ROYSTON SITE

ENVIRONMENTAL PERMIT VARIATION APPLICATION

Environmental Risk Assessment

Prepared for: **Johnson Matthey PLC**

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SLR

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CONTENTS

DOCUMENT REFERENCES

TABLES

FIGURES

APPENDICES

DRAWINGS

1.0 Introduction

SLR Consulting Ltd (SLR) has been instructed by Johnson Matthey PLC (JM) to prepare an application for a variation to the Environmental Permit (Ref: EPR/BT7086IJ) (the Permit) for their Royston Site located at Orchard Road, Royston, Hertfordshire, SG8 5HE (the Site).

1.1 Methodology

This Environmental Risk Assessment (ERA) has been prepared in support of the permit variation application and has been undertaken in accordance with the Environment Agency (EA) guidance *Risk assessments for your environmental permit*[1] (2016). The purpose of the assessment is to identify any significant risks that may affect receptors and demonstrate that the risk of pollution or harm will be acceptable by taking the appropriate measures to manage these risks.

This ERA uses the following approach, as set out in the EA's guidance, for identifying and assessing the risks from the proposed PFA processing facility:

Step One	Identify and consider risks for your Site and the sources of the risks;
Step Two	Identify the receptors at risk from the Site;
Step Three	Identify the possible pathways from the sources of the risks to the receptors;
Step Four	Assess the risks relevant to your specific activity and check they are acceptable and can be screened out;
Step Five	State what you will do to control risks if they are too high; and
Step Six	Submit your risk assessment as part of your application.

1.2 Proposed Changes to Site Operations

JM are developing a new hydrogen fuel cell manufacturing facility at the Royston Site as part of the company's pledge to invest ca. £1 billion in the research, development and deployment of clean hydrogen technologies by 2030. This will require a variation to the existing Permit to include the following changes:

1	Project Apollo	Production of coated membrane with Platinum Group Metals (PGM) (platinum). 2 Directly Associated Activities (DAA) – analytical laboratory and dispensing and packaging
2	Hydrogen Technology Test Facility	The installation of the Test Stand facility will include four Single Cell Test Stands for testing individual cells up to 0.5 kW output, and three larger Short Stack Test Stands for testing stacked cells up to 12 kW output.
3	Boiler Replacement	Replacement of the three existing Site boilers with new boilers with a similar but more efficient specification.

This ERA considers the risks to receptors associated with these specific changes.

[1] https://www.gov.uk/guidance/risk-assessments-for-your-environmental-permit accessed December 2020

2.0 Identifying the Risks

This section considers the potential risks to the environment listed in the EA's guidance to identify those which will apply to the proposed changes to site operations and which require further assessment, and to screen out those which are not relevant.

The EA Guidance identifies the potential risks that may require assessment for 'most sites' as follows:

- any discharge, for example sewage or trade effluent to surface or groundwater;
- accidents;
- odour (not for standalone water discharge and groundwater activities);
- noise and vibration (not for standalone water discharge and groundwater activities);
- uncontrolled or unintended ('fugitive') emissions, for which risks include dust, litter, pests and pollutants that should not be in the discharge;
- visible emissions, e.g. smoke or visible plumes; and
- release of bioaerosols, for example from shredding, screening and turning, or from stack or open point source release such as a biofilter.

In addition, the EA guidance identifies risks from specific activities for which additional risk assessments must be completed depending on the activity being carried out and where substances are released or discharged into the environment. The EA guidance *Risk assessment for installations, waste and mining waste operations and landfill sites* indicates that the following additional risk assessments may be required for this Site:

- risks of air emissions;
- the global warming impact of your air emissions;
- risks to groundwater; and
- risks to surface water from hazardous pollutants, sanitary and other pollutants.

Potential risks can be screened out if they are not relevant for the site or by carrying out tests to check whether they are within acceptable limits or environmental standards. If they are, any further assessment of the pollutant is not necessary because the risk to the environment is insignificant. Table 1 provides a summary of the risks for each of the 4 proposed changes described in section 1.2, identifying those that can be screened out as not relevant (grey shaded) and the type of risk assessment carried out for those that are identified as relevant.

Table 1 Scope of Risk Assessment

Risk Type	Relevant	Justification	Type of Risk Assessment
PROJECT APOLLO			
Air emissions	Yes	Release of combustion products from thermal oxidiser: CO, NOx & VOCs	Air Quality Detailed Dispersion Modelling and Impact Assessment. Photochemical ozone creation potential (POCP) assessment
Global Warming Impact	Yes	Direct releases of CO_2 from thermal oxidiser;	H1 assessment

