its impacts are controlled in several ways. Prior to commencement of construction of the BESS, a Battery Safety Management Plan (in accordance with the ~~**oBSMP**~~ **Outline BSMP** **[EN010158/APP/7.9.2]** submitted with the Application) is required to be submitted to the relevant local planning authority and approved, in consultation with Buckinghamshire Fire Authority and the Environment Agency. The Applicant must operate the BESS in accordance with the approved plan.

4.6.7. Further, pursuant to a requirement of the DCO, the detailed design of the BESS must be in accordance with the oBSMP (which includes various safety requirements for the BESS design) and the **Design Commitments [EN010158/APP/5.9] and ES Volume 3, Appendix 3.1: Height Parameters [EN010149/APP/6.3]**. An assessment will be undertaken, based on the actual battery system chosen for the BESS, to demonstrate that the risk of thermal runaway and impacts from a fire will be no worse than as assessed in this **BESS Plume Assessment Summary [EN010158/APP/7.13]**.

4.6.8. In this way, the Applicant can confirm that if the BESS constructed is different to that assessed in this plume assessment, its impacts in the event of a thermal runaway would be no worse than those assessed in this plume assessment, and therefore the risk to the local population would be very low.

4.6.9. A Layer of Protection Analysis (LOPA) has estimated the frequency of a cell venting event at approximately once every 5000~~344~~ years (1.7~~2.9~~x10-~~3~~4 yr-1) for the example BESS array in the Proposed Development.

Explosive gas volume

4.6.10. The volume of the enclosure, less the volume of the material within it, is used as the maximum volume of explosive gas (in the cell vent concentrations). This assumes continuous cell(s) venting, without ignition, replacing the enclosure atmosphere until an explosion occurs.

4.6.11. A number of failures of protection systems would have to occur before and during the event. i.e., cell and module monitoring systems, system monitoring and gas detection systems.

4.6.12. It should be clear that with all of the mitigations in place this scenario is unlikely, and is considered to give an upper bound.

4.6.13. By the time of the construction it is also likely that any battery enclosure would have automatic fresh air venting to prevent any build-up of gasses (NFPA 69 explosion prevention systems).

Event Duration

4.6.14. Once the potential for gas release is determined, the impact of any release is then proportional to the duration of the release. The faster it is released the greater the potential impact. The exact nature of an event such as a thermal runaway is difficult to predict, therefore we have drawn on a number of laboratory fire tests and reviewed the timeline of a number of battery fires globally. Generally it has been observed that once ignited a grid scale battery enclosure typically tends to take around 12h for a fire to be exhausted (noting that not all combustibles would be fully consumed), giving an approximate duration for the release of gasses over 12 hours.

4.6.15. To allow for uncertainty in the release rate and to allow for the unpredictable nature of an event we have modelled the release over 4 hours to give a credible worst case time duration and concentration of gasses, i.e. as the time of the release is proportional to the dilution this is a further conservative assumption.

4.7. Scenarios

4.7.1. It was assessed that the worst credible scenarios could be:

- Prolonged release of toxic Hydrogen Fluoride over periods of up to 4 hours.
- Prolonged release of toxic Carbon Monoxide over periods of up to 4 hours.
- Prolonged release of flammable Methane over periods of up to 4 hours.
- Instantaneous explosion of a compartment of Methane.
- Fire inside the compartment resulting from ignition of Methane.

Meteorology

4.7.2. Site data was acquired along with atmospheric data for the assessment. Wind data from the nearest weather station at High Wycombe Hqair was taken from the CEDA website, with temperature and climate data for High

Wycombe taken from the Met Office and 'Climate Data' websites respectively.

4.7.3. The key data is summarised as follows:

Average annual ambient temperature:	10.3 °C
Average annual humidity:	79 %
Prevailing wind direction:	220° or SW (South-Westerly)

The plot shows the distribution of wind direction which has the following values:

Mean :	207°	(average)
Mode :	220°	(most common = prevailing)
Median :	220°	(middle)

4.7.4. The prevailing wind direction is show as a blue arrow on the radar diagram, the wind rose is shown in red and considers all wind directions.

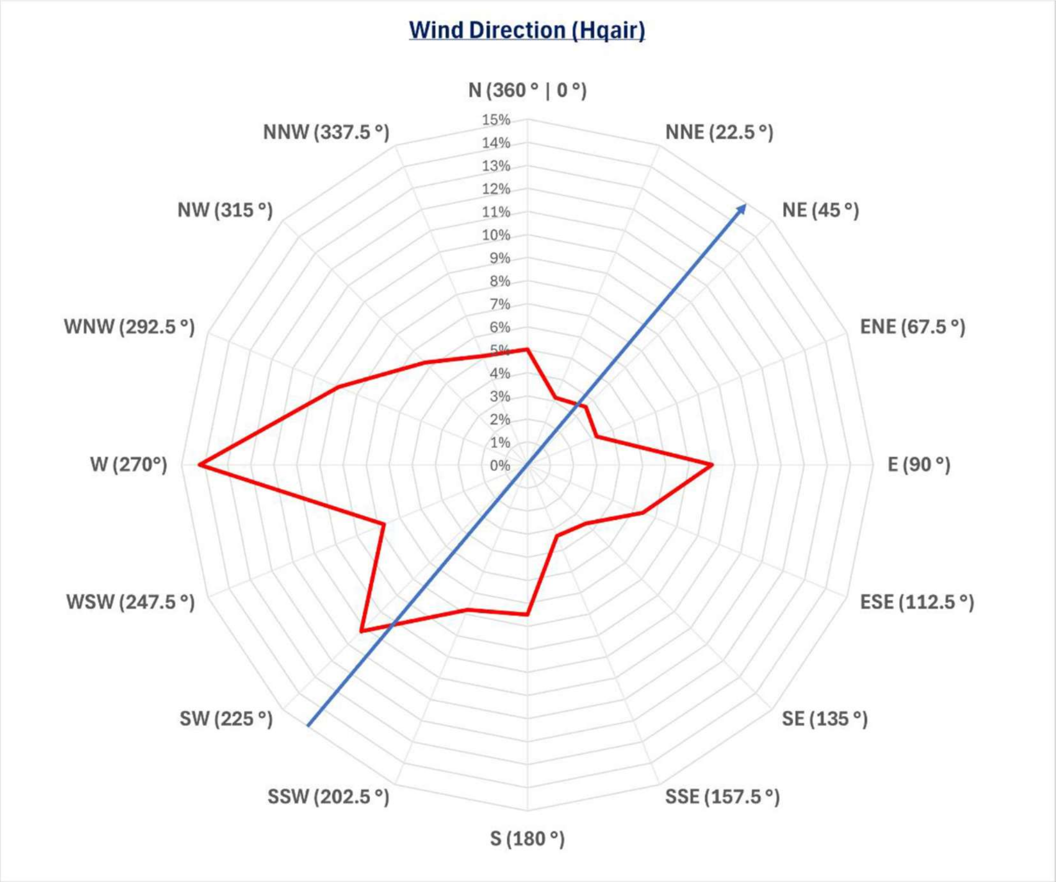

Figure 1 - Wind Rose Considering all Directions

4.7.5. Average wind speed: 3.2 m/s (6.2 knots or 7.1 mph)

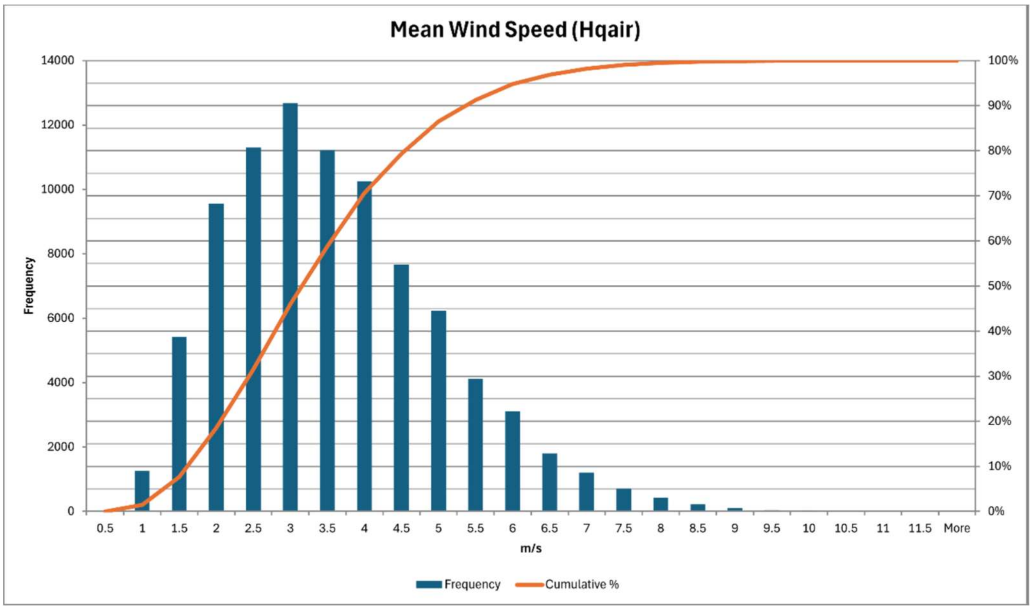

Figure 2 - Mean Wind Speed (m/s)

4.7.6. In accordance with industry practice the following conditions were assumed:

4.7.7. Still conditions (Pasquill-Gifford stability classification F2) tend to dominate the results of a toxic cloud release (since the low speed/turbulence does not contribute much dilution effect), however the more common D5 conditions have also been modelled (in PHAST) for HF releases as these are potentially the most harmful and therefore the impact of wind speed/stability on dispersion needs to be better understood.

4.7.8. These are derived from the Pasquill-Gifford stability classification method where the prefix letter refers to the stability class:

A. Very Unstable

B. Unstable

C. Slightly Unstable

D. Neutral

E. Slightly Stable

F. Stable

4.7.9. The suffix number refers to the wind speed in m/s.

4.7.10. Due to the low wind speed and lack of turbulence, the smoke plume is anticipated to be less than 10m in width at potentially irritating concentrations of 4.5 ppm. It should also be noted that the modelled plume remained well formed and showed a gradually rise as it moves downwind further reducing the risk to people at ground level.

4.8. Criteria

Toxic release impact assessment.

4.8.1. The modelling has been undertaken using both HSE guidance and Chemical Industries Association (UK) (CIA) for Specified Level of Toxicity (SLOT) and Significant Likelihood of Death (SLOD).

4.8.2. These are generally defined as follows:

- SLOT criteria reflect exposure conditions just on the verge of causing a low percentage of deaths (1% mortality) in the exposed population.

- SLOD criteria relates to the mortality of 50% of an exposed population.

Toxic release findings

4.8.3. For the toxic plume assessments the findings of the study have shown that the worst case impact of a toxic release varies dependent upon the prevailing wind direction and speed.

4.8.4. The modelling undertaken demonstrates that a significant impact beyond the Site is unlikely.

4.8.5. The SLOT extent contour for Hydrogen Fluoride (HF) for a 4h exposure is around 72m from the source. Due to the low wind speed and lack of turbulence the cloud is anticipated to be less than 10m in width. It should also be noted that the modelled plume remained well formed and showed a gradual rise to as it moves downwind, reducing the risk to people at ground level.

4.8.6. For Carbon monoxide, is it possible that members of the public could be harmfully impacted at less than 67m.

4.8.7. As noted the location of the battery site was determined with our understanding of the risk of toxic plume. It was sited to be as far as possible from any off site receptors, the nearest being approximately 400m south of the Site. Noting that the prevailing wind direction for the site is typically south-westerly, the likelihood is that any plume would be more likely to move to the north-east. Therefore the likely impact on the general public, particular nearby residents is deemed to be very low.

4.8.8. This would leave only site operatives, emergency responders and passers-by at risk. These risks would be managed through an emergency response plan which will be put in place for the Site, as secured in the **~~oBSMP~~ Outline BSMP [EN010158/APP/7.9.2]**.

4.8.9. It should be noted that these worst case (distance travelled) plumes are very narrow, due to the low wind speed resulting in low turbulence. The plume will consist of not only the target gas but will be part of a larger plume of smoke, which site operatives and or passers-by are unlikely to remain within unless incapacitated.

4.8.10. The emergency response plan would also cover these eventualities;

- The duration of dwell for any site personnel, responder or member of the public will be controlled (minimized) to reduce the exposure time & concentration.
- This may include installation of visual e.g. beacons and/or audible e.g. klaxons alarms to alert onsite & offsite personnel of a venting event. The site is remote (with few members of the general public in the vicinity),

therefore beacons/klaxons may be of limited value for those not aware of the hazards the site may present.

- This may include installation of a met mast or other relevant system on the site to measure wind speed and direction so that this can be shared in real-time with emergency responders and others to inform relevant and effective emergency response.
- As would be the case in any fire event, relevant nearby properties in the downwind direction would receive recommendations for people to remain indoors and keep doors and windows closed to further reduce any impact.
- A site cordon / exclusion zone would be in place;
- This may extend to the Public Rights of Way (PRoW) to the West however dwell times in the smoky plume would need to be reasonable for any impact on receptors and the smoke would serve to encourage people to avoid the area.
- The immediate downwind areas would be investigated for casualties.
- It is anticipated that the emergency response would take no more than a few tens of minutes to attend site, meaning that only incapacitated people in the immediate vicinity (within the site) would be at significant risk during this time. Discussions regarding the emergency response are ongoing; the ERP drafted with LFRS at the detailed design stage will fully address this type of emergency response scenario.
- The appropriate highways authorities would be alerted in the event of a thermal runaway (or other major incident) at the BESS location and take appropriate actions.

Flammable Release Impact Assessment

4.8.11. The distance to reach the Lower Explosive Limit (LEL) of Methane (CH4) is predicted to evaluate the potential for a flammable release which may ignite after a time delay, thus presenting a threat to emergency response personnel in the vicinity. The 10% LEL of Methane is not flammable over 4 hour release rate.

4.8.12. To assist in the controlling of a fire and to understand the likely impact of a fire the CIA (Chemical Industries Association) guidelines for Occupied Buildings, the radiation threshold of 6.3 kW/m2 was selected. Radiation levels below this are taken as ‘safe escape’ with a 1% chance of fatality if exposed for 90 seconds.

Flammable Release Findings

4.8.13. A jet type fire of the vented hydrogen has also been modelled with the industry threshold of 6.3kW/m2 being reached at less than 10m from the source. However, this would be assessed on the ground during any event as a precautionary measure.

4.8.14. The model predicts that the LEL of Methane would extend less than 5m from the release point. This is considered to be secondary to the H2 risk considered.

Explosion Impact Assessment

4.8.15. The effects of a vapor cloud explosion (VCE) depend on a number of factors. By default, the time of ignition is unknown, and it is assumed that the cloud is ignited by a flame or spark.

4.8.16. Although the site will be locally congested, there is a pressure release panel on each container and an uncongested explosion has been assumed.

4.8.17. The CIA guidelines for Occupied Buildings suggest an explosion overpressure threshold of 30 mbar as overpressures below this are insufficient to cause structural damage or significant window glass hazards. As the modelling software has a lower limit of 0.5 psi (~35 mbar ~3.5kPa) for calculating overpressure this has been used

4.8.18. An extreme threshold of 15,800 pascals (15.8 kPa) which may result in structural damage has also been considered. This is also around the pressure level that studies have shown that people can reasonably tolerate in an explosion.

Explosion Findings

4.8.19. The unconfined explosive potential has been modelled to be around 20m to reach the 3.5kPa value with the 15kPa being slightly less than 14m. This would ensure that any explosive effects are contained within the site perimeter.

- This information will be used in the emergency response plan to assist the fire service in setting a safe operational distance during an event with an appropriate factor of safety.

5. Summary

5.1.1. With consideration of the findings against the outcomes of the reported BESS compound incidents both globally and in the UK it has been seen that the risk of fire and explosion is real and that generally our understanding of the real world outcomes appears to correlate with the modelling findings.

5.1.2. This plume assessment has considered the potential impacts from all types of battery failures, finding that in the occurrence of credible worst-case scenarios, nearby receptors are likely to remain unaffected relative to thresholds outlined in existing guidance. The arrangement and placement of the example design ensures receptors sensitive to the types of emergency situations associated with BESS failure are largely protected prior to implementation of specific emergency response planning or control systems, and deployment of these will only increase protection in these eventualities. However, to ensure safe management of emergency situations by onsite workers and emergency responders, an Emergency Response Plan will be developed and deployed prior to construction of the BESS facility.

5.1.3. All plume assessments are site specific and any comparison should only be for indicative purposes.

5.1.4. Therefore, the Applicant considers that this document demonstrates a deep understanding of the risks of building and operating a ~~large scale~~large-scale battery storage installation. It has been demonstrated that under day-to-day operation there is a low risk of an incident, and in the event of an incident the credible hazards are understood and have been evaluated at this concept design stage to demonstrate that the risk to the local population remains very low.

Plume Assessment Addendum: Air Quality Assessment

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Executive Summary

An air quality assessment has been undertaken to support the operation of a Battery Energy Storage System (BESS) at the Rosefield Solar Farm. This has been carried out in addition to a BESS air quality assessment that will be carried out at the detailed design stage and is secured in the **Outline Battery Safety Management Plan (BSMP) [EN010158/APP/7.2.2]**, as agreed with the UK Health Security Agency.

A BESS does not produce routine emissions; however, there is the potential for a battery thermal runaway heating incident to produce high short-term emissions. The risk of a thermal runaway event has been determined to be a very small risk of failure with a probability magnitude of the event happening as more than 1 in 5000 years. This also assumes that other preventative safety measures and mitigation built into the system have failed, which is considered very unlikely. This is a conservative aggregate figure which accounts for all BESS enclosures within the compound. Any event that might occur would be appropriately managed through the detailed Battery Safety Management Plan and the future Emergency Response Plan for the Proposed Development.

The assessment has been undertaken to be deliberately conservative, accounting for five years of meteorological data, a number of possible locations of a battery thermal runaway heating incident, constant operation to account for all meteorological conditions against the short-term objectives and predicting concentrations at nearby residential receptors and public footpaths.

The main findings when considering the results from all modelling scenarios and sensitivity tests (including **BESS Plume Assessment Summary [EN010158/APP/7.13.2]**) were:

- Hazards of toxic gas concentrations are shown to be confined to the immediate surroundings (within 72 m) of the BESS under thermal runaway (using the PHAST and ALOHA models); and
- No significant air quality effects, when considering the impacts on commonly applied Air Quality Standards, including US EPA Acute Exposure Guidelines Level (AEGL) and UK Air Quality Standards at any footpath or residential receptors, with the majority of impacts below the Environmental Agency's commonly applied insignificance thresholds, of 1% and 10% for long-and short-term standards, respectively.

Results at modelled receptors within 1 km of the BESS boundary and at the worst-case affected modelled footpath receptor for the AEGLs and UK Air Quality Standards, where the impacts are predicted to be greatest, are presented below.

Methods to protect personnel and first responders in the vicinity of the event will be detailed in the future Emergency Response Plan, which will be developed in line with Buckinghamshire and Milton Keynes Fire Authority, as outlined in the **Outline BSMP [EN010158/APP/7.2.2]**, where it is likely that full Personal Protective Equipment will be worn by the first responders.

When considering that a BESS incident is understood to be extremely unlikely and the potential for effects that create notable discomfort (i.e. at AEGL 1 level) are not predicted using a conservative methodology, the risk of significant health effects to the surrounding land uses is judged to be very low. This includes at the nearest residential receptor (Borshaw Farm).

Summary of the Worst-Case Impacts against the Hydrogen Fluoride 10-minute Acute Exposure Guidelines Levels (AEGLs)

Receptor ID	Receptor Name	BESS Impact		% of Standard (AEGL)	Receptor Distance (km)
		$\mu g/m^3$	PPM		
R1	Borshaw Farm	90.06	0.1	10.5%	0.4
R2	Coppice Lowhill Farm	42.01	0.05	4.9%	0.7
R3	Weir Lane	55.70	0.06	6.5%	0.6
R4	31 Weir Lane	49.47	0.06	5.8%	0.7
R6	Middle Farm	28.59	0.03	3.3%	0.9
R7	Hogshaw Farm	52.48	0.06	6.1%	0.6
R8	1 Oak Cottages	36.93	0.04	4.3%	0.9
R9	Hil End Farm	33.41	0.04	3.9%	1.0
R11	2 Bernwood Jubilee Way	41.12	0.05	4.8%	0.8
R12	45 Botyl Road	34.15	0.04	4.0%	0.9
FR14	Worst Case Footpath Receptor	672.37	0.78	78.2%	50 m
Hydrogen Fluoride 1-hour (AEGL 1)				**860 $\mu g/m^3$/ 1 ppm**	

Summary of the Worst-Case Impacts against the PM_{10} Annual Air Quality Standard (AQS).

Receptor ID	Receptor Name	BESS Impact (µg/m³)	% of Standard (AQS)	Impact Descriptor*	Receptor Distance (km)
R1	Borshaw Farm	0.260	0.7%	Insignificant	0.4
R2	Coppice Lowhill Farm	0.055	0.1%	Insignificant	0.7
R3	Weir Lane	0.126	0.3%	Insignificant	0.6
R4	31 Weir Lane	0.137	0.3%	Insignificant	0.7
R6	Middle Farm	0.036	0.1%	Insignificant	0.9
R7	Hogshaw Farm	0.094	0.2%	Insignificant	0.6
R8	1 Oak Cottages	0.055	0.1%	Insignificant	0.9
R9	Hil End Farm	0.044	0.1%	Insignificant	1.0
R11	2 Bernwood Jubilee Way	0.115	0.3%	Insignificant	0.8
R12	45 Botyl Road	0.095	0.2%	Insignificant	0.9
FR14	Worst Case Footpath Receptor	1.429	3.6%**	n/a**	50 m
PM_{10} Annual (AQS)			**40 µg/m³**		

[*] Long-term impacts of less than 1.5% of the PM_{10} annual mean Air Quality Objective are considered negligible/insignificant when the baseline is less than 94% of the objective (which is the case here; **see Table 4.5**), based on the IAQM guidance **[Ref. 1-9].**

[**] The annual objective does not apply at footpath locations.

Summary of the Worst-Case Impacts against the $PM_{2.5}$ Annual Air Quality Standard (AQS).

Receptor ID	Receptor Name	BESS Impact (µg/m^3)	% of Standard (AQS)	Impact Descriptor*	Receptor Distance (km)
R1	Borshaw Farm	0.260	1.3/2.6**	Insignificant	0.4
R2	Coppice Lowhill Farm	0.055	0.3/0.6**	Insignificant	0.7
R3	Weir Lane	0.126	0.6/1.3**	Insignificant	0.6
R4	31 Weir Lane	0.137	0.7/1.4**	Insignificant	0.7
R6	Middle Farm	0.036	0.2/0.4**	Insignificant	0.9
R7	Hogshaw Farm	0.094	0.5/1.0**	Insignificant	0.6
R8	1 Oak Cottages	0.055	0.3/0.6**	Insignificant	0.9
R9	Hil End Farm	0.044	0.2/0.4**	Insignificant	1.0
R11	2 Bernwood Jubilee Way	0.115	0.6/1.2**	Insignificant	0.8
R12	45 Botyl Road	0.095	0.5/1.0**	Insignificant	0.9
FR14	Worst Case Footpath Receptor	1.429	7.1/14.2	n/a***	50 m
$PM_{2.5}$ Annual (AQS)			**20 (10**) µg/m^3**		

[*] Long-term impacts of less than 1.5% of the $PM_{2.5}$ annual mean Air Quality Objective (20 µg/m^3) are considered negligible/insignificant when the baseline is less than 94% of the objective (which is the case here; **see Table 4.5**), based on the IAQM guidance **[Ref. 1-9]**.

** The legally binding target to be achieved by 2040

[***] The annual objective does not apply at footpath locations.

1. Introduction

1.1.1. This report represents the findings of an air quality assessment undertaken to support the operation of a Battery Energy Storage System (BESS) at the Rosefield Solar Farm (the Proposed Development). The full description of the Proposed Development is provided in **ES Volume 1, Chapter 3: Proposed Development Description [EN010158/APP/6.1.2]**.

1.1.2. It is recommended that this assessment be read alongside the **Outline BSMP [EN010158/APP/7.2.2]** which outlines the key safety provisions.

1.1.3. The BESS site covers an area of 10.5 ha and could contain multiple 5MWh battery containers. The installation of a BESS allows excess solar energy to be balanced and utilised during peak times when required by the national grid, rather than simply not being collected. The Site lies within the administrative area of Buckinghamshire Council, which has declared five Air Quality Management Areas (AQMAs); the nearest being 12.5 km to the southeast of the BESS area. The BESS area is located within the south of the Proposed Development, with the BESS location in relation to the surrounding area presented in **Figure 1.1: Site Location**.

1.1.4. A BESS does not produce routine emissions; however, there is the potential for a battery thermal runaway heating incident to produce high short-term emissions that have the potential to impact nearby human receptors. The following report presents the findings of the impact assessment from emissions of nitrogen dioxide (NO_2), carbon monoxide (CO), particulate matter (PM_{10} and $PM_{2.5}$), hydrogen fluoride (HF), hydrogen chloride (HCl), hydrogen cyanide (HCN), benzene and 1,3-butadiene.

1.1.5. This assessment has considered both the long- and short-term air quality impacts on human receptors of any BESS battery thermal runaway incident utilising dispersion modelling.

Figure 1.1 Site Location

Imagery @2025 Airbus, Maxar Technologies Map data @2025

2. Legislation and Guidance

2.1. Legislation

Air quality standards and objectives

2.1.1. The air quality standards (AQSs) and air quality objectives (AQOs) in the United Kingdom are derived from EC directives and are adopted into English law via the Air Quality (England) Regulations 2000 **[Ref. 1]** and Air Quality (England) Amendment Regulations 2002 **[Ref. 2]**. Directive 2008/50/EC **[Ref. 3]** set limits values, and was translated into UK law in 2010 via the Air Quality Standards Regulations 2010 **[Ref. 4]**. The European Union (Withdrawal) Act retains existing EU environmental provisions in the UK.

The Environment Act 2021

2.1.1. The Environment Act 2021 **[Ref. 5]** amends the Environment Act 1995 **[Ref. 6]** to establish the use of local air quality management frameworks in order to encourage cooperation at the local level and broaden the range of organisations that play a role in improving local air quality. The Act requires the government to have an Environmental Improvement Plan (EIP) covering at least 15 years and setting out steps it intends to take to improve the environment. Part 1 of The Environment Act requires targets to be set for fine particulate matter $PM_{2.5}$, and these were introduced in The Environmental Targets (Fine Particulate Matter) (England) Regulations 2023 **[Ref. 7]**, as follows:

- $PM_{2.5}$ concentration interim target, annual mean of 12µg/m^3 by 2028;
- $PM_{2.5}$ exposure reduction interim target of 22% reduction compared to 2018 by 2028;
- $PM_{2.5}$ concentration binding target of annual mean of 10µg/m^3 by 2040;
- $PM_{2.5}$ exposure reduction binding target of 35% reduction compared to 2018 by 2040.

2.2. Guidance

Local Air Quality Management Technical Guidance

2.2.1. The Department for Environment, Food and Rural Affairs (Defra) has published technical guidance for use by local authorities in their air quality review and assessment work. This guidance, referred to in this document as the Local Air Quality Management Technical Guidance (‘Local Air Quality Management Technical Guidance 22’) **[Ref. 8]**.

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

2.2.2. Environmental Protection UK and the Institute of Air Quality Management jointly published a revised version of the guidance note 'Land-Use Planning & Development Control: Planning for Air Quality' in 2017 (herein the 'Environmental Protection UK- Institute of Air Quality Management 2017 guidance') **[Ref. 9]** to facilitate consideration of air quality within local development control processes. It provides a framework for air quality considerations, promoting a consistent approach to the treatment of air quality issues within development control decisions.

2.2.3. The guidance includes methods for undertaking an air quality assessment and an approach for assessing the significance of effects, which has been used within this assessment. The guidance note is widely accepted as an appropriate reference method for this purpose.

Environmental Agency Guidance

2.2.4. The Environment Agency (EA) has published multiple documents relating to the assessment of emissions to air under the Environmental Permitting Regulations. While this development does not currently fall within the scope of Environmental Permitting Regulations, the assessment techniques contained in these documents are suitable and have been used for assessing pollutants commonly regulated under Environmental Permitting Regulations (such as those addressed in this assessment). These documents include:

- Air emissions risk assessment for your environmental permit **[Ref. 10]**; and
- Environmental permitting: air dispersion modelling reports **[Ref. 11]**.

3. Assessment Criteria

3.1.1. As described in Section 2, the AQSs and AQOs in the United Kingdom are derived from EC directives and are adopted into English law.

3.1.2. Based on the current UK regulations, and the timeframe of any BESS incident, the AQSs for the pollutants proposed for assessment are presented in **Table 3.1**.

3.1.3. While the PM_{10} 24-hour mean objective has been presented below, an assessment against this objective has not been undertaken. This is due to the likelihood of a BESS incident occurrence across 35 24-hour periods (the number of exceedances of the objective allowed) within a year is practically zero.

Table 3.1: Air Quality Standards Relevant to the Assessment

Pollutant	**Averaging period**	**Exceedances allowed per year**	**Ground level concentration limit ($\mu g/m^3$)**	**Designation**
Nitrogen dioxide (NO_2)	calendar year mean	-	40	AQO*
	1-hour mean	18	200	AQO*
1,3-butadiene	Rolling calendar year mean	-	2.25	AQO
Benzene	calendar year mean	-	5	AQO*
Carbon Monoxide (CO)	Maximum 8-hour running mean in any daily period	-	10,000	AQO*
PM_{10}	calendar year mean	-	50	AQO*
	24-hour mean	35	40	AQO*
$PM_{2.5}$	calendar year mean	-	10**/20***	AQS

* The limit value is the same as the AQO.

** The legally binding target to be achieved by 2040.

*** There is no AQO; therefore, the limit value has been used.

3.1.4. In addition to the UK regulations, and due to the short-term nature of any BESS battery thermal runaway incident, impacts have also been compared to the United States Environmental Protection Agency's (US EPA) Acute Exposure Guidelines Levels (AEGLs) **[Ref. 13]**. These are used by emergency planners and responders worldwide as guidance in dealing with rare or accidental releases. AEGLs are calculated for five relatively short exposure periods – 10 minutes, 30 minutes, 1 hour, 4 hours, and 8 hours – as differentiated from air standards based on longer or repeated exposures. AEGL "levels" are dictated by the severity of the toxic effects caused by the exposure, with Level 1 being the least (notable discomfort) and Level 3 being the most severe (Life-threatening health effects or death). The AEGLs for the pollutants proposed for assessment are presented in **Table 3.2**. There are no AEGLs for PM_{10} or $PM_{2.5}$.