Risk Type	Relevant	Justification	Type of Risk Assessment
		Direct and indirect releases from heat and power requirements (grid and on-site CHP).	
Groundwater	No	No direct or indirect releases to groundwater	Not required
Surface Water	No	JM have confirmed that there is no additional volume or pollution load in effluent release to sewer or off-site treatment as a result of the activity	Not required
Accidents	Yes	Potential for emissions from equipment failure etc.	Qualitative
Odour	Yes	Emissions to air of VOCs	Qualitative
Noise & Vibration	Yes	Use of mechanical equipment	Semi-quantitative
Fugitive emissions	Yes	Emissions to air of VOCs	Qualitative
Visible emissions	No	No visible plume	Not required
Bioaerosols	No	None emitted	Not required
Hydrogen Technology Test Facility			
Air emissions	No	Small amounts of hydrogen, oxygen and nitrogen only. It is considered that any impacts will be negligible.	Not required
Global Warming Impact	Yes	Direct release of small amounts of Hydrogen. Indirect releases from energy supply.	Quantitative
Groundwater	No	No direct or indirect releases to groundwater	Not required
Surface Water	No	Small quantity of condensate discharge is routed to the site drainage and treated in the site effluent plant, but this does not contain any potentially polluting substances.	Not required
Accidents	Yes	Potential for emissions from equipment failure etc.	Qualitative
Odour	No	No odorous materials are used or produced by the facility	Not required
Noise & Vibration	Yes	Use of mechanical equipment	Semi-quantitative
Fugitive emissions	No	No significant releases of fugitive emissions are anticipated	Not required
Visible emissions	No	No visible plume	Not required
Bioaerosols	No	None emitted	Not required

Risk Type	Relevant	Justification	Type of Risk Assessment
Boiler Replacement			
Air emissions	Yes	Emissions from combustion of natural gas: CO, NOx	Detailed Dispersion Modelling and Impact Assessment POCP assessment
Global Warming Impact	Yes	Direct releases of CO_2.	H1 assessment
Groundwater	No	No direct or indirect releases to groundwater	Not required
Surface Water	No	JM have confirmed that there is no additional volume or pollution load in effluent released to sewer or treated off-site as a result of the activity	Not required
Accidents	No	The boilers are a direct replacement of existing units. They use the same fuel but are a more efficient specification. It is considered that there will be no change to existing accident risks as a result of their installation and therefore a risk assessment is not required.	Not required
Odour	No	No odorous feedstocks or emissions	Not required
Noise & Vibration	No	The boilers are a direct replacement of existing units. They use the same fuel but are a more efficient specification. It is considered that there will be no change to existing noise and vibration risks as a result of their installation and therefore a risk assessment is not required.	Not required
Fugitive emissions	No	The boilers are a direct replacement of existing units. They use the same fuel but are a more efficient specification. It is considered that there will be no change to existing fugitive emission risks as a result of their installation and therefore a risk assessment is not required.	Not required
Visible emissions	No	No visible plume	Not required
Bioaerosols	No	None emitted	Not required

3.0 Site Setting and Receptors

This section identifies the potentially sensitive receptors in the vicinity of the Site that could be harmed (at potentially significant risk) by emissions from the activities within the proposed PFA processing facility.

The guidance[1] requires all receptors that are near the Site and could reasonably be affected by the proposed activities to be identified and considered as part of the ERA. The following distances have been used to identify the relevant receptors:

- a 2km radius for SSSIs and other sites of cultural and ecological; and
- a radius of 500m from the proposed permit boundary has been adopted for all other potentially sensitive receptors (for example, residential, commercial, industrial, agricultural and surface water receptors).

3.1 Site Setting

The site is centred on National Grid Reference TL 34824 41498 and located in the north-western part of Royston, between the town centre and the A505 Royston bypass. The site lies within the Orchard Road Industrial Estate. A number of residential, commercial and agricultural receptors are located in close proximity to the site. In addition, two SSSIs and several other conservation sites lie within 2km of the site boundary.

A summary of the immediate surrounding land use is provided in Table 2.

Table 2 Surrounding Land Uses

Boundary	Description
North	Local transport network (including the A505), commercial premises beyond which lies a ditch, a solar farm and agricultural land.
East	Commercial premises, residential properties and recreational facilities.
South	Local transport network, industrial and commercial premises, a railway line, beyond which lies residential premises, an educational facility and a recreational area.
West	Industrial and commercial premises, local transport network (A505) and agricultural land.

The surrounding land uses and receptors within 500m are identified on Drawing 003 Environmental Site Setting Plan. Cultural and Natural Heritage receptors and European designated sites within 2km are identified on Drawing 004 Cultural and Natural Heritage Receptors.

The immediate surrounding land use is described in detail below.

3.1.1 Commercial and Industrial

Commercial and industrial premises lie in all directions of the site's permit boundary. The closest of which lie adjacent to the west and 10m north, east and south of the permit boundary.

3.1.2 Local Transport Network

York Way and Orchard Road lie adjacent to the north and south of the permit boundary respectively. Additionally, the A505 lies approximately 100m north and 245m west of the permit boundary.

A railway line lies approximately 230m south of the permit boundary.

3.1.3 Open ground / Agricultural

Agricultural land lies approximately 160m north and 390m west of the permit boundary.

3.1.4 Residential

Residential properties as part of the wider Royston area lie approximately 40m east and 240m south of the permit boundary.

3.1.5 Solar Farm

Bassingbourn Solar Farm lies approximately 290m north of the permit boundary.

3.1.6 Educational

The Tannery Drift First School lies approximately 445m south of the permit boundary.

3.1.7 Recreational

Royston Bowling Club lies approximately 260m south of the permit boundary. A playground lies approximately 85m east of the permit boundary.

3.1.8 Surface Water Features

A ditch lies approximately 130m north of the permit boundary.