Table 3.2: AEGLs Relevant to the Assessment

Pollutant	**AEGL Level**	**Concentration (µg/m^3)***				
		10min	**30min**	**60min**	**4hr**	**8hr**
CO	AEGL1	-	-	-	-	-
	AEGL2	505,182	180,422	99,834	39,693	32,476
	AEGL3	2,044,784	721,688	396,929	181,042	156,366
HCL	AEGL1	2,819	2,819	2,819	2,819	2,819
	AEGL2	156,624	67,348	34,457	17,229	17,229
	AEGL3	971,066	328,909	156,624	40,722	40,722
HF	AEGL1	860	860	860	860	860
	AEGL2	81,660	29,226	20,630	10,315	10,315
	AEGL3	146,129	53,294	37,822	18,911	18,911
HCN	AEGL1	2,902	2,902	2,322	1,509	1,161
	AEGL2	19,736	11,609	8,243	4,063	2,902
	AEGL3	31,345	24,380	17,414	9,984	7,662
NO_2	AEGL1	988	988	988	988	988
	AEGL2	39,530	29,647	23,718	16,207	13,242
	AEGL3	67,200	49,412	39,530	27,671	21,741
1,3-butadiene	AEGL1	1,556,798	1,556,798	1,556,798	1,556,798	1,556,798
	AEGL2	15,567,978	15,567,978	12,314,968	7,900,168	6,273,663
	AEGL3	62,736,627	62,736,627	51,118,733	32,530,103	15,800,336
Benzene	AEGL1	436,205	244,946	174,482	60,398	30,199
	AEGL2	6,710,843	3,690,963	2,684,337	1,342,169	671,084
	AEGL3	32,547,587	18,790,359	13,421,685	6,710,843	3,321,867

* The AEGLs are presented in ppm on the USEPA website. The conversion from ppm to µg/m^3 applied in this table assumes an ambient temperature of 10.7°C, taken from the UK Met Office's annual mean temperature

between 1990 and 2024 for England Southeast and Central South.

3.1.5. As part of their regulatory position, the EA and Defra have produced environmental assessment levels (EALs) to regulate hazardous pollutants produced by industry that are not captured within the Air Quality Regulations. These are non-statutory guideline values and are contained within its air emissions risk guidance **[Ref. 1-10]**. However, as they are non-statutory and designed for the assessment of operational releases and not accident-type releases, these have not been considered further.

4. Assessment Methodology

4.1. Overall Scope

4.1.1. The BESS example design includes the installation and operation of multiple 5MWh BESS containers. These BESS allow excess solar energy to be balanced and utilised during peak times when required by the national grid, rather than simply not being collected.

4.1.2. A BESS does not produce routine emissions; however, there is the potential for battery thermal runaway heating or fire events to produce high short-term emissions. These are the effects that have been assessed as part of this assessment.

4.1.3. The assessment will utilise dispersion modelling to predict concentrations of the identified pollutants in **Section 3** at nearby human receptors. The predictions will be made for short- and long-term time periods where there are applicable standards (see **Table 3.1** and **Table 3.2** in **Section 3**).

4.2. Dispersion Modelling Methodology

Understanding of the BESS Operations

4.2.1. An example design could include the operation of multiple 5MWh BESS containers. Each of these 5MWh BESS containers could be made up of 4,991 314Ah (3.2V) Lithium Iron Phosphate cells (batteries). These 4,991 cells are typically organised into 48 104-cell deep racks split across six compartments.

4.2.2. An example container could operate 24 hours a day, 365 days a year, with the batteries being in various states of charge (SOC).

Modelling Scenarios

4.2.3. As discussed, there could be multiple 5MWh BESS containers on-site. These containers are designed to meet the specifications provided by the National Fire Chiefs Council (NFCC) and the National Fire Protection Association (NFPA) 855 guidance documents. Therefore, they are designed with sufficient distances to stop container to container propagation, and it is unlikely that more than one BESS container will experience a thermal runaway incident at any one time. Therefore, the assessment assumes that only one container could experience a thermal runaway incident at any one time.

4.2.4. However, as it is not known which of the BESS containers will experience a thermal runaway incident, emissions have been modelled from four separate BESS containers, one at each corner of the Site. This allows the worst-case impact at each receptor to be identified. The location of each modelled BESS container is shown in **Figure 4.1.**

4.2.5. Estimates from the BESS manufacturers indicate that any BESS battery thermal runaway heating or fire incident would last between 4 - 12 hours before burning out. Therefore, as a conservative assumption, emission estimates (see **Paragraph 4.2.9** onwards) assume that all pollutants from the burning of an entire 5MWh battery container will be released across a 4-hour period, which is judged to be worst case.

4.2.6. While any thermal runaway incident could last up to 12 hours before burning out, the weather conditions under which such an incident will occur cannot be known. Therefore, as best practice, the model has been run based on 5 years' worth of meteorological data, with the most conservative (or highest) results presented, i.e., the results presented are the predicted impacts if the BESS event were to coincide with worst-case meteorological conditions. However, this does not suggest that any incident would last 5 years.

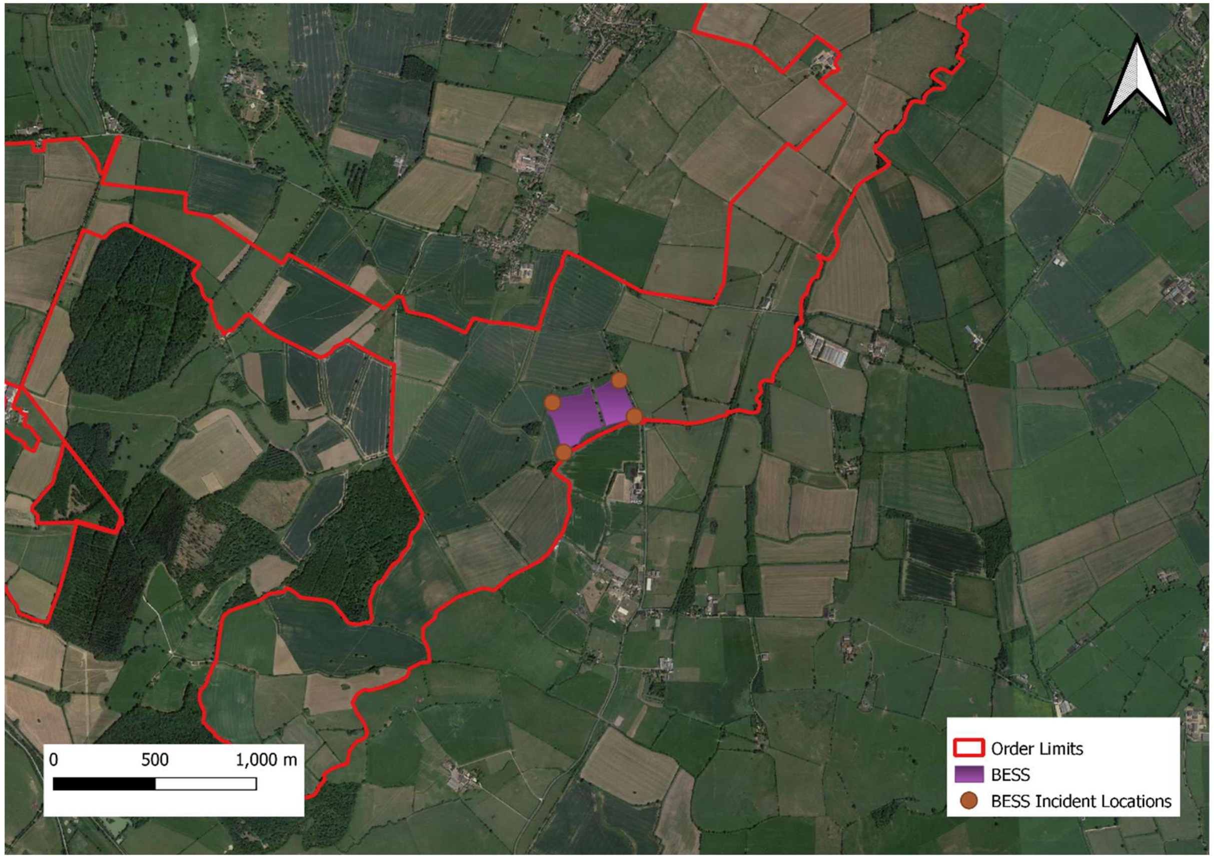
Modelling Software

4.2.7. The model used in this study is the Atmospheric Dispersion Modelling System (ADMS) Version 6, developed by the Cambridge Environmental Research Consultants (CERC). ADMS is a steady-state new-generation Gaussian plume atmospheric dispersion model; that being, it characterises the atmospheric boundary layer properties using the boundary layer depth and Monin-Obukhov length rather than the Pasquill-Gifford stability classes.

4.2.8. The ADMS model can include the treatment of both surface and elevated sources, complex terrain, buildings and chemistry effects. The model calculates downwind pollutant concentrations in the surrounding area for each hour of the day and night. Statistics on the frequency and concentration of pollutants at the receptor sites are based on hourly calculations.

4.2.9. Along with the AERMOD dispersion model, ADMS is commonly used within the UK for regulatory purposes and is judged fit for purpose for this assessment.

Figure 4.1 BESS Source Locations



Imagery @2025 Airbus, Maxar Technologies Map data @2025

Emission Parameters

Emission Rates

4.2.10. As detailed above, the modelling scenarios assume that only one 5MWh BESS container will experience a battery thermal runaway heating/fire incident.

4.2.11. In order to estimate the total emissions released during a BESS battery thermal runaway incident, the following information was used:

- information provided on likely worst-case mass emissions, based on DNV reports, UL9540A cell testing data and industry good practice;
- emissions data from a full-scale container thermal runaway test; and
- US EPA AP-42 emission factors **[Ref. 14]**.

4.2.12. The total mass emissions anticipated to be released from a thermal runaway incident (provided by DNV) for pollutants HF, 1,3-butadiene and CO are provided in **Table 4.1.** These estimates are based on the gas volumes of each pollutant emitted from the thermal heating test of a single UL9540A cell and have been upscaled to account for all 4,991 cells in a proposed 5 MW BESS. Concentrations of hydrogen fluoride were not measured in the same way; however, based on DNV tests and good industry practice, hydrogen fluoride consists of 0.1% of any gases released during a thermal heating event, and this principle has been assumed here.

Table 4.1: Maximum Emission Concentrations

Pollutant	**Maximum Mass Emission Rate (kg per 5MW BESS)**
CO	137.86
HF	2.68
1,3-butadiene	3.45

4.2.13. As information is not known for other key pollutants, these were estimated based on the above data and concentrations measured from a full-scale container thermal runaway test, undertaken in 2023 (**Table 4.2**). The ratio between HF and the other pollutants released during this test has been multiplied by the estimated total HF released (based on DNV tests) from **Table 4.1**.

Table 4.2: Maximum Emission Concentrations

Pollutant	Maximum Emission Concentrations Measured during the full-scale test (PPM)	Ratio to HF during the full-scale test	Calculated Mass Emission Rate (kg per 5MW BESS)
HCl	114.4	0.2	0.572
HCN	54.5	0.1	0.286
HF	575.6	1.0	2.68
NO_x	59.4	0.1	0.286

4.2.14. Emissions of particulate matter were not recorded directly above any full-scale container thermal runaway test (only in ambient air away from a container). Therefore, concentrations have been derived by using the ratio between the particulate matter (as PM) and CO concentrations from an automobile fire emissions testing measurement study, detailed within the USEPA AP-42 emissions factor database **[Ref. 14]**. As the USEPA AP-42 emissions factor database only contains emission factors for total particles, half of the emissions have assumed to be PM_{10} and $PM_{2.5}$ equally. Based on single battery thermal runaway data, the concentrations of PM used are judged to be very conservative.

4.2.15. No information is available on the likely emissions of benzene; therefore, it has been assumed that benzene emissions are equal to 1,3-butadiene, a VOC with a similar air quality standard.

4.2.16. The final modelled emissions take the total emissions predicted to be released per 5 MW BESS and divided them equally by a 4-hour burn time. These modelling emission rates are presented in **Table 4.3**.

4.2.17. Table 4.3: Modelled Emissions Rates

Parameter	Modelling Scenario Emission Rate (g/s) 4-hour Burn Time	Notes
CO Emission Rate (g/s)	9.574	Based on the emission rate per 5MW BESS in **Table 4.1.**
HCl Emission Rate (g/s)	0.040	Based on the factored emissions in **Table 4.2.**
HF Emission Rate (g/s)	0.199	Based on the emission rate per 5MW BESS in **Table 4.1.**
HCN Emission Rate (g/s)	0.020	Based on factored emissions in **Table 4.2.**

NOx Emission Rate (g/s)	0.020	
PM$_{10}$ Emission Rate (g/s)	3.829	Assumed to be 80% of the CO emissions rate based on the US EPA AP-42 Emission Factors. Then split equally between PM$_{10}$ and PM$_{2.5}$.
PM$_{2.5}$ Emission Rate (g/s)	3.829	
1,3-butadiene/benzene Emission Rate (g/s)	0.24	Based on the emission rate per 5MW BESS in **Table 4.1.**
benzene Emission Rate (g/s)	0.24	Based on the emission rate for 1,3-butadiene

4.2.18. The uncertainties associated with the above assumption on the conclusions of this assessment have been discussed in **Section 5**.

Physical Parameters

4.2.19. The height of the emissions has been estimated based on the height of a PowerTitan 2 (2.896m) and the estimated flame height. This was reported in the PowerTitan 2 fire test as being between one and four metres. A one metre flame height has been used for conservatism purposes, but also because a 4m flame height was only reported to occur when the fire was at its most vigorous and would not be representative of the entire heating/fire incident.

4.2.20. An area source has been used to model the fire within ADMS, with the area of the emissions assumed to be the size of a PowerTitan 2 BESS (14.7m^2).

4.2.21. The model requires a gas exit temperature in order to account for the thermal buoyancy of the plume. A temperature of 342°C has been used as it represents an average of container roof temperatures recorded during a full-scale battery fire container test.

4.2.22. There will be no associated mechanical buoyancy associated with the plume, which is common for air being forced from a stack; therefore, the exit velocity has been set at 0.01 m/s.

4.2.23. All physical parameters entered into the model have been presented in **Table 4.2**, with the emission rates for each scenario presented in **Table 4.3.**

Table 4.2: Physical and Flow Parameters

Parameter	Values	Assumption and Source
Battery Type	314Ah LFP cells	Using example supplier information
Cell power output (Wh)	1,004.8	Using example supplier information
Number of Cells per container	4,992	Using example supplier information
Container Capacity (MWh)	5.01552	Using example supplier information
Height (m)	3.896	Top of container (2.896m) + plus a 1m flame height.
Area (m^2)	14.769404	Based on information provided in the PowerTitan 2.0 specification sheet.
Exit Velocity (m/s)	0.01	Assumes no mechanical buoyancy
Exit Temperature (°C)	342	See **Paragraph 4.2.19**

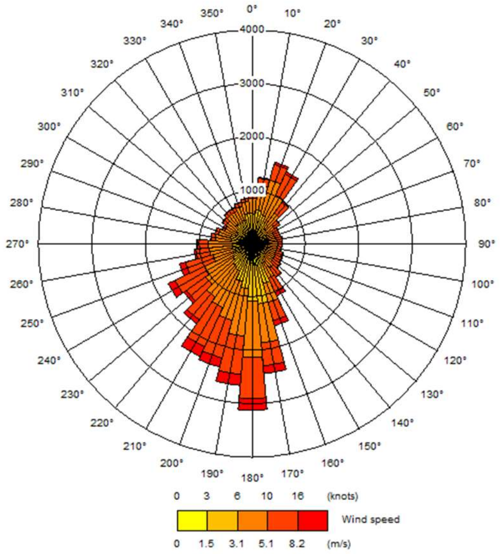
Meteorological Data

4.2.24. Hourly sequential meteorological data from the Benson meteorological station from between 2020 and 2024 have been used within the model. The Benson meteorological station is 34.4 km to the southeast of the BESS site and is judged to be the nearest suitable meteorological station to the site with valid data capture; both the meteorological station and the proposed development are located in rural areas in the southeast of England.

4.2.25. Each year has been modelled separately, with the worst-case prediction presented at each receptor presented within the report.

4.2.26. Examination of the wind roses indicates that the winds are predominantly from the directions of between 170° and 220°, i.e., predominantly southerly winds. The wind rose diagram for the entire modelled period (2020 – 2024) is presented in **Figure 4.2**.

Figure 4.2: Wind Rose for Benson Meteorological Station (2020 - 2024)



4.2.27. The Monin-Obukhov Length is the height above ground where mechanically produced (by vertical shear) turbulence is in balance with the dissipative effect of negative buoyancy. The minimum Monin-Obukhov Length parameter is an important component of the ADMS model, which allows the user to account for the heat production of cities and can have significant effects on the modelling results. For this assessment, the minimum Monin-Obukhov Length of 1m was used for the meteorological site location and the dispersion site location (representing rural areas).

Buildings

4.2.28. Buildings have the potential to disrupt atmospheric flow. In the case of emissions from a stack, they can entrain pollutants into the leeward side of the building (known as a cavity region). This cavity region is highly turbulent, often bringing pollutants rapidly towards ground level, increasing their concentrations. These concentrations will then reduce with diminishing turbulent wake. ADMS does not have the capability to model the impacts of pollutants being emitted from an area source. As such, the effects of buildings have not been included. However, given the distance to the closest residential receptors and the size and height of the containers, the building wake affects on pollutant concentrations are likely to be minimal and not considered to affect the conclusions of this study.

Terrain and Land Use

4.2.29. The topographical features surrounding a site will have an influence on the dispersion of pollution within the area. This is accounted for in the surface roughness length (z0) specified in the model input.

4.2.30. A z0 surface value of 0.1m was used for the land use around the site, which the model guidance indicates is appropriate for ‘root crops’.

Furthermore, a surface roughness length of 0.3m has been used to represent the land use around the meteorological site. Furthermore, model default values were used for surface albedo (0.23) and the Priestley-Taylor parameter (1).

4.2.31. The model author (CERC) **[Ref. 15]** advises that slopes with a gradient of greater than 1:10 can affect dispersion. In this case, there are no significant terrain gradients between the BESS and chosen discrete receptors; however, terrain heights have been included within the model due to elevated terrain in the wider model domain.

Time-Averages and the Fluctuation Model

4.2.32. The model concentration outputs have been configured to align with the time periods for the short-term AQSs (as described in **Section 3**). These time periods include 10-minute, 30-minute, 1-hour, 4-hour and 8-hour periods; however, for completeness, concentration outputs for 24-hour and annual periods have also been produced.

4.2.33. Furthermore, ADMS's fluctuation module has been used in this assessment. This option allows the user to account for variations in concentrations caused by short-term scale turbulence in the lower atmosphere. As such, the meteorological conditions are kept constant with changes in concentration due to predicted changes in boundary layer turbulence. For this assessment, the fluctuation averaging time has been set at 600 and 1800 seconds (10 and 30 minutes) to compare against the 10- and 30-minute AEGLs, and the 100th percentile concentration predicted across the hour.

Model Output Grid

4.2.34. A uniform Cartesian grid measuring 5km x 5km with 20m increments, centering over the BESS container, was used. The receptor heights were set at 1.5m.

Human Receptors

4.2.35. The discrete receptors considered were chosen based on where people may be located and judged in terms of the likely duration of their exposure to pollutants and proximity to the site, following the guidance given in **Section 2.2**. Furthermore, consideration was given to the National Fire Chiefs Council's examples of sensitive receptors[1], who requested that all receptors within a 1 km area of any potential BESS area be considered. Additional receptors at greater distances have also been considered.

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[1] Draft Guidance on Grid Scale Battery Energy Storage Systems (BESS) - NFCC

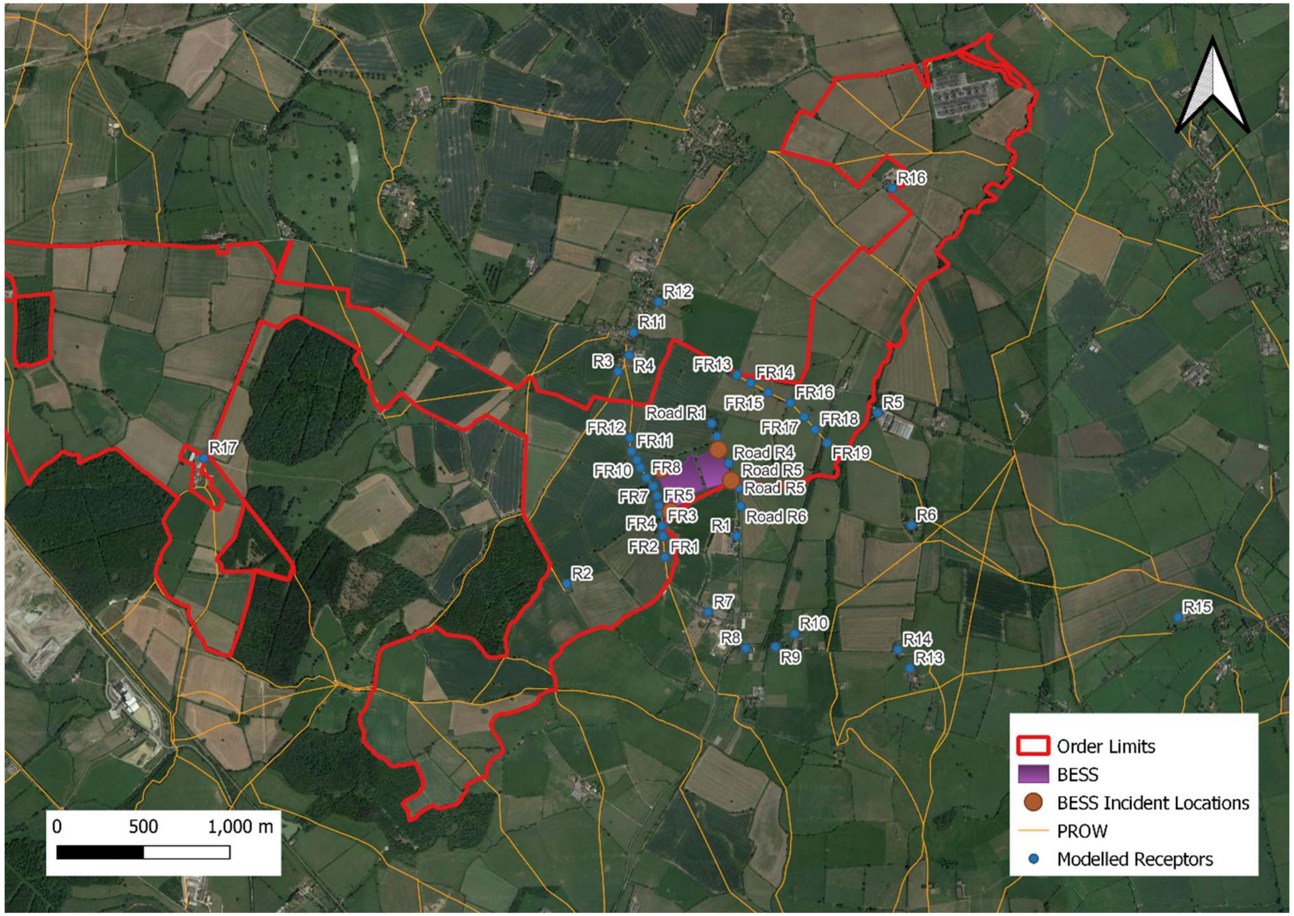
4.2.36. **Table 4.4** details the discrete human receptors included within the model, which are presented in **Figure 4.3.** It is noted that R1 – R17 is classified as residential receptors while FR1 – FR19 represents the receptors for public rights of way (PROW).

Table 4.4: Discrete Human Receptors Included in the Model

Receptor ID	X (m)	Y (m)	Height (m)	Distance from BESS
R1	473937	223348	1.5	0.4 km
R2	472955	223071	1.5	0.7 km
R3	473252	224296	1.5	0.6 km
R4	473316	224390	1.5	0.7 km
R5	474752	224057	1.5	0.9 km
R6	474947	223409	1.5	0.9 km
R7	473773	222907	1.5	0.6 km
R8	473990	222697	1.5	0.9 km
R9	474161	222705	1.5	1.0 km
R10	474272	222780	1.5	1.0 km
R11	473342	224522	1.5	0.8 km
R12	473487	224698	1.5	0.9 km
R13	474938	222581	1.5	1.5 km
R14	474870	222688	1.5	1.4 km
R15	476487	222876	1.5	2.7 km
R16	474837	225354	1.5	1.8 km
R17	470859	223796	1.5	2.7 km
FR1	473523	223225	1.5	250 m
FR2	473512	223346	1.5	150 m
FR3	473507	223405	1.5	100 m
FR4	473501	223480	1.5	50 m
FR5	473489	223521	1.5	75 m
FR6	473478	223578	1.5	120 m
FR7	473456	223634	1.5	110 m
FR8	473415	223683	1.5	95 m
FR9	473381	223742	1.5	110 m
FR10	473362	223784	1.5	150 m

FR11	473330	223837	1.5	200 m
FR12	473321	223913	1.5	250 m
FR13	473939	224276	1.5	0.4 km
FR14	474019	224231	1.5	0.4 km
FR15	474118	224175	1.5	0.5 km
FR16	474248	224116	1.5	0.5 km
FR17	474328	224034	1.5	0.5 km
FR18	474391	223962	1.5	0.6 km
FR19	474460	223884	1.5	0.6 km

Figure 4.3: Receptor Locations



Imagery @2025 Airbus, Maxar Technologies Map data @2025

Baseline Data

4.2.37. Hydrogen fluoride or hydrogen cyanide are not routinely monitored in ambient air due to its specialised nature and limited emission sources. A literature review reveals no sources of relevant baseline data within the UK; therefore, the baseline is assumed to be zero.

Buckinghamshire Council

4.2.38. Buckinghamshire Council has declared five AQMAs. However, no AQMAs are located close to the BESS site. Therefore, the proposed BESS site is not located within an AQMA.

4.2.39. According to the Buckinghamshire Council's 2024 Air Quality Annual Status Report **[Ref. 16]**, there were two automatic monitoring stations and non-automatic nitrogen dioxide (NO_2) diffusion tube monitoring at 176 locations in the district during 2023, with the closest location in Winslow, 5.4km north-east of the development. As this location is not likely to be representative of the study area (being a roadside location), Defra background data has been used within the assessment.

Defra Background Data

4.2.40. Estimated background air quality data is available from the Local Air Quality Management website operated by Defra **[Ref. 17]**.

4.2.41. This website provides estimated annual average background concentrations of NO_2, PM_{10}, $PM_{2.5}$, CO, benzene and 1,3-butadiene on a 1 km^2 grid basis. **Table 4.5** reproduces the 2025 estimated annual average background concentrations for the grid square containing the BESS site.

Table 4.5: Estimated 2025 Background Annual Average Concentrations at the Proposed Development Site (from the 2021 base maps for NO_2, PM_{10}, $PM_{2.5}$ and 2001 for CO, benzene and 1,3-butadiene)

Pollutant	**Annual Concentration ($\mu g/m^3$)**	**AQS ($\mu g/m^3$)**
NO_2	5.81	40
PM_{10}	11.72	40
$PM_{2.5}$	6.41	20
CO	270*	-
1,3-butadiene	0.15*	2.25
benzene	0.32*	5

* 2001 predicted concentrations

UKEAP: Acid Gases & Aerosol Network

4.2.42. Concentrations of gaseous hydrogen chloride were monitored by the UKEAP: Acid Gases & Aerosol Network **[Ref. 18]** until 2015. The latest available annual mean concentration (from 2015) from the nearest monitoring stations (Rothamsted, located 45 km from Rosefield BESS) was recorded as 0.28 µg/m^3.

Conversion of NO to NO_2

4.2.43. NO_x emitted to the atmosphere as a result of combustion will consist largely of nitric oxide (NO). Once released into the atmosphere, NO is oxidised to NO_2, which is of concern with respect to health and other impacts. The proportion of NO converted to NO_2 depends on a number of factors, including wind speed, distance from the source, solar irradiation and the availability of oxidants, such as ozone (O_3). The dispersion modelling exercise predicts concentrations of NO_x, which subsequently require conversion to NO_2 for comparison with objectives for human health.

4.2.44. Based on Environment Agency recommendations, NO_x Process Contributions (PCs) have been converted to the respective NO_2 concentrations using 70% for long-term emissions and 35% for short-term emissions based on 'worst case' conversion criteria.

Results Post-Processing

4.2.45. With the exception of the above NO_x to NO_2 conversion, no results processing has been undertaken on the short-term raw modelled results. For the annual modelled predictions, the output concentration has been multiplied by a factor of 0.0114 (100/8760) to reflect a very conservative assumption that an incident could occur for 100 hours of the year.

4.2.46. As previously mentioned, each year has been modelled separately, with the worst-case prediction from any of the modelled BESS locations presented at each receptor.

Interpretation of Modelled Results

4.2.47. There is no official guidance on how to determine the significance of air quality impacts; therefore, recommendations from the Institute of Air Quality Management's (IAQM) planning guidance **[Ref. 9]** have been used. This guidance highlights that the significance of air quality impacts should be based on professional judgement, which should be transparent and logically set out.

4.2.48. In this case, as we are primarily interested in the short-term impacts, and due to the majority of pollutants emitted from a BESS incident similar to those emitted by facilities regulated by the Environment Agency (i.e., less commonly considered under the LAQM regime), the Environment Agency's screening criteria[2] to assess whether a facility's Process Contribution (PC) is insignificant has been used as the starting point for the determination of significance, using the following criteria:

- if the short-term PC is less than 10% of the short-term; environmental standard, then a PC can be considered insignificant; and
- if the long-term PC is less than 1% of the long-term environmental standard, then a PC can be considered insignificant.

4.2.49. To assist in the determination of whether ambient air quality impacts are significant, the modelled long- and short-term Predicted Environmental Concentration (process contribution + baseline) (PECs) at the discrete receptors and across the modelled grid have been compared against the relevant AQSs/AEGLs. If ground-level concentrations caused by a BESS thermal runaway incident cause an exceedance of any AQSs/AEGLs, the effects may be considered significant, unless other justification is relevant. In reverse, if the ground-level concentrations do cause an exceedance of any AQSs/AEGLs, then impacts can be considered 'not significant', again, unless other considerations are relevant (other nearby major sources or the number of receptors impacted).

4.2.50. Furthermore, the annual impact on each human receptor has also been described using the criteria in Environmental Protection UK and Institute of Air Quality Management's Land-Use Planning & Development Control: Planning For Air Quality guidance. The method in this guidance derives the magnitude of impacts using the percentage of change in annual pollutant concentration relative to an Air Quality Assessment Level (AQAL) (AQS/AEGL etc.) and long-term average pollutant concentration at the receptor, as presented in **Table 4.6.** It is common for moderate or greater impacts to be considered significant; however, this is normally considered alongside the likelihood of an AQAL exceedance and the number of receptors impacted.