3.1.9 Geology, Hydrogeology and Hydrology

Geology

A review of the British Geological Survey (BGS) map[2] reveals that the site is underlain by bedrock of Holywell Nodular Chalk Formation, comprising of chalk which formed between 100.5 and 89.8 million years ago during the Cretaceous period.

Hydrogeology

Multi Agency Geographical Information for the Countryside (MAGIC)[3] Map identifies the bedrock at the site as a Principal Aquifer, which is defined as:

> *"layers of rock or drift deposits that have high intergranular and/or fracture permeability, meaning they usually provide high level of water storage and transmission. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifers."*

The site is not underlain by superficial aquifer.

The site lies within Source Protection Zone (SPZ) III.

Hydrology

The site lies in an area of high soluble rock risk ground water vulnerability.

[2] British Geological Survey, Available at www.bgs.ac.uk, accessed in September 2022
[3] Multi Agency Geographical Information for the Countryside Map (MAGIC), available at https://magic.defra.gov.uk/MagicMap.aspx, accessed in September 2022

Flooding

The site lies in Flood Zone 1[4], defined as an area with low probability of flooding.

3.1.10 Ecology

European/Internationally Designated Sites

A search of MAGIC Map identified that there are two Sites of Special Scientific Interest (SSSI) within the 2km of the site boundary:

- Therfield Heath (SSSI) lies approximately 665m southwest; and
- Holland Hall (Melbourn) Railway Cutting lies approximately 1415m east of the permit boundary.

Other Designated Sites

Searches on MAGIC confirmed there are none of the following within 2km of the permit boundary:

- Special Areas of Conservation;
- Special Protection Areas; or
- RAMSAR.

Nationally/Locally Designated Sites

A review of MAGIC Map identified Therfield Heath Local Nature Reserve lies approximately 665m southwest.

Searches on MAGIC confirmed there are none of the following within 2km of the permit boundary:

- Areas of Outstanding Natural Beauty (AONB);
- National Nature Reserves (NNR);
- National Parks;
- RSPB Reserves;
- Ancient Woodland; or
- Biosphere Reserves.

A review of the Nature and Heritage Conservation screening (Appendix 01) report confirmed that six Local Wildlife Sites (LWS) lie within 2km of the site boundary:

- Therfield, south of Tumulus;
- Royston Chalk Pit;
- Shaftesbury Green;
- Green Lane S. of Royston;
- Therfield Green Lane; and
- Icknield Way, A505 North of Gallows Hill.

[4] Flood Map for Planning, available at https://flood-map-for-planning.service.gov.uk/, accessed in September 2022

Cultural Heritage

A review of MAGIC Map confirmed that all listed buildings lie to the east and southeast of the permit boundary. The closet of which is Number 2 and 4, including front railings a Grade II listed building, which lies approximately 390m east. The closest Grade I listed building 23, Kneesworth Street lies approximately 770m southeast and the closest Grade II* listed building, 17-21, Kneesworth Street lies approximately 790m southeast of the permit boundary.

A review of MAGIC Map confirmed that 16 Scheduled Monuments lie within 2km of the permit boundary, the closest of which, Sites revealed by air photography lies 875m northwest of the permit boundary.

Searches on MAGIC Map confirmed there are none of the following within 2km of the EP boundary:

- Registered Parks and Gardens; or
- Registered Battlefields;

3.1.11 Identified Receptors

Local receptors within 500m of the Site are recorded in Table 3, along with natural and cultural receptors within 2km.

Table 3 Receptors

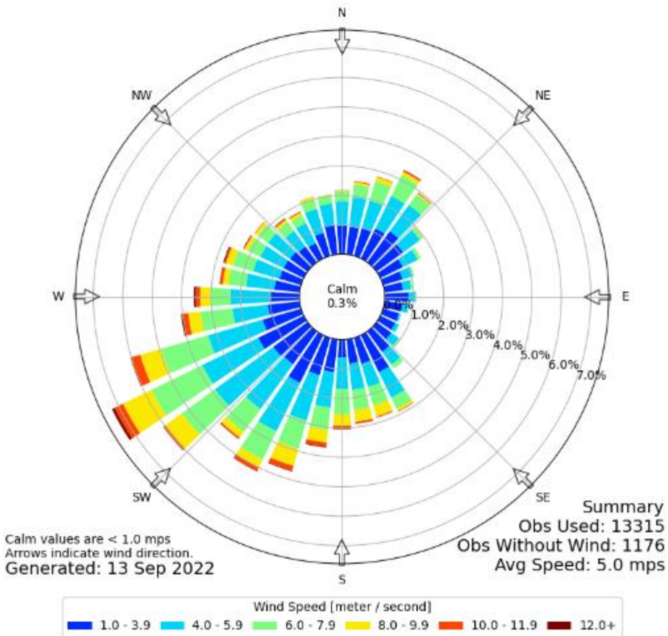
Receptor Name	Receptor Type	Direction from Site	Approximate Distance from Site Boundary (at nearest point) (m)
Local receptors within 500m of the Environmental Permit Boundary as shown on Drawing 003 Environmental Site Setting			
Orchard Road Industrial Estate	Commercial and industrial	West	Adjacent
York Way	Local Transport Network	North	Adjacent
Orchard Road	Local Transport Network	South	Adjacent
Orchard Road Industrial Estate	Commercial and industrial	North, east and south	10
Residential	Residential	East	40
Playground	Recreational	East	85
A505	Local Transport Network	North/West	100/245
Ditch	Surface Water Features	North	130
Agricultural Land	Agricultural Land	North	160
Railway Line	Local Transport Network	South	230
Residential	Residential	South	240
Royston Bowling Club	Recreational	South	260
Bassingbourn Solar Farm	Solar Farm	North	290
Agricultural Land	Agricultural Land	West	390
Tannery Drift First School	Educational	South	445

Receptor Name	Receptor Type	Direction from Site	Approximate Distance from Site Boundary (at nearest point) (m)
Cultural and ecological receptors within 2km of the EP boundary as shown in Drawing 004 Cultural and Natural Heritage.			
Number 2 and 4, including front railings	Listed Buildings (Grade II)	East	390
Therfield Heath	Sites of Special Scientific Interest	Southwest	665
Therfield Heath	Local Nature Reserve	Southwest	665
23, Kneesworth Street	Listed Building (Grade I)	Southeast	770
17-21, Kneesworth Street	Listed Building (Grade II*)	Southeast	790
Sites revealed by air photography	Scheduled Monument	Northwest	875
Holland Hall (Melbourn) Railway Cutting	Sites of Special Scientific Interest	East	1415

3.2 Windrose

A wind rose from Cambridge Meteorological Station, located approximately 21km northeast, providing the frequency of wind speed and direction from 2018 - 2022 is presented in Figure 3-1 below. The wind rose shows that winds from the southwest are most frequent. Winds from the north, east and south are less frequent.

Figure 3-1
Cambridge Meteorological Station, 2018 - 2022



4.0 Environmental Risk Assessment

This section considers the potential pathways between source and receptor and where appropriate, the assessment demonstrates how the risk of pollution or harm can be mitigated by measures to manage these risks and/or block the pathways. An assessment in terms of hazards posed, receptors and pathways, along with management and residual risks for the following hazards is presented for each of the four proposed changes to the activities, in accordance with the risks identified in Table 1 of this report.

4.1 Apollo

The following impacts have been identified as requiring assessment for the Apollo activity (see Table 1):

- Air emissions
- Global Warming Impact
- Accidents
- Odour
- Noise & Vibration
- Fugitive Emissions

4.1.1 Air Emissions

Emissions to air from the Apollo activity include carbon monoxide, nitrogen oxides and VOCs which have potential impacts on air quality and photochemical ozone creation potential.

Air Quality Impacts

The emissions from the proposed Apollo activity have been included in a detailed dispersion modelling and Air Emissions Risk Assessment, in combination with the existing releases from the installation and the other changes proposed in this variation. An assessment against air quality standards for the protection of human health was carried out for all offsite locations. For nearby designated conservation areas, assessment against critical levels for the protection of vegetation and ecosystems and critical loads for nitrogen and acid deposition was carried out. The AERA is presented in Appendix 02 to this report.

Photochemical Ozone Creation Potential

Emissions of nitrogen oxides, carbon monoxide and VOCs from the Apollo process have a photochemical ozone creation potential. This is summarised in Table 4:

Table 4 POCP for emissions from the Apollo Process

Source	Emission	Annual mass (tonnes)	POCP[5]	POCP
RTO	Ethanol	<2.1	39.9	83
RTO	Propanol	<2.1	56.1	117.81
RTO	Acetaldehyde (ethanal)	<2.1	64.1	134.61
RTO	Nitrogen Dioxide	<50	2.8	14.70

[5] *H1 Annex F – Air Emissions: Appendix A - Photochemical Ozone Creation Potential*

Source	Emission	Annual mass (tonnes)	POCP[5]	POCP
RTO	Carbon Monoxide	<50	2.7	14.18

The annual mass of emissions from the Apollo process that contribute to photochemical ozone creation potential are relatively small and are therefore not considered significant. Furthermore, the POCP value for each of the substances are all at the lower end of the POCP scale, which ranges up to 138). The overall POCP for the Apollo Process is 364.30 per year.

4.1.2 Global Warming Impact

The Apollo process results in direct releases of CO_2 from the RTO as well as indirect releases from energy used for the process. The Global Warming Potential is summarised in Table 5:

Table 5 Global Warming Potential of Apollo Project

Source	Rating	Estimated annual Energy Consumption[a]	Conversion factor (2022)	Tonnes CO2e
Natural gas (RTO)	60 Nm^3/h	522,720Nm^3	2.017	1,054
Electricity (total)	1,965 kW	17,119,080kWh	0.19338	3,310

[a] based on 24 hour operation 363 days per annum

The Apollo process includes multiple measures to manage energy efficiency and hence reduce the impact on global warming potential, a summary is set out below:

- The RTO will include the following energy saving measures:
  - Optimised burner type to allow for maximum efficiency.
  - Heat exchange media shall be optimised for maximum heat capacity and lowest pressure drop.
  - High efficiency motors.
  - Using inverters where appropriate to reduce energy consumption.
  - Steam condensate recovery from air handling units.
- The membrane and cathode coating lines have been designed to optimise material flow which will reduce energy consumption due to the unnecessary movement of materials in process. This will also minimise wasted heat due to inefficiencies in design.
- All processes with heating (electrical, steam or natural gas) will have temperature monitoring and be programmable logic controlled to ensure optimised operations with respect to the use of energy and raw materials.
- Low energy lighting and use of natural light wherever possible.
- Automated processes.
- The building has been designed with energy efficiency in mind and meets all building regulations.