Table 4.6: Impact Descriptors for Individual Receptors

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[2] Relevant to the H1 screening tool, but commonly applied to modelling assessments.

Long term average concentration at receptor in assessment year	% Change in concentration relative to Air Quality Assessment Level (AQAL)			
	1	2-5	6-10	>10
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
79 – 94% of AQAL	Negligible	Slight	Moderate	Moderate
95 – 102% of AQAL	Slight	Moderate	Moderate	Substantial
103 – 109% of AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial

4.3. Uncertainties and Assumptions

4.3.1. The following uncertainties and assumptions have been made in the air quality assessment:

- There will be uncertainties introduced because the modelling has simplified real-world processes into a series of algorithms. For example, it has been assumed that wind conditions measured at Benson meteorological monitoring station for the years 2020 to 2024 were representative of wind conditions at the site. This is the case for all dispersion modelling studies and is not specific to this assessment;

- It is unlikely that a single cell will behave in the same way as a container of cells when heated/on fire. A literature review shows that there is a large variation in emission release rates during such incidents; and

- The emission rates provided assumed total mass of emissions are released during a fire. In reality, it is likely that propagation rates between cells will not allow all emissions to be released, or at such speeds; thus, making this assessment conservative.

- There is an element of uncertainty in all measured and modelled data. All values presented within the report are the most up to date available emissions data. This is the case for all dispersion modelling studies, and why conservatism in chosen data/modelling parameters has been used where appropriate.

5. Assessment of Impacts

5.1.1. This section sets out a summary of the dispersion modelling results, and is based on the results presented in **Annex 1**, which represent the worst-case concentrations across five years of meteorological data and the worst-case location of any of the four BESS container scenarios modelled, at any receptor. Furthermore, the dispersion profile of the maximum predicted HF 1-hour average concentrations (assuming emissions from all four BESS location scenarios at each grid point) for the year 2021 are shown in **Figure 5.1** as a contour plot.

5.2. Carbon Monoxide (CO)

5.2.1. The results presented in **Annex 1** demonstrate that all impacts during a BESS incident are below the AEGLs and AQSs at all nearby applicable residential and PROW receptors. Furthermore, PECs are also below the AEGLs and AQSs. Therefore, the impacts are not significant.

5.3. Hydrogen Chloride (HCl)

5.3.1. The results presented in **Annex 1** demonstrate that all impacts during a BESS incident are below the AEGLs at all nearby applicable residential and PROW receptors. Furthermore, PECs are also below the AEGLs. Therefore, the impacts are not significant.

5.4. Hydrogen Fluoride (HF)

5.4.1. The results presented in **Annex 1** demonstrate that all impacts during a BESS incident are below the AEGLs at all nearby applicable residential and PROW receptors. Furthermore, PECs are also below the AEGLs. Therefore, the impacts are not significant.

5.5. Hydrogen Cyanide (HCN)

5.5.1. The results presented in **Annex 1** demonstrate that all impacts during a BESS incident are below the AEGLs at all nearby applicable residential and PROW receptors. Furthermore, PECs are also below the AEGLs. Therefore, the impacts are not significant.

5.6. Nitrogen Dioxide (NO_2)

5.6.1. The results presented in **Annex 1** demonstrate that all impacts during a BESS incident are below the AEGLs and AQSs at all nearby applicable residential and PROW receptors. Furthermore, PECs are also below the AEGLs and AQSs and impacts are considered negligible with respect to IAQMs criteria (see **Table 4.6**). Therefore, the impacts are not significant.

5.6.2. No assessment has been made against the annual NO_2 AQS at PROW receptors. It is judged reasonable to assume that walkers would at most be here for short periods each day, and is therefore not representative of annual exposure, as supported by LAQM TG.22 **[Ref. 1-8]**.

5.7. Particulate Matter (PM_{10} and $PM_{2.5}$)

5.7.1. The results presented in **Annex 1** demonstrate that all impacts during a BESS incident are below the AQSs at all nearby applicable residential and PROW receptors. Furthermore, PECs are also below the AQSs and impacts are considered negligible with respect to IAQMs criteria (see **Table 4.6**). Therefore, the impacts are not significant.

5.7.2. No assessment has been made against the annual and 24-hour PM_{10} and annual $PM_{2.5}$ AQSs at PROW receptors. It is judged reasonable to assume that walkers would at most be here for short periods each day, and is therefore not representative of annual exposure, as supported by LAQM TG.22 **[Ref. 1-8]**.

5.7.3. Furthermore, no assessment has been made against the 24-hour PM_{10} AQS at residential receptors. This is because the AQS allows for 35 24-hour yearly exceedances, which far exceeds the number of 24-hour periods where an incident would occur within a year.

5.8. 1,3-butadiene

5.8.1. The results presented in **Annex 1** demonstrate that all impacts during a BESS incident are below the AQS and AEGLs at all nearby applicable residential and PROW receptors. Furthermore, PECs are also below the AQSs and AEGLs. Therefore, the impacts are not significant.

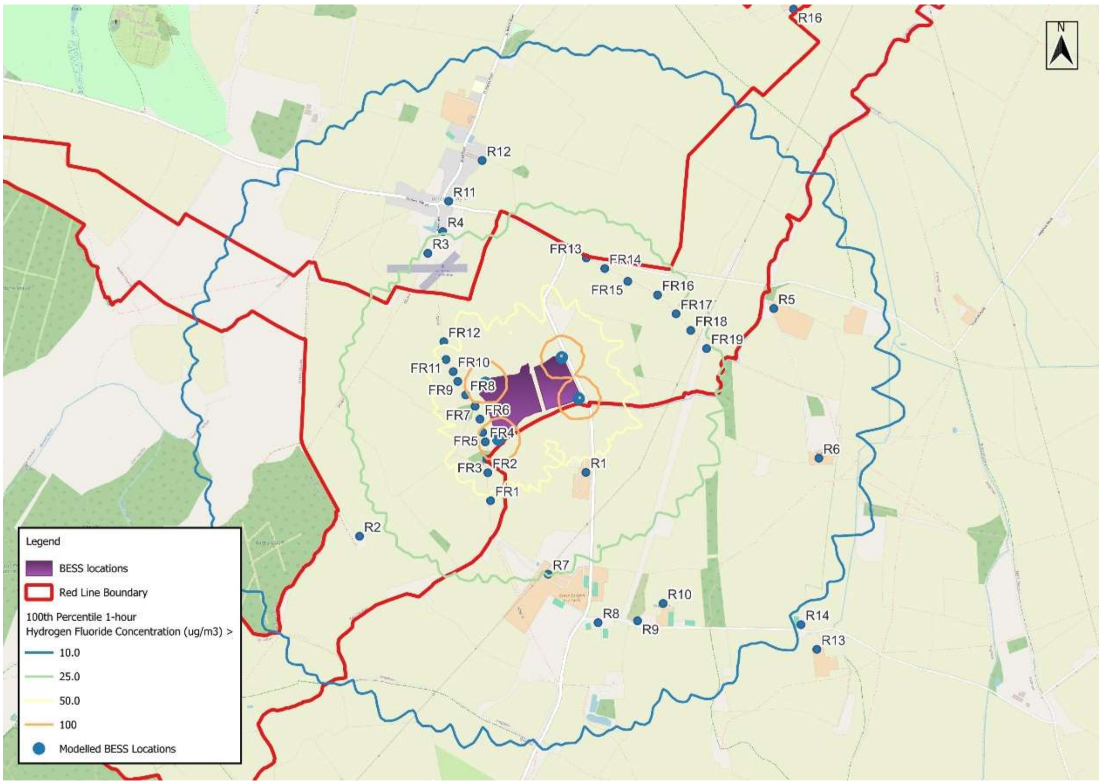
5.8.2. No assessment has been made against the annual 1,3-butadiene AQS at PROW receptors. It is judged reasonable to assume that walkers would at most be here for short periods each day, and is therefore not representative of annual exposure, as supported by LAQM TG.22 **[Ref. 1-8]**.

5.9. Benzene

5.9.1. The results presented in **Annex 1** demonstrate that all impacts during a BESS incident are below the AQS and AEGLs at all nearby applicable residential and PROW receptors. Furthermore, PECs are also below the AQSs and AEGLs. Therefore, the impacts are not significant.

5.9.2. No assessment has been made against the annual benzene AQS at PROW receptors. It is judged reasonable to assume that walkers would at most be here for short periods each day, and is therefore not representative of annual exposure, as supported by LAQM TG.22 **[Ref. 1-8]**.

Figure 5.1: Hydrogen Fluoride 100th percentile 1-hour average concentrations



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6. Discussions

6.1. Summary of Plume Assessment

The plume assessment **BESS Plume Assessment Summary [EN010158/APP/7.13.2]** undertaken to support the Rosefield BESS application utilised ALOHA and PHAST models to determine the impacts against the Specified Level of Toxicity (SLOT) and Significant Likelihood of Death (SLOD) levels for HF and CO. This assessment concluded that for a 4-hour exposure, the SLOT threshold was exceeded up to 72m away from the source for HF and 67 m for CO.

6.2. Summary of the ADMS assessment

6.2.1. A conservative methodology that is precautionary in terms of the magnitude of emission rates assumed, dispersion modelling parameters (exit temperature and velocity etc.) and the assessment across 5-years of meteorological data where the incident is occurring constantly (in order to account for all likely meteorological conditions) has been used in this assessment.

6.2.2. The results of this assessment predict no exceedances of any AEGLs and AQS at any receptor as a result of a BESS incident. Furthermore, PECs are also below the AQSs and AEGLs and annual impacts are considered negligible with respect to IAQMs criteria (see **Table 4.6**).

6.2.3. In addition, the majority of impacts are below the Environmental Agency's commonly applied insignificance thresholds, of 1% and 10% for long-and short-term standards, respectively.

6.3. Significance

6.3.1. As detailed above, there are not predicted to be any exceedances of any air quality standards (AEGLs and AQS).

6.3.2. When considering that a BESS incident is understood to be an extremely low probability and the potential for effects that create notable discomfort (i.e. at AEGL 1 level) are not predicted using a conservative methodology, the risk of significant health effects to the surrounding land uses is judged to be very low.

6.3.3. The above is further supported by the plume assessment that predicts no exceedances of the SLOT threshold beyond 72 m. The SLOT assessment is based on different dispersion models; therefore, different results are expected; however, this adds weight to the conclusions of this assessment, that two different methods and models reach similar conclusions.

7. Conclusion

7.1.1. An assessment of the air quality impacts of a 5MWh BESS thermal runaway incident at the Proposed Development has been undertaken, with reference to existing air quality in the area and relevant air quality legislation, policy and guidance.

7.1.2. This assessment has considered both the long- and short-term air quality impacts on human receptors for a four-hour 5MWh BESS thermal runaway incident utilising dispersion modelling.

7.1.3. Using a conservative methodology that is precautionary in terms of the magnitude of emission rates assumed, dispersion modelling parameters (exit temperature and velocity etc.) and the assessment across 5-years of meteorological data where the incident is occurring constantly (in order to account for all likely meteorological conditions), the impacts at all receptors are judged to be not significant.

7.1.4. When considering that a BESS incident is understood to an extremely low probability event and the potential for effects that create notable discomfort (i.e. at AEGL 1 level) are not predicted using a conservative methodology, the risk of significant health effects to the surrounding land uses is judged to be very low.

7.1.5. The above conclusions are supported by a plume assessment utilising dispersion models PHAST and ALOHA, adding weight to the conclusions of this assessment.

8. References

- **Ref. 1-1**: Air Quality (England) Regulations 2000. Available online: https://www.legislation.gov.uk/uksi/2000/928/contents/made
- **Ref. 1-2**: Air Quality (England) (Amendment) Regulations 2002. Available online: https://www.legislation.gov.uk/uksi/2002/3043/contents/made
- **Ref. 1-3**: Directive 2008/50/EC of the European Parliament and of the Council of 21st May 2008 on Ambient Air Quality and Cleaner Air for Europe. Available online: https://faolex.fao.org/docs/pdf/eur80016.pdf
- **Ref. 1-4**: Air Quality Standards Regulations 2010. Available online: https://www.legislation.gov.uk/uksi/2010/1001/contents/made
- **Ref. 1-5**: Environment Act 1995. Available online: https://www.legislation.gov.uk/ukpga/1995/25/contents
- **Ref. 1-6**: Environment Act 2021. Available online: https://www.legislation.gov.uk/ukpga/2021/30/contents/enacted
- **Ref. 1-7**: Environment Targets (Fine Particulate Matter) (England) Regulations 2023. Available online: https://www.legislation.gov.uk/uksi/2023/96/contents/made
- **Ref. 1-8**: Department for Environment, Food and Rural Affairs (2022) Local Air Quality Management Technical Guidance (TG22). Available online: https://laqm.defra.gov.uk/wp-content/uploads/2022/08/LAQM-TG22-August-22-v1.0.pdf
- **Ref. 1-9**: Environmental Protection UK and Institute of Air Quality Management (2017) Land-Use Planning and Development Control: Planning for Air Quality. Available online: https://www.iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf
- **Ref. 1-10**: Environment Agency (2025) Air emissions risk assessment for your environmental permit. Available online: https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit
- **Ref. 1-11**: Environment Agency (2023) Specified generators: dispersion modelling assessment. Available online: https://www.gov.uk/guidance/specified-generators-dispersion-modelling-assessment
- **Ref. 1-12**: Defra (2008) Consultation on Addendum to Guidelines for halogen an hydrogen halides in ambient air for protecting human health against acute irritancy effects states Available online: https://uk-air.defra.gov.uk/assets/documents/reports/cat11/0805151602_Halogen_and_Hydrogen_Halides_Addendum.pdf

- **Ref. 1-13**: US EPA (2025) Acute Exposure Guideline Levels for Airborne Chemicals. Available online: https://www.epa.gov/aegl
- **Ref. 1-14**: US EPA (2025) AP-42: Compilation of Air Emissions Factors from Stationary Sources. Available online: https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emissions-factors-stationary-sources
- **Ref. 1-15**: CERC (2025) ADMS 6 User Guide. Available online: https://www.cerc.co.uk/environmental-software/assets/data/doc_userguides/CERC_ADMS_6_User_Guide.pdf
- **Ref. 1-16**: Buckinghamshire Council (2024) Annual Status Report 2024. Available online: https://media.buckinghamshire.gov.uk/documents/2024_Air_Quality_Annual_Status_Report_ASR.pdf
- **Ref. 1-17**: Department for Environment, Food and Rural Affairs (2025). Background Mapping Data for Local Authorities-2021. Available online: https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2021
- **Ref. 1-18**: Department for Environment, Food and Rural Affairs (2025). UKAIR AURN. Available online: https://uk-air.defra.gov.uk/networks/network-info?view=aurn

Annex 1: Full Result for Receptors within 1km of a BESS

This section sets out the full dispersion modelling results at each receptors within 1 km of the BESS. These results represent the worst-case concentrations across five years of meteorological data and the worst-case location of any of the four BESS container scenarios modelled, at any receptor. The modelling was undertaken in line with the methodology described in **Section 4.**

Where the PCs exceed the Environment Agency's 1% and 10% screening criteria, PECs have not been presented.

The results have been compared against the ambient AQSs and AEGLs. Results have not been presented for the worst-case footpath receptor, where LAQM TG.22 suggests the air quality standard's exposure period (e.g. greater than 1-hour) does not apply.

Table C.1: Predicted 10-minute Maximum CO Impacts at the Worst-case Residential and Footpath Receptors against the AEGLs

Receptor	Concentration (µg/m^3)	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	4,341	505,182	0.9%	2,044,784	0.2%
R2	2,025	505,182	0.4%	2,044,784	0.1%
R3	2,685	505,182	0.5%	2,044,784	0.1%
R4	2,385	505,182	0.5%	2,044,784	0.1%
R6	1,378	505,182	0.3%	2,044,784	0.1%
R7	2,530	505,182	0.3%	2,044,784	0.1%
R8	1,780	505,182	0.5%	2,044,784	0.1%
R9	1,610	505,182	0.4%	2,044,784	0.1%
R11	1,982	505,182	0.3%	2,044,784	0.1%
R12	1,646	505,182	0.3%	2,044,784	0.1%
FR4	32,410	505,182	6.4%	2,044,784	1.6%

Table C.2: Predicted 30-minute Maximum CO Impacts at the Worst-case Residential and Footpath Receptors against the AEGLs

Receptor	Concentration ($\mu g/m^3$)	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	2,964	180,422	1.6%	721,688	0.4%
R2	1,360	180,422	0.8%	721,688	0.2%
R3	1,824	180,422	1.0%	721,688	0.3%
R4	1,612	180,422	0.9%	721,688	0.2%
R6	900	180,422	0.6%	721,688	0.2%
R7	1,684	180,422	0.5%	721,688	0.1%
R8	1,174	180,422	0.9%	721,688	0.2%
R9	1,065	180,422	0.7%	721,688	0.2%
R11	1,323	180,422	0.6%	721,688	0.1%
R12	1,083	180,422	0.6%	721,688	0.1%
FR4	20,010/20,550*	180,422	11.1%/11.4%*	721,688	2.8%

* PC/PEC

Table C.3: Predicted 60-minute Maximum CO Impacts at the Worst-case Residential and Footpath Receptors against the AEGLs

Receptor	Concentration ($\mu g/m^3$)	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	2,158	99,834	2.2%	396,929	0.5%
R2	996	99,834	1.0%	396,929	0.3%
R3	1,341	99,834	1.3%	396,929	0.3%
R4	1,180	99,834	1.2%	396,929	0.3%
R6	653	99,834	0.7%	396,929	0.2%
R7	1,234	99,834	1.2%	396,929	0.3%
R8	855	99,834	0.9%	396,929	0.2%
R9	776	99,834	0.8%	396,929	0.2%
R11	964	99,834	1.0%	396,929	0.2%
R12	784	99,834	0.8%	396,929	0.2%
FR4	7,053	99,834	7.1%	396,929	1.8%

Table C.4: Predicted 4-hour Maximum CO Impacts at the Worst-case Residential Receptors against the AEGLs

Receptor	Concentration (µg/m^3)	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	1,759	39,693	4.4%	181,042	1.0%
R2	650	39,693	1.6%	181,042	0.4%
R3	1,034	39,693	2.6%	181,042	0.6%
R4	988	39,693	2.5%	181,042	0.5%
R6	432	39,693	1.1%	181,042	0.2%
R7	1,029	39,693	2.6%	181,042	0.6%
R8	607	39,693	1.5%	181,042	0.3%
R9	520	39,693	1.3%	181,042	0.3%
R11	739	39,693	1.9%	181,042	0.4%
R12	616	39,693	1.6%	181,042	0.3%

Table C.5: Predicted 8-hour Maximum CO Impacts at the Worst-case Residential Receptors against the AEGLs

Receptor	Concentration (µg/m^3)	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	1,401	32,476	4.3%	156,366	0.9%
R2	496	32,476	1.5%	156,366	0.3%
R3	741	32,476	2.3%	156,366	0.5%
R4	683	32,476	2.1%	156,366	0.4%
R6	317	32,476	1.0%	156,366	0.2%
R7	558	32,476	1.7%	156,366	0.4%
R8	386	32,476	1.2%	156,366	0.2%
R9	405	32,476	1.2%	156,366	0.3%
R11	635	32,476	2.0%	156,366	0.4%
R12	481	32,476	1.5%	156,366	0.3%

Table C.6: Predicted 8-hour Maximum CO Impacts at the Worst-case Residential Receptors against the UK AQS

Receptor	Concentration ($\mu g/m^3$)	AQS	% of AQS
R1	1,401	10,000	14.0%
R2	496	10,000	5.0%
R3	741	10,000	7.4%
R4	683	10,000	6.8%
R6	317	10,000	3.2%
R7	558	10,000	5.6%
R8	386	10,000	3.9%
R9	405	10,000	4.0%
R11	635	10,000	6.3%
R12	481	10,000	4.8%

Table C.7: Predicted 10-min Maximum HCl Impacts at the Worst-case Residential and Footpath Receptor against the AEGLs

Receptor	Concentration ($\mu g/m^3$)	AEGL1	% of AEGL1	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	18.01	2,819	0.6%	156,624	<0.1%	971,066	<0.1%
R2	8.40	2,819	0.3%	156,624	<0.1%	971,066	<0.1%
R3	11.14	2,819	0.4%	156,624	<0.1%	971,066	<0.1%
R4	9.89	2,819	0.4%	156,624	<0.1%	971,066	<0.1%
R6	5.72	2,819	0.2%	156,624	<0.1%	971,066	<0.1%
R7	10.50	2,819	0.4%	156,624	<0.1%	971,066	<0.1%
R8	7.39	2,819	0.3%	156,624	<0.1%	971,066	<0.1%
R9	6.68	2,819	0.2%	156,624	<0.1%	971,066	<0.1%
R11	8.22	2,819	0.3%	156,624	<0.1%	971,066	<0.1%
R12	6.83	2,819	0.2%	156,624	<0.1%	971,066	<0.1%
FR4	134.47	2,819	4.8%	156,624	0.1%	971,066	<0.1%

Table C.8: Predicted 30-min Maximum HCl Impacts at the Worst-case Residential and Footpath Receptor against the AEGLs

Receptor	Concentration ($\mu g/m^3$)	AEGL1	% of AEGL1	AEGL2	% of AEGL2	AEGL3	% of AEGL3

R1	12.3	2,819	0.4%	67,348	<0.1%	328,909	<0.1%
R2	5.6	2,819	0.2%	67,348	<0.1%	328,909	<0.1%
R3	7.6	2,819	0.3%	67,348	<0.1%	328,909	<0.1%
R4	6.7	2,819	0.2%	67,348	<0.1%	328,909	<0.1%
R6	3.7	2,819	0.2%	67,348	<0.1%	328,909	<0.1%
R7	7.0	2,819	0.1%	67,348	<0.1%	328,909	<0.1%
R8	4.9	2,819	0.2%	67,348	<0.1%	328,909	<0.1%
R9	4.4	2,819	0.2%	67,348	<0.1%	328,909	<0.1%
R11	5.5	2,819	0.2%	67,348	<0.1%	328,909	<0.1%
R12	4.5	2,819	0.2%	67,348	<0.1%	328,909	<0.1%
FR4	83.0	2,819	2.9%	67,348	0.1%	328,909	<0.1%

Table C.9: Predicted 60-min Maximum HCl Impacts at the Worst-case Residential and Footpath Receptor against the AEGLs

Receptor	Concentration ($\mu g/m^3$)	AEGL1	% of AEGL1	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	9.0	2,819	0.3%	34,457	<0.1%	156,624	<0.1%
R2	4.1	2,819	0.1%	34,457	<0.1%	156,624	<0.1%
R3	5.6	2,819	0.2%	34,457	<0.1%	156,624	<0.1%
R4	4.9	2,819	0.2%	34,457	<0.1%	156,624	<0.1%
R6	2.7	2,819	0.1%	34,457	<0.1%	156,624	<0.1%
R7	5.1	2,819	0.2%	34,457	<0.1%	156,624	<0.1%
R8	3.5	2,819	0.1%	34,457	<0.1%	156,624	<0.1%
R9	3.2	2,819	0.1%	34,457	<0.1%	156,624	<0.1%
R11	4.0	2,819	0.1%	34,457	<0.1%	156,624	<0.1%
R12	3.3	2,819	0.1%	34,457	<0.1%	156,624	<0.1%
FR4	29.3	2,819	1.0%	34,457	0.1%	156,624	<0.1%

Table C.10: Predicted 4-hour Maximum HCl Impacts at the Worst-case Residential Receptor against the AEGLs

Receptor	Concentration ($\mu g/m^3$)	AEGL1	% of AEGL1	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	7.3	2,819	0.3%	17,229	<0.1%	40,722	<0.1%

R2	2.7	2,819	0.1%	17,229	<0.1%	40,722	<0.1%
R3	4.3	2,819	0.2%	17,229	<0.1%	40,722	<0.1%
R4	4.1	2,819	0.1%	17,229	<0.1%	40,722	<0.1%
R6	1.8	2,819	0.1%	17,229	<0.1%	40,722	<0.1%
R7	4.3	2,819	0.2%	17,229	<0.1%	40,722	<0.1%
R8	2.5	2,819	0.1%	17,229	<0.1%	40,722	<0.1%
R9	2.2	2,819	0.1%	17,229	<0.1%	40,722	<0.1%
R11	3.1	2,819	0.1%	17,229	<0.1%	40,722	<0.1%
R12	2.6	2,819	0.1%	17,229	<0.1%	40,722	<0.1%

Table C.11: Predicted 8-hour Maximum HCl Impacts at the Worst-case Residential Receptor against the AEGLs

Receptor	Concentration (μg/m^3)	AEGL1	% of AEGL1	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	5.8	2,819	0.2%	17,229	<0.1%	40,722	<0.1%
R2	2.1	2,819	0.1%	17,229	<0.1%	40,722	<0.1%
R3	3.1	2,819	0.1%	17,229	<0.1%	40,722	<0.1%
R4	2.8	2,819	0.1%	17,229	<0.1%	40,722	<0.1%
R6	1.3	2,819	0.0%	17,229	<0.1%	40,722	<0.1%
R7	2.3	2,819	0.1%	17,229	<0.1%	40,722	<0.1%
R8	1.6	2,819	0.1%	17,229	<0.1%	40,722	<0.1%
R9	1.7	2,819	0.1%	17,229	<0.1%	40,722	<0.1%
R11	2.6	2,819	0.1%	17,229	<0.1%	40,722	<0.1%
R12	2.0	2,819	0.1%	17,229	<0.1%	40,722	<0.1%

Table C.12: Predicted 10-min Maximum HF Impacts at the Worst-case Residential and Footpath Receptor against the AEGLs

Receptor	Concentration (μg/m^3)	AEGL1	% of AEGL1	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	90.06	860	10.5%*	81,660	0.1%	146,129	0.1%
R2	42.01	860	4.9%	81,660	0.1%	146,129	0.0%

R3	55.70	860	6.5%	81,660	0.1%	146,129	<0.1%
R4	49.47	860	5.8%	81,660	0.1%	146,129	<0.1%
R6	28.59	860	3.3%	81,660	<0.1%	146,129	<0.1%
R7	52.48	860	6.1%	81,660	<0.1%	146,129	<0.1%
R8	36.93	860	4.3%	81,660	<0.1%	146,129	<0.1%
R9	33.41	860	3.9%	81,660	<0.1%	146,129	<0.1%
R11	41.12	860	4.8%	81,660	0.1%	146,129	<0.1%
R12	34.15	860	4.0%	81,660	<0.1%	146,129	<0.1%
FR4	672.37	860	78.2%*	81,660	<0.1%	146,129	0.5%

* Background is assumed to be zero, so the PC and PEC are the same.

Table C.13: Predicted 30-min Maximum HF Impacts at the Worst-case Residential and Footpath Receptor against the AEGLs

Receptor	**Concentration (µg/m^3)**	**AEGL1**	**% of AEGL1**	**AEGL2**	**% of AEGL2**	**AEGL3**	**% of AEGL3**
R1	61.5	860	7.2%	29,226	0.2%	53,294	0.1%
R2	28.2	860	3.3%	29,226	0.1%	53,294	0.1%
R3	37.8	860	4.4%	29,226	0.1%	53,294	0.1%
R4	33.4	860	3.9%	29,226	0.1%	53,294	0.1%
R6	18.7	860	2.7%	29,226	0.1%	53,294	<0.1%
R7	34.9	860	2.2%	29,226	0.1%	53,294	<0.1%
R8	24.4	860	4.1%	29,226	0.1%	53,294	0.1%
R9	22.1	860	2.8%	29,226	0.1%	53,294	<0.1%
R11	27.4	860	2.6%	29,226	0.1%	53,294	<0.1%
R12	22.5	860	2.6%	29,226	0.1%	53,294	<0.1%
FR4	415.1	860	48.3%*	29,226	1.4%	53,294	0.8%

* Background is assumed to be zero, so the PC and PEC are the same.

Table C.14: Predicted 60-min Maximum HF Impacts at the Worst-case Residential and Footpath Receptor against the AEGLs

Receptor	**Concentration (µg/m^3)**	**AEGL1**	**% of AEGL1**	**AEGL2**	**% of AEGL2**	**AEGL3**	**% of AEGL3**
R1	44.8	860	5.2%	20,630	0.2%	37,822	0.1%
R2	20.7	860	2.4%	20,630	0.1%	37,822	0.1%

R3	27.8	860	3.2%	20,630	0.1%	37,822	0.1%
R4	24.5	860	2.8%	20,630	0.1%	37,822	0.1%
R6	13.5	860	1.6%	20,630	0.1%	37,822	<0.1%
R7	25.6	860	3.0%	20,630	0.1%	37,822	0.1%
R8	17.7	860	2.1%	20,630	0.1%	37,822	<0.1%
R9	16.1	860	1.9%	20,630	0.1%	37,822	<0.1%
R11	20.0	860	2.3%	20,630	0.1%	37,822	0.1%
R12	16.3	860	1.9%	20,630	0.1%	37,822	<0.1%
FR4	146.3	860	17.0%*	20,630	0.7%	37,822	0.4%

* Background is assumed to be zero, so the PC and PEC are the same.