4.1.3 Accident Risk Assessment

The potential consequences from accidents and mitigation of risks is provided in Table 6. It is considered that the mitigation measures proposed for the new activity will mean that the risk of impacts form accidents on receptors will be low.

Table 6 Accident Risk Assessment

What do you do that can harm and what could be harmed			Managing the Risk	Assessing the Risk		
Hazard	**Receptor**	**Pathway**	**Risk management**	**Probability of exposure**	**Consequence**	**What is the overall risk**
What has the potential to cause harm?	What is at risk what do I wish to protect?	How can the hazard get to the receptor?	What measures will you take to reduce the risk? – Who is responsible for what?	How likely is this contact?	What is the harm that can be caused?	What is the risk that still remains? The balance of probability and consequence
Spillage of materials or loss of containment (liquids)	Surface Water; Commercial, residential and ecological receptors.	Release to sewer; Air	UN approved containers used. Site Traffic management plan including trained FLT operatives. Impermeable surfacing and sealed surface drains discharge to site effluent treatment plant for treatment before release to sewer Spill kits deployed around site All processing takes place under cover or within buildings. Secondary containment / bunding Internal and external bunds are routinely maintained, all bunds are under a condition monitoring schedule.	Low	Nuisance/ contamination	**Low**
Airborne dust from spillage of materials (solids)	Commercial, residential and ecological receptors.	Air	Reagents used in liquid solutions where possible and are pumped into vessels from UN approved containers. LEV containment used for materials handling. Use of plastic liners for bagging in and out material. All processing takes place under cover or within buildings. Building HVAC system designed to minimise exposure in event of spill.	Low	Nuisance/ contamination	**Low**
Abatement or control failure – releases to air & site drainage	Surface Water; Commercial, residential and ecological receptors.	Release to sewer; Air	All equipment will be subject to pre-planned preventative maintenance checks and maintained in accordance with manufacturer's recommendations. Key abatement parameters will be continuously monitored and if any measurements are out of range this will cause a process alarm within the Programmable Logic Controller (PLC). Operators will be trained to deal with these. A Planned Preventative Maintenance (PPM) system will be in place to			

What do you do that can harm and what could be harmed			Managing the Risk	Assessing the Risk		
Hazard	**Receptor**	**Pathway**	**Risk management**	**Probability of exposure**	**Consequence**	**What is the overall risk**
What has the potential to cause harm?	What is at risk what do I wish to protect?	How can the hazard get to the receptor?	What measures will you take to reduce the risk? – Who is responsible for what?	How likely is this contact?	What is the harm that can be caused?	What is the risk that still remains? The balance of probability and consequence
			reduce the likelihood of a mechanical failure, the abatement plant will be part of this PPM schedule. All vessels have continuous level and high level detectors which will alarm, if out of safe working parameters. The whole building is also bunded in line with R&CE bund specification, with segregation of incompatible materials, and will hold all vessel spills. Operating procedures and training in place for failure modes.			
Fire – emissions to air and run-off of fire-water	Surface water (vis sewer), commercial, residential and ecological receptors	Surface and groundwater, air and land.	Fire protection measures and procedures will be followed On site fire team Sealed drainage system with isolation from sewer	Medium	Nuisance/ contamination	**Low**
Security and vandalism – unplanned release	Surface water (vis sewer), commercial, residential and ecological receptors	Surface and groundwater, air and land.	JM Royston is a highly secure site where staff are required to go through security clearance before being allowed to work. The site is covered by an external security fence and there is no access available from the public. The site is supervised at night in addition to the security cameras present throughout.	Low	Nuisance / contamination	**Low**

4.1.4 Odour

Odour may arise from the use of raw materials, intermediates and emissions from the process. A qualitative assessment of accident risk is provided in Table 7 which assesses the probability of exposure in terms of the likelihood of the receptors being exposed to the hazard.

The assessment concludes that it is not anticipated that the new Apollo plant will emit any odours at concentrations likely to cause concern to members of the public, due to the location of the plant in the centre of site and the mitigation measures in place.

Table 7 Odour Risk Assessment

What do you do that can harm and what could be harmed			Managing the Risk	Assessing the Risk		
Hazard	**Receptor**	**Pathway**	**Risk management**	**Probability of exposure**	**Consequence**	**What is the overall risk**
What has the potential to cause harm?	What is at risk what do I wish to protect?	How can the hazard get to the receptor?	What measures will you take to reduce the risk? – Who is responsible for what?	How likely is this contact?	What is the harm that can be caused?	What is the risk that still remains? The balance of probability and consequence
Odorous raw materials and emissions	Potentially sensitive receptors as listed in Table 2 and detailed on Drawing 003, including commercial/industrial properties and residential properties.	Fugitive and point source releases to air	It is not expected that the activities on site will give rise to significant levels of odour, due to the types of raw materials and processes used to abate emissions. Solvents used in the process, ethanol and propanol are only slightly odorous. Emissions of gaseous pollutants are not strongly odorous. The following odour mitigation measures will be in place: • The Apollo plant is located in a building within the centre of the installation which reduces the risk of odour detection by receptors. • To prevent the release of any odours, all process vessels will be suitably draughted and ducted to the RTO. • Any other potentially odorous raw materials will not be stored within the building unless appropriate extraction to the RTO and bunding facilities are in place. • In the event of suspected odour issues from Apollo these will be investigated and reported in accordance with R&CE accident and indecent investigation and reporting procedures.	Low	Nuisance	**Low**

4.1.5 Noise & Vibration

The site carries out noise monitoring every two years and will continue to report this to the EA as part of the existing permit requirement. The noise survey carried out in October 2020 concluded that as JM operates 24 hours a day, 7 days a week, therefore the noise from the site is therefore almost constant, although there will be some small fluctuation in level as individual noise sources are turned on and off. Many of the main noise sources on site are shielded from the surrounding area by acoustic screens and/or other buildings, so the noisiest sources may not necessarily be audible at the boundary.

Potential sources of noise that may impact the site boundary from Project Apollo are listed below:

- Pumps (both located inside CSF2 building and external)
- RTO : process fan, combustion fan, furnace & Stack (External)
- Chiller (external)

These elements will be designed to ensure no increase of noise will be detectable at the installation boundary. All fans will be fitted with anti-vibration mounts.

A noise impact assessment has also been completed for the combined changes and is presented in Appendix 03 of this report.

4.1.6 Fugitive Emissions

Uncontrolled or unintended emissions may arise from the processing, storage and handling of materials at the site. The EA's guidance states that these may include dust, litter, pests and pollutants that should not be in the discharge.

A qualitative assessment of accident risk is provided in Table 8 which assesses the probability of exposure in terms of the likelihood of the receptors being exposed to the hazard.

Table 8 Uncontrolled or unintended emissions Risk Assessment

What do you do that can harm and what could be harmed			Managing the Risk	Assessing the Risk		
Hazard	**Receptor**	**Pathway**	**Risk management**	**Probability of exposure**	**Consequence**	**What is the overall risk**
What has the potential to cause harm?	What is at risk what do I wish to protect?	How can the hazard get to the receptor?	What measures will you take to reduce the risk? – Who is responsible for what?	How likely is this contact?	What is the harm that can be caused?	What is the risk that still remains? The balance of probability and consequence
Pests	Adjacent commercial/industrial properties, residential properties and open ground.	Land, Water, Air	No materials are used in, or produced by, the proposed activity which would be expected to attract pests. The site will be inspected daily to ensure that pests are not present on site. In the event that pests are found, an investigation will be undertaken to locate the problematic waste. The problematic material will be isolated and removed from site to a suitably licenced facility. In the unlikely event that birds, vermin or pests are identified on site, a specialist pest control contractor will be employed to undertake measures to remove the animals from the Site.	Negligible	Nuisance	Negligible
Litter from packaging	Adjacent commercial/industrial properties, residential properties and open ground.	Land, Air	No materials are used in, or produced by, the proposed activity which would be expected to generate litter. The proposed activities take place within enclosed building.	Negligible	Nuisance	Negligible
Dust from raw materials, processing and products	Adjacent commercial/industrial properties, residential properties and open ground.	Air	No dusty materials are used in the proposed process. The activities take place in an enclosed building.	Low	Nuisance	Low

What do you do that can harm and what could be harmed			Managing the Risk	Assessing the Risk		
Hazard	**Receptor**	**Pathway**	**Risk management**	**Probability of exposure**	**Consequence**	**What is the overall risk**
What has the potential to cause harm?	What is at risk what do I wish to protect?	How can the hazard get to the receptor?	What measures will you take to reduce the risk? – Who is responsible for what?	How likely is this contact?	What is the harm that can be caused?	What is the risk that still remains? The balance of probability and consequence
Fugitive emissions from the process	Adjacent commercial/industrial properties, residential properties and open ground.	Air	Foreseeable sources of fugitive emissions have been identified and will be suitably draughted and ducted to the RTO. JM have designed the plant and storage vessels to minimise fugitive emissions from the plant. All vessels which may give rise to fugitive emissions are attached to a suitable draught system including their own vent systems.	Low	Nuisance	Low
Runoff from process buildings and site surfaces	Adjacent commercial/industrial properties, residential properties and open ground.	Land, Surface Water	The site benefits from an impermeable surface and sealed drainage such that run-off will be capture in the site drainage system. The activities take place within a central location of the site such that run-off is unlikely to leave the site boundary. The site surface and drainage system will be regularly inspected to ensure it is in good condition. Any weaknesses will be repaired immediately using temporary solutions and with permanent measures implemented as soon as practicable. All liquids and hazardous materials will be stored in secure, fit for purpose, containment located on impermeable surfacing within bunded areas. The bunds will be capable of containing at least 110% of the volume of the largest container within the bund or 25% of the total tank volume within the bund, whichever is the greater. Any rainwater within the bunds will be pumped through an oil interceptor to drain.	Low	Nuisance	Low

4.2 Hydrogen Technology Test Facility

The following impacts have been identified as requiring assessment for the Hydrogen Technology Test facility (HTTF) (see Table 1):

- Global Warming Impact
- Accidents
- Noise & Vibration

4.2.1 Global Warming Impact

The HTTF results in very minor releases of Hydrogen from one of the three relief vent stacks (stack 3) which indirectly contributes to global warming potential, this has not been considered further. There will be an increase in electricity demand from the HTTF, however, this will replace some of the energy demand for Clean Air operations in CSF2 building which will be stopped. The Global Warming Potential is summarised in Table 9.