Table C.15: Predicted 4-hour Maximum HF Impacts at the Worst-case Residential Receptor against the AEGLs

Receptor	Concentration (µg/m^3)	AEGL1	% of AEGL1	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	36.5	860	4.2%	10,315	0.4%	18,911	0.2%
R2	13.5	860	1.6%	10,315	0.1%	18,911	0.1%
R3	21.4	860	2.5%	10,315	0.2%	18,911	0.1%
R4	20.5	860	2.4%	10,315	0.2%	18,911	0.1%
R6	9.0	860	1.0%	10,315	0.1%	18,911	<0.1%
R7	21.3	860	2.5%	10,315	0.2%	18,911	0.1%
R8	12.6	860	1.5%	10,315	0.1%	18,911	0.1%
R9	10.8	860	1.3%	10,315	0.1%	18,911	0.1%
R11	15.3	860	1.8%	10,315	0.1%	18,911	0.1%
R12	12.8	860	1.5%	10,315	0.1%	18,911	0.1%

Table C.16: Predicted 8-hour Maximum HF Impacts at the Worst-case Residential Receptor against the AEGLs

Receptor	Concentration (µg/m^3)	AEGL1	% of AEGL1	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	29.1	860	3.4%	10,315	0.3%	18,911	0.2%
R2	10.3	860	1.2%	10,315	0.1%	18,911	0.1%

R3	15.4	860	1.8%	10,315	0.1%	18,911	0.1%
R4	14.2	860	1.6%	10,315	0.1%	18,911	0.1%
R6	6.6	860	0.8%	10,315	0.1%	18,911	<0.1%
R7	11.6	860	1.3%	10,315	0.1%	18,911	0.1%
R8	8.0	860	0.9%	10,315	0.1%	18,911	<0.1%
R9	8.4	860	1.0%	10,315	0.1%	18,911	<0.1%
R11	13.2	860	1.5%	10,315	0.1%	18,911	0.1%
R12	10.0	860	1.2%	10,315	0.1%	18,911	0.1%

Table C.17: Predicted 10-min Maximum HCN Impacts at the Worst-case Residential and Footpath Receptor against the AEGLs

Receptor	Concentration ($\mu g/m^3$)	AEGL1	% of AEGL1	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	9.01	2,902	0.3%	19,736	<0.1%	31,345	<0.1%
R2	4.20	2,902	0.1%	19,736	<0.1%	31,345	<0.1%
R3	5.57	2,902	0.2%	19,736	<0.1%	31,345	<0.1%
R4	4.95	2,902	0.2%	19,736	<0.1%	31,345	<0.1%
R6	2.86	2,902	0.1%	19,736	<0.1%	31,345	<0.1%
R7	5.25	2,902	0.2%	19,736	<0.1%	31,345	<0.1%
R8	3.69	2,902	0.1%	19,736	<0.1%	31,345	<0.1%
R9	3.34	2,902	0.1%	19,736	<0.1%	31,345	<0.1%
R11	4.11	2,902	0.1%	19,736	<0.1%	31,345	<0.1%
R12	3.42	2,902	0.1%	19,736	<0.1%	31,345	<0.1%
FR4	67.24	2,902	2.3%	19,736	0.3%	31,345	0.2%

Table C.18: Predicted 30-min Maximum HCN Impacts at the Worst-case Residential and Footpath Receptor against the AEGLs

Receptor	Concentration ($\mu g/m^3$)	AEGL1	% of AEGL1	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	6.1	2,902	0.2%	11,609	0.1%	24,380	<0.1%
R2	2.8	2,902	0.1%	11,609	<0.1%	24,380	<0.1%
R3	3.8	2,902	0.1%	11,609	<0.1%	24,380	<0.1%

R4	3.3	2,902	0.1%	11,609	<0.1%	24,380	<0.1%
R6	1.9	2,902	0.1%	11,609	<0.1%	24,380	<0.1%
R7	3.5	2,902	0.1%	11,609	<0.1%	24,380	<0.1%
R8	2.4	2,902	0.1%	11,609	<0.1%	24,380	<0.1%
R9	2.2	2,902	0.1%	11,609	<0.1%	24,380	<0.1%
R11	2.7	2,902	0.1%	11,609	<0.1%	24,380	<0.1%
R12	2.2	2,902	0.1%	11,609	<0.1%	24,380	<0.1%
FR4	41.5	2,902	1.4%	11,609	0.4%	24,380	0.2%

Table C.19: Predicted 60-min Maximum HCN Impacts at the Worst-case Residential and Footpath Receptor against the AEGLs

Receptor	Concentration (µg/m^3)	AEGL1	% of AEGL1	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	4.5	2,322	0.2%	8,243	0.1%	17,414	<0.1%
R2	2.1	2,322	0.1%	8,243	<0.1%	17,414	<0.1%
R3	2.8	2,322	0.1%	8,243	<0.1%	17,414	<0.1%
R4	2.4	2,322	0.1%	8,243	<0.1%	17,414	<0.1%
R6	1.4	2,322	0.1%	8,243	<0.1%	17,414	<0.1%
R7	2.6	2,322	0.1%	8,243	<0.1%	17,414	<0.1%
R8	1.8	2,322	0.1%	8,243	<0.1%	17,414	<0.1%
R9	1.6	2,322	0.1%	8,243	<0.1%	17,414	<0.1%
R11	2.0	2,322	0.1%	8,243	<0.1%	17,414	<0.1%
R12	1.6	2,322	0.1%	8,243	<0.1%	17,414	<0.1%
FR4	14.6	2,322	0.6%	8,243	0.2%	17,414	0.1%

Table C.20: Predicted 4-hour Maximum HCN Impacts at the Worst-case Residential Receptor against the AEGLs

Receptor	Concentration (µg/m^3)	AEGL1	% of AEGL1	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	3.6	1,509	0.2%	4,063	0.1%	9,984	<0.1%
R2	1.3	1,509	0.1%	4,063	<0.1%	9,984	<0.1%
R3	2.1	1,509	0.1%	4,063	0.1%	9,984	<0.1%
R4	2.0	1,509	0.1%	4,063	0.1%	9,984	<0.1%

R6	0.9	1,509	0.1%	4,063	<0.1%	9,984	<0.1%
R7	2.1	1,509	0.1%	4,063	0.1%	9,984	<0.1%
R8	1.3	1,509	0.1%	4,063	<0.1%	9,984	<0.1%
R9	1.1	1,509	0.1%	4,063	<0.1%	9,984	<0.1%
R11	1.5	1,509	0.1%	4,063	<0.1%	9,984	<0.1%
R12	1.3	1,509	0.1%	4,063	<0.1%	9,984	<0.1%

Table C.21: Predicted 8-hour Maximum HCN Impacts at the Worst-case Residential Receptor against the AEGLs

Receptor	Concentration (µg/m^3)	AEGL1	% of AEGL1	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	2.9	1,161	0.3%	2,902	0.1%	7,662	<0.1%
R2	1.0	1,161	0.1%	2,902	<0.1%	7,662	<0.1%
R3	1.5	1,161	0.1%	2,902	0.1%	7,662	<0.1%
R4	1.4	1,161	0.1%	2,902	<0.1%	7,662	<0.1%
R6	0.7	1,161	0.1%	2,902	<0.1%	7,662	<0.1%
R7	1.2	1,161	0.1%	2,902	<0.1%	7,662	<0.1%
R8	0.8	1,161	0.1%	2,902	<0.1%	7,662	<0.1%
R9	0.8	1,161	0.1%	2,902	<0.1%	7,662	<0.1%
R11	1.3	1,161	0.1%	2,902	<0.1%	7,662	<0.1%
R12	1.0	1,161	0.1%	2,902	<0.1%	7,662	<0.1%

Table C.22: Predicted 10-min Maximum NO_2 Impacts at the Worst-case Residential and Footpath Receptor against the AEGLs

Receptor	Concentration (µg/m^3)	AEGL1	% of AEGL1	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	3.15	988	0.3%	39,530	<0.1%	67,200	<0.1%
R2	1.47	988	0.1%	39,530	<0.1%	67,200	<0.1%
R3	1.95	988	0.2%	39,530	<0.1%	67,200	<0.1%
R4	1.73	988	0.2%	39,530	<0.1%	67,200	<0.1%
R6	1.00	988	0.1%	39,530	<0.1%	67,200	<0.1%

R7	1.84	988	0.2%	39,530	<0.1%	67,200	<0.1%
R8	1.29	988	0.1%	39,530	<0.1%	67,200	<0.1%
R9	1.17	988	0.1%	39,530	<0.1%	67,200	<0.1%
R11	1.44	988	0.1%	39,530	<0.1%	67,200	<0.1%
R12	1.20	988	0.1%	39,530	<0.1%	67,200	<0.1%
FR4	23.53	988	2.4%	39,530	0.1%	67,200	<0.1%

Table C.23: Predicted 30-min Maximum NO_2 Impacts at the Worst-case Residential and Footpath Receptor against the AEGLs

Receptor	Concentration (µg/m^3)	AEGL1	% of AEGL1	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	2.2	988	0.2%	29,647	<0.1%	49,412	<0.1%
R2	1.0	988	0.1%	29,647	<0.1%	49,412	<0.1%
R3	1.3	988	0.1%	29,647	<0.1%	49,412	<0.1%
R4	1.2	988	0.1%	29,647	<0.1%	49,412	<0.1%
R6	0.7	988	0.1%	29,647	<0.1%	49,412	<0.1%
R7	1.2	988	0.1%	29,647	<0.1%	49,412	<0.1%
R8	0.9	988	0.1%	29,647	<0.1%	49,412	<0.1%
R9	0.8	988	0.1%	29,647	<0.1%	49,412	<0.1%
R11	1.0	988	0.1%	29,647	<0.1%	49,412	<0.1%
R12	0.8	988	0.1%	29,647	<0.1%	49,412	<0.1%
FR4	14.5	988	1.5%	29,647	<0.1%	49,412	<0.1%

Table C.24: Predicted 60-min Maximum NO_2 Impacts at the Worst-case Residential and Footpath Receptor against the AEGLs

Receptor	Concentration (µg/m^3)	AEGL1	% of AEGL1	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	1.6	988	0.2%	23,718	<0.1%	39,530	<0.1%
R2	0.7	988	0.1%	23,718	<0.1%	39,530	<0.1%
R3	1.0	988	0.1%	23,718	<0.1%	39,530	<0.1%
R4	0.9	988	0.1%	23,718	<0.1%	39,530	<0.1%
R6	0.5	988	0.0%	23,718	<0.1%	39,530	<0.1%

R7	0.9	988	0.1%	23,718	<0.1%	39,530	<0.1%
R8	0.6	988	0.1%	23,718	<0.1%	39,530	<0.1%
R9	0.6	988	0.1%	23,718	<0.1%	39,530	<0.1%
R11	0.7	988	0.1%	23,718	<0.1%	39,530	<0.1%
R12	0.6	988	0.1%	23,718	<0.1%	39,530	<0.1%
FR4	5.1	988	0.5%	23,718	<0.1%	39,530	<0.1%

Table C.25: Predicted 4-hour Maximum NO_2 Impacts at the Worst-case Residential Receptor against the AEGLs

Receptor	Concentration (µg/m^3)	AEGL1	% of AEGL1	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	1.3	988	0.1%	16,207	<0.1%	27,671	<0.1%
R2	0.5	988	<0.1%	16,207	<0.1%	27,671	<0.1%
R3	0.8	988	0.1%	16,207	<0.1%	27,671	<0.1%
R4	0.7	988	0.1%	16,207	<0.1%	27,671	<0.1%
R6	0.3	988	<0.1%	16,207	<0.1%	27,671	<0.1%
R7	0.7	988	0.1%	16,207	<0.1%	27,671	<0.1%
R8	0.4	988	<0.1%	16,207	<0.1%	27,671	<0.1%
R9	0.4	988	<0.1%	16,207	<0.1%	27,671	<0.1%
R11	0.5	988	0.1%	16,207	<0.1%	27,671	<0.1%
R12	0.4	988	<0.1%	16,207	<0.1%	27,671	<0.1%

Table C.26: Predicted 8-hour Maximum NO_2 Impacts at the Worst-case Residential Receptor against the AEGLs

Receptor	Concentration (µg/m^3)	AEGL1	% of AEGL1	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	1.0	988	0.1%	13,242	<0.1%	21,741	<0.1%
R2	0.4	988	<0.1%	13,242	<0.1%	21,741	<0.1%
R3	0.5	988	0.1%	13,242	<0.1%	21,741	<0.1%
R4	0.5	988	0.1%	13,242	<0.1%	21,741	<0.1%
R6	0.2	988	<0.1%	13,242	<0.1%	21,741	<0.1%
R7	0.4	988	<0.1%	13,242	<0.1%	21,741	<0.1%

R8	0.3	988	<0.1%	13,242	<0.1%	21,741	<0.1%
R9	0.3	988	<0.1%	13,242	<0.1%	21,741	<0.1%
R11	0.5	988	<0.1%	13,242	<0.1%	21,741	<0.1%
R12	0.3	988	<0.1%	13,242	<0.1%	21,741	<0.1%

Table C.27: Predicted 1-hr 99.7 Percentile NO_2 Impacts at the Worst-case Residential and Footpath Receptors against the UK AQS

Receptor	Concentration (µg/m^3)	AQS	% of AQS
R1	1.4	200	0.7%
R2	0.5	200	0.3%
R3	0.8	200	0.4%
R4	0.8	200	0.4%
R6	0.3	200	0.2%
R7	0.7	200	0.4%
R8	0.5	200	0.2%
R9	0.4	200	0.2%
R11	0.7	200	0.3%
R12	0.5	200	0.2%
FR4	4.8	200	2.4%

Table C.28: Predicted Annual Average NO_2 Impacts at the Worst-case Residential Receptors against the UK AQS

Receptor	Concentration (µg/m^3)	AQS	% of AQS
R1	<0.01	40	<0.1%
R2	<0.01	40	<0.1%
R3	<0.01	40	<0.1%
R4	<0.01	40	<0.1%
R6	<0.01	40	<0.1%
R7	<0.01	40	<0.1%
R8	<0.01	40	<0.1%
R9	<0.01	40	<0.1%

R11	<0.01	40	<0.1%
R12	<0.01	40	<0.1%

Table C.29: Predicted Annual Average PM_{10} Impacts at the Worst-case Residential Receptors against the UK AQS

Receptor	**Concentration ($\mu g/m^3$)**	**AQS**	**% of AQS**
R1	0.260	40	0.7%
R2	0.055	40	0.1%
R3	0.126	40	0.3%
R4	0.137	40	0.3%
R6	0.036	40	0.1%
R7	0.094	40	0.2%
R8	0.055	40	0.1%
R9	0.044	40	0.1%
R11	0.115	40	0.3%
R12	0.095	40	0.2%

Table C.30: Predicted Annual Average $PM_{2.5}$ Impacts at the Worst-case Residential Receptors against the UK AQS

Receptor	**Concentration ($\mu g/m^3$)**	**AQS**	**PC % of AQS**
R1	0.260/6.6**	20/10*	1.3/2.6
R2	0.055	20/10*	0.3/0.6
R3	0.126	20/10*	0.6/1.3
R4	0.137	20/10*	0.7/1.4
R6	0.036	20/10*	0.2/0.4
R7	0.094	20/10*	0.5/1.0
R8	0.055	20/10*	0.3/0.6
R9	0.044	20/10*	0.2/0.4

R11	0.115	20/10*	0.6/1.2
R12	0.095	20/10*	0.5/1.0

* The legally binding target to be achieved by 2040

** PC/PEC

Table C.31: Predicted 10-min Maximum 1,3-butadiene Impacts at the Worst-case Residential and Footpath Receptors against the AEGLs

Receptor	Concentration ($\mu g/m^3$)	AEGL1	% of AEGL1	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	109	1,556,798	<0.1%	15,567,978	<0.1%	62,736,627	<0.1%
R2	51	1,556,798	<0.1%	15,567,978	<0.1%	62,736,627	<0.1%
R3	67	1,556,798	<0.1%	15,567,978	<0.1%	62,736,627	<0.1%
R4	60	1,556,798	<0.1%	15,567,978	<0.1%	62,736,627	<0.1%
R6	34	1,556,798	<0.1%	15,567,978	<0.1%	62,736,627	<0.1%
R7	63	1,556,798	<0.1%	15,567,978	<0.1%	62,736,627	<0.1%
R8	45	1,556,798	<0.1%	15,567,978	<0.1%	62,736,627	<0.1%
R9	40	1,556,798	<0.1%	15,567,978	<0.1%	62,736,627	<0.1%
R11	50	1,556,798	<0.1%	15,567,978	<0.1%	62,736,627	<0.1%
R12	41	1,556,798	<0.1%	15,567,978	<0.1%	62,736,627	<0.1%
FR4	811	1,556,798	0.1%	15,567,978	<0.1%	62,736,627	<0.1%

Table C.32: Predicted 30-min Maximum 1,3-butadiene Impacts at the Worst-case Residential and Footpath Receptors against the AEGLs