Table 9 Global Warming Impact of HTTF

Source	Rating	Estimated annual Energy Consumption	Conversion factor (2022)	Tonnes CO2e
Electricity	336kW (ave)	2,795,842	0.19338	541

4.2.2 Accidents

The HTTF process is not anticipated to increase the likelihood or consequence of accidents significantly due to the limited scale of the operation and low potential for emissions.

In summary, the following safety controls will be implemented to provide additional safeguards to prevent accidents:

- A H_2 detector (CE-ATEX/UL/CSA rated)
- Safe shut down procedures including E-stops, Safe Purge and inerting system upon any E-stop/alarm.

4.2.3 Noise & Vibration

Whilst the addition of the new process will include equipment which has the potential to generate noise, this is not expected to be significant in relation to the site as a whole due to the following factors:

- The limited scale of the operation;
- Selection of low-noise specification for the HTTF; and
- The HTTF is operated within a building with no external noise-emitting equipment.

4.3 Replacement Boilers

The following impacts have been identified as requiring assessment for the new boilers (see Table 1):

- Air emissions
- Global Warming Impact

4.3.1 Air Emissions

The emissions will include CO and NOx which will have potential impacts on air quality and for photochemical ozone creation potential.

Air Quality Impacts

The emissions from the proposed new boilers have been included in a detailed dispersion modelling and Air Emissions Risk Assessment, in combination with the existing releases from the installation and the other changes proposed in this variation. An assessment against air quality standards for the protection of human health was carried out for all offsite locations. For nearby designated conservation areas, assessment against critical levels for the protection of vegetation and ecosystems and critical loads for nitrogen and acid deposition was carried out. The AERA is presented in Appendix 02 to this report.

Photochemical Ozone Creation Potential

Emissions of nitrogen oxides and carbon monoxide from the replacement boilers have a photochemical ozone creation potential. An assessment of this is provided in Table 10 based on the following data:

- NOx emissions of 0.0444 g/s and gas flow rate of 0.71m/s[6] from each of the three boilers = 4.2 tonnes per annum total boiler emissions; and
- CO emissions of 1ppm[7] and gas flow rate of 0.71m/s from each of the three boilers = 0.132 tonnes per annum total boiler emissions.

Table 10 Photochemical Ozone Creation Potential from Replacement Boilers

Source	Emission	Annual mass (tonnes)	POCP[1]	POCP
Boilers 1, 2, 3	Nitrogen Dioxide	4.2	2.8	11.76
Boilers 1, 2, 3	Carbon Monoxide	0.132	2.7	0.36

The annual mass of emissions from the replacement boilers that contribute to photochemical ozone creation potential are small and not significant. Furthermore, the POCP value for each of the substances are all at the lower end of the POCP scale, which ranges up to 138). The overall POCP for the replacement boilers is 12.12 per year.

4.3.2 Global Warming Impact

Three new natural gas fired boilers, each with a thermal input rating of 2,940Kw and a 15kW combustion fan are being introduced as part of the variation. The three boilers each have intermittent operation, this is heavily dependent on steam demand. Information provided by the manufacturer identifies the following percentage load data:

- 100%: 2,940kWh
- 75%: 2,210.9 kWh
- 50%: 1,480.9 kWh

Based on the intermittent operation of the boilers, a 50% percentage load has been assumed and an annual operating time of 4,200 hours for each of the three boilers. A summary is presented below:

[6] CERC Dispersion Modelling Report – See Appendix 02
[7] Maximum recorded during commissioning of new boilers – data held by JM.

Table 11 Global Warming Potential of Replacement Boilers

Source	Rating	Estimated annual Energy Consumption	Conversion factor (2022)	Tonnes CO2e
3 natural gas boilers	2,940 kWh	18,659,340 kWh	0.18	3,359
Combustion fan	15kW	189,000 kWh	0.19338	37

The overall annual total of tonnes of CO2e from the three replacement boilers 3,396 tonnes. The new boilers are more efficient than the boilers they have replaced, resulting in fewer emissions per unit of energy delivered to the site. The boilers will operate under an Energy Efficiency Plan to ensure maximum efficiency, this includes water treatment (ion exchange, reverse osmosis), condensate recovery, the development of energy KPIs and the monitoring of energy usage, and regular combustion analysis tests completed by trained boiler operators.

5.0 CONCLUSION

This ERA has been undertaken in accordance with EA guidance in support of the environmental permit variation application for the proposed changes to the activities carried out at the Royston Site.

The assessment has screened the risks that are relevant to the proposed changes to the facility, identified the potential receptors and provided an assessment of the risk taking into account he proposed mitigation measures.

The assessments conclude that with the implementation of the proposed risk management measures described, potential hazards from the proposed changes to the activities at the Royston Site are not likely to be significant and no further assessment is required.

APPENDIX 01

Nature & Heritage Conservation

Nature and Heritage Conservation

Screening Report: Bespoke Installation

Reference	**EPR/BT7086IJ/V018**
NGR	**TL 34824 41498**
Buffer (m)	**175**
Date report produced	**10/08/2022**
Number of maps enclosed	**3**

The nature conservation sites identified in the table below must be considered in your application.