Receptor	Concentration ($\mu g/m^3$)	AEGL1	% of AEGL1	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	74.2	1,556,798	<0.1%	15,567,978	<0.1%	62,736,627	<0.1%
R2	34.0	1,556,798	<0.1%	15,567,978	<0.1%	62,736,627	<0.1%
R3	45.6	1,556,798	<0.1%	15,567,978	<0.1%	62,736,627	<0.1%
R4	40.3	1,556,798	<0.1%	15,567,978	<0.1%	62,736,627	<0.1%
R6	22.5	1,556,798	<0.1%	15,567,978	<0.1%	62,736,627	<0.1%
R7	42.1	1,556,798	<0.1%	15,567,978	<0.1%	62,736,627	<0.1%
R8	29.4	1,556,798	<0.1%	15,567,978	<0.1%	62,736,627	<0.1%

R9	26.7	1,556,798	<0.1%	15,567,978	<0.1%	62,736,627	<0.1%
R11	33.1	1,556,798	<0.1%	15,567,978	<0.1%	62,736,627	<0.1%
R12	27.1	1,556,798	<0.1%	15,567,978	<0.1%	62,736,627	<0.1%
FR4	501	1,556,798	<0.1%	15,567,978	<0.1%	62,736,627	<0.1%

Table C.33: Predicted 60-min Maximum 1,3-butadiene Impacts at the Worst-case Residential and Footpath Receptors against the AEGLs

Receptor	Concentration ($\mu g/m^3$)	AEGL1	% of AEGL1	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	54.0	1,556,798	<0.1%	12,314,968	<0.1%	51,118,733	<0.1%
R2	24.9	1,556,798	<0.1%	12,314,968	<0.1%	51,118,733	<0.1%
R3	33.6	1,556,798	<0.1%	12,314,968	<0.1%	51,118,733	<0.1%
R4	29.5	1,556,798	<0.1%	12,314,968	<0.1%	51,118,733	<0.1%
R6	16.3	1,556,798	<0.1%	12,314,968	<0.1%	51,118,733	<0.1%
R7	30.9	1,556,798	<0.1%	12,314,968	<0.1%	51,118,733	<0.1%
R8	21.4	1,556,798	<0.1%	12,314,968	<0.1%	51,118,733	<0.1%
R9	19.4	1,556,798	<0.1%	12,314,968	<0.1%	51,118,733	<0.1%
R11	24.1	1,556,798	<0.1%	12,34,968	<0.1%	51,118,733	<0.1%
R12	19.6	1,556,798	<0.1%	12,314,968	<0.1%	51,118,733	<0.1%
FR4	176.5	1,556,798	<0.1%	12,314,968	<0.1%	51,118,733	<0.1%

Table C.34: Predicted 4-hour Maximum 1,3-butadiene Impacts at the Worst-case Residential Receptors against the AEGLs

Receptor	Concentration ($\mu g/m^3$)	AEGL1	% of AEGL1	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	44.0	1,556,798	<0.1%	7,900,168	<0.1%	32,530,103	<0.1%
R2	16.3	1,556,798	<0.1%	7,900,168	<0.1%	32,530,103	<0.1%
R3	25.9	1,556,798	<0.1%	7,900,168	<0.1%	32,530,103	<0.1%
R4	24.7	1,556,798	<0.1%	7,900,168	<0.1%	32,530,103	<0.1%
R6	10.8	1,556,798	<0.1%	7,900,168	<0.1%	32,530,103	<0.1%
R7	25.7	1,556,798	<0.1%	7,900,168	<0.1%	32,530,103	<0.1%
R8	15.2	1,556,798	<0.1%	7,900,168	<0.1%	32,530,103	<0.1%
R9	13.0	1,556,798	<0.1%	7,900,168	<0.1%	32,530,103	<0.1%

R11	18.5	1,556,798	<0.1%	7,900,168	<0.1%	32,530,103	<0.1%
R12	15.4	1,556,798	<0.1%	7,900,168	<0.1%	32,530,103	<0.1%

Table C.35: Predicted 8-hour Maximum 1,3-butadiene Impacts at the Worst-case Residential Receptors against the AEGLs

Receptor	Concentration (µg/m^3)	AEGL1	% of AEGL1	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	35.1	1,556,798	<0.1%	6,273,663	<0.1%	15,800,336	<0.1%
R2	12.4	1,556,798	<0.1%	6,273,663	<0.1%	15,800,336	<0.1%
R3	18.5	1,556,798	<0.1%	6,273,663	<0.1%	15,800,336	<0.1%
R4	17.1	1,556,798	<0.1%	6,273,663	<0.1%	15,800,336	<0.1%
R6	7.9	1,556,798	<0.1%	6,273,663	<0.1%	15,800,336	<0.1%
R7	14.0	1,556,798	<0.1%	6,273,663	<0.1%	15,800,336	<0.1%
R8	9.7	1,556,798	<0.1%	6,273,663	<0.1%	15,800,336	<0.1%
R9	10.1	1,556,798	<0.1%	6,273,663	<0.1%	15,800,336	<0.1%
R11	15.9	1,556,798	<0.1%	6,273,663	<0.1%	15,800,336	<0.1%
R12	12.0	1,556,798	<0.1%	6,273,663	<0.1%	15,800,336	<0.1%

Table C.36: Predicted Annual Average Maximum 1,3-butadiene Impacts at the Worst-case Residential Receptors against the UK AQS

Receptor	Concentration (µg/m^3)	AQS	% of AQS
R1	0.016	2.25	0.7%
R2	<0.01	2.25	0.2%
R3	<0.01	2.25	0.4%
R4	<0.01	2.25	0.4%
R6	<0.01	2.25	0.1%
R7	<0.01	2.25	0.3%
R8	<0.01	2.25	0.2%
R9	<0.01	2.25	0.1%
R11	<0.01	2.25	0.3%
R12	<0.01	2.25	0.3%

Table C.37: Predicted 10-min Maximum Benzene Impacts at the Worst-case Residential Receptor against the AEGLs

Receptor	Concentration ($\mu g/m^3$)	AEGL1	% of AEGL1	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	109	436,205	<0.1%	6,710,843	<0.1%	32,547,587	<0.1%
R2	51	436,205	<0.1%	6,710,843	<0.1%	32,547,587	<0.1%
R3	67	436,205	<0.1%	6,710,843	<0.1%	32,547,587	<0.1%
R4	60	436,205	<0.1%	6,710,843	<0.1%	32,547,587	<0.1%
R6	34	436,205	<0.1%	6,710,843	<0.1%	32,547,587	<0.1%
R7	63	436,205	<0.1%	6,710,843	<0.1%	32,547,587	<0.1%
R8	45	436,205	<0.1%	6,710,843	<0.1%	32,547,587	<0.1%
R9	40	436,205	<0.1%	6,710,843	<0.1%	32,547,587	<0.1%
R11	50	436,205	<0.1%	6,710,843	<0.1%	32,547,587	<0.1%
R12	41	436,205	<0.1%	6,710,843	<0.1%	32,547,587	<0.1%
FR4	811	436,205	0.2%	6,710,843	<0.1%	32,547,587	<0.1%

Table C.38: Predicted 30-min Maximum Benzene Impacts at the Worst-case Residential Receptor against the AEGLs

Receptor	Concentration ($\mu g/m^3$)	AEGL1	% of AEGL1	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	74.2	244,946	<0.1%	3,690,963	<0.1%	18,790,359	<0.1%
R2	34.0	244,946	<0.1%	3,690,963	<0.1%	18,790,359	<0.1%
R3	45.6	244,946	<0.1%	3,690,963	<0.1%	18,790,359	<0.1%
R4	40.3	244,946	<0.1%	3,690,963	<0.1%	18,790,359	<0.1%
R6	22.5	244,946	<0.1%	3,690,963	<0.1%	18,790,359	<0.1%
R7	42.1	244,946	<0.1%	3,690,963	<0.1%	18,790,359	<0.1%
R8	29.4	244,946	<0.1%	3,690,963	<0.1%	18,790,359	<0.1%
R9	26.7	244,946	<0.1%	3,690,963	<0.1%	18,790,359	<0.1%
R11	33.1	244,946	<0.1%	3,690,963	<0.1%	18,790,359	<0.1%
R12	27.1	244,946	<0.1%	3,690,963	<0.1%	18,790,359	<0.1%

FR4	501	244,946	0.2%	3,690,963	<0.1%	18,790,359	<0.1%

Table C.39: Predicted 60-min Maximum Benzene Impacts at the Worst-case Residential Receptor against the AEGLs

Receptor	Concentration ($\mu g/m^3$)	AEGL1	% of AEGL1	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	54.0	174,482	<0.1%	2,684,337	<0.1%	13,421,685	<0.1%
R2	24.9	174,482	<0.1%	2,684,337	<0.1%	13,421,685	<0.1%
R3	33.6	174,482	<0.1%	2,684,337	<0.1%	13,421,685	<0.1%
R4	29.5	174,482	<0.1%	2,684,337	<0.1%	13,421,685	<0.1%
R6	16.3	174,482	<0.1%	2,684,337	<0.1%	13,421,685	<0.1%
R7	30.9	174,482	<0.1%	2,684,337	<0.1%	13,421,685	<0.1%
R8	21.4	174,482	<0.1%	2,684,337	<0.1%	13,421,685	<0.1%
R9	19.4	174,482	<0.1%	2,684,337	<0.1%	13,421,685	<0.1%
R11	24.1	174,482	<0.1%	2,684,337	<0.1%	13,421,685	<0.1%
R12	19.6	174,482	<0.1%	2,684,337	<0.1%	13,421,685	<0.1%
FR4	176.5	174,482	0.1%	2,684,337	<0.1%	13,421,685	<0.1%

Table C.40: Predicted 4-hour Maximum Benzene Impacts at the Worst-case Residential Receptor against the AEGLs

Receptor	Concentration ($\mu g/m^3$)	AEGL1	% of AEGL1	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	44.0	60,398	0.1%	1,342,169	<0.1%	6,710,843	<0.1%
R2	16.3	60,398	<0.1%	1,342,169	<0.1%	6,710,843	<0.1%
R3	25.9	60,398	<0.1%	1,342,169	<0.1%	6,710,843	<0.1%
R4	24.7	60,398	<0.1%	1,342,169	<0.1%	6,710,843	<0.1%
R6	10.8	60,398	<0.1%	1,342,169	<0.1%	6,710,843	<0.1%
R7	25.7	60,398	<0.1%	1,342,169	<0.1%	6,710,843	<0.1%
R8	15.2	60,398	<0.1%	1,342,169	<0.1%	6,710,843	<0.1%
R9	13.0	60,398	<0.1%	1,342,169	<0.1%	6,710,843	<0.1%
R11	18.5	60,398	<0.1%	1,342,169	<0.1%	6,710,843	<0.1%

R12	15.4	60,398	<0.1%	1,342,169	<0.1%	6,710,843	<0.1%

Table C.41: Predicted 8-hour Maximum Benzene Impacts at the Worst-case Residential Receptor against the AEGLs

Receptor	Concentration ($\mu g/m^3$)	AEGL1	% of AEGL1	AEGL2	% of AEGL2	AEGL3	% of AEGL3
R1	35.1	30,199	0.1%	671,084	<0.1%	3,321,867	<0.1%
R2	12.4	30,199	<0.1%	671,084	<0.1%	3,321,867	<0.1%
R3	18.5	30,199	0.1%	671,084	<0.1%	3,321,867	<0.1%
R4	17.1	30,199	0.1%	671,084	<0.1%	3,321,867	<0.1%
R6	7.9	30,199	<0.1%	671,084	<0.1%	3,321,867	<0.1%
R7	14.0	30,199	<0.1%	671,084	<0.1%	3,321,867	<0.1%
R8	9.7	30,199	<0.1%	671,084	<0.1%	3,321,867	<0.1%
R9	10.1	30,199	<0.1%	671,084	<0.1%	3,321,867	<0.1%
R11	15.9	30,199	0.1%	671,084	<0.1%	3,321,867	<0.1%
R12	12.0	30,199	<0.1%	671,084	<0.1%	3,321,867	<0.1%

Table C.42: Predicted Annual Average Maximum Benzene Impacts at the Worst-case Residential Receptors against the UK AQS

Receptor	Concentration ($\mu g/m^3$)	AQS	% of AQS
R1	0.016	5	0.3%
R2	<0.01	5	0.1%
R3	<0.01	5	0.2%
R4	<0.01	5	0.2%
R6	<0.01	5	<0.1%
R7	<0.01	5	0.1%
R8	<0.01	5	0.1%
R9	<0.01	5	0.1%
R11	<0.01	5	0.1%
R12	<0.01	5	0.1%

Annex 2: LOPA

Impact Event Description	Severity Level	Ref	Initiating Cause	Initiation Likelihood	B0-Qualification	converter enclosure (physical protection) (metal box)	B20 - Temperature Monitoring	B14 (independent temp shutdown)	Internal screens and methods of work	IP rating of modules	System level fire resilience L:arge scale testing	B1 Breakers	B3 Converter Protection	B3 CID	B5 Shutdown	B9 Fire rating	B11 Fuses	B15 Mod Cool	Overall	B6 Fire Detection	B12 Gas Detection	B16 Module Propogation	B2 Cell Propogation	Likelihood Of HARM	SIF PFD	Mitigated Event Likelihood
				Frequency	Probability							Probability	Probability	Probability	Probability	Probability	Probability	Probability		Probability	Probabilit	Probabilit	Probabilit	Frequency	Probability	Frequency
				per year								1	2	3	4	5	6	7		5	6	7	8	per year		per year
	5		T1-Short-Cell	2.5E-04	0.25	1	1	1	1	1	1	1	1	0.1	1	1	0.1	1	6.2E-07	0.5	0.1	0.1	0.1	3.1E-10		
			T2-BMSFailure	5.0E-02	0.25	1	1	1	1	1	1	1	1	0.1	0.1	1	1	1	1.3E-04	0.5	0.1	0.1	0.1	6.3E-08		
			T3-Converter	1.0E-02	1	0.5	1	1	1	1	1	1	0.1	0.1	0.1	1	1	1	5.0E-06	0.5	0.1	0.1	0.1	2.5E-09		
			T4-Communication	5.0E-02	1	1	1	0.1	1	1	1	1	1	0.1	0.1	1	1	1	5.0E-05	0.5	0.1	0.1	0.1	2.5E-08		
			T5-HVACFailure	1.0E-01	1	1	0.1	0.1	1	1	1	1	1	0.1	0.1	1	1	1	1.0E-05	0.5	0.1	0.1	0.1	5.0E-09		
			T6-ExternalShort	1.0E-01	1	1	1	1	0.1	1	1	0.1	1	0.1	1	1	0.1	1	1.0E-05	0.5	0.1	0.1	0.1	5.0E-09		
			T8-WaterIngress	5.0E-02	1	1	1	1	1	0.1	1	0.1	1	0.1	0.1	1	0.1	1	5.0E-07	0.5	0.1	0.1	0.1	2.5E-10		
			T9-ExternalFire	1.0E-02	1	1	1	1	1	1	0.1	1	1	1	1	0.1	1	0.1	1.0E-05	0.5	0.1	0.1	0.1	5.0E-09		
			T10-FullModFail	1.0E-04	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0.0E+00	0.5	0.1	0.1	1	0.0E+00		
					.																			0.0E+00		
																								0.0E+00		
														Gas Released every years					**4737**	years				1.1E-07	9.5E+00	1.0E-06

	1632		3c groups
Target	1.7E-04		per year
	5804.60		years

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