Nature and heritage conservation sites	Screening distance (km)	Further information
Sites of Special Scientific Interest (SSSI)	2	Natural England
Holland Hall (Melbourn) Railway Cutting (SSSI)		
Therfield Heath (SSSI)		
Local Nature Reserve (LNR)	2	Natural England
Therfield Heath (LNR)		
Local Wildlife Sites (LWS)	2	Appropriate Local Record Centre (LRC)
Therfield, South of Tumulus		
Royston Chalk Pit		
Shaftesbury Green		
Green Lane S. of Royston		

Therfield Green Lane

Icknield Way, A505 North of Gallows Hill

The relevant Local Records Centre must be contacted for information on the features within local wildlife sites. A small administration charge may also be incurred for this service.

Please note we have screened this application for protected and priority sites, habitats and species for which we have information. It is however your responsibility to comply with all environmental and planning legislation, this information does not imply that no other checks or permissions will be required.

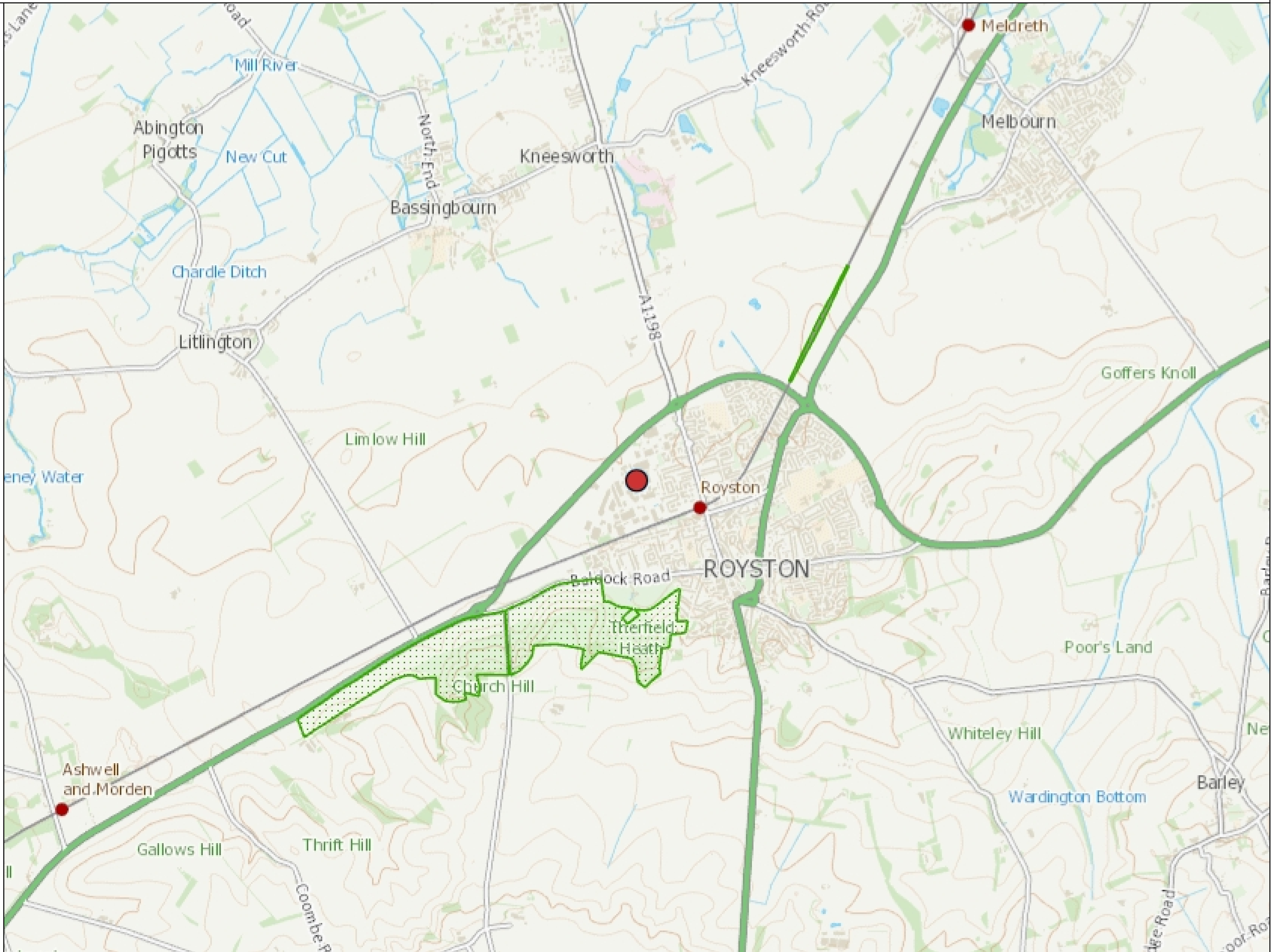
Please note the nature and heritage screening we have conducted as part of this report is subject to change as it is based on data we hold at the time it is generated. We cannot guarantee there will be no changes to our screening data between the date of this report and the submission of the permit application, which could result in the return of an application or requesting further information.

Sites of Special Scientific Interest

Environment Agency

Legend

SSSI (England)



1: 50,000

0 1,250

Metres

N E S W

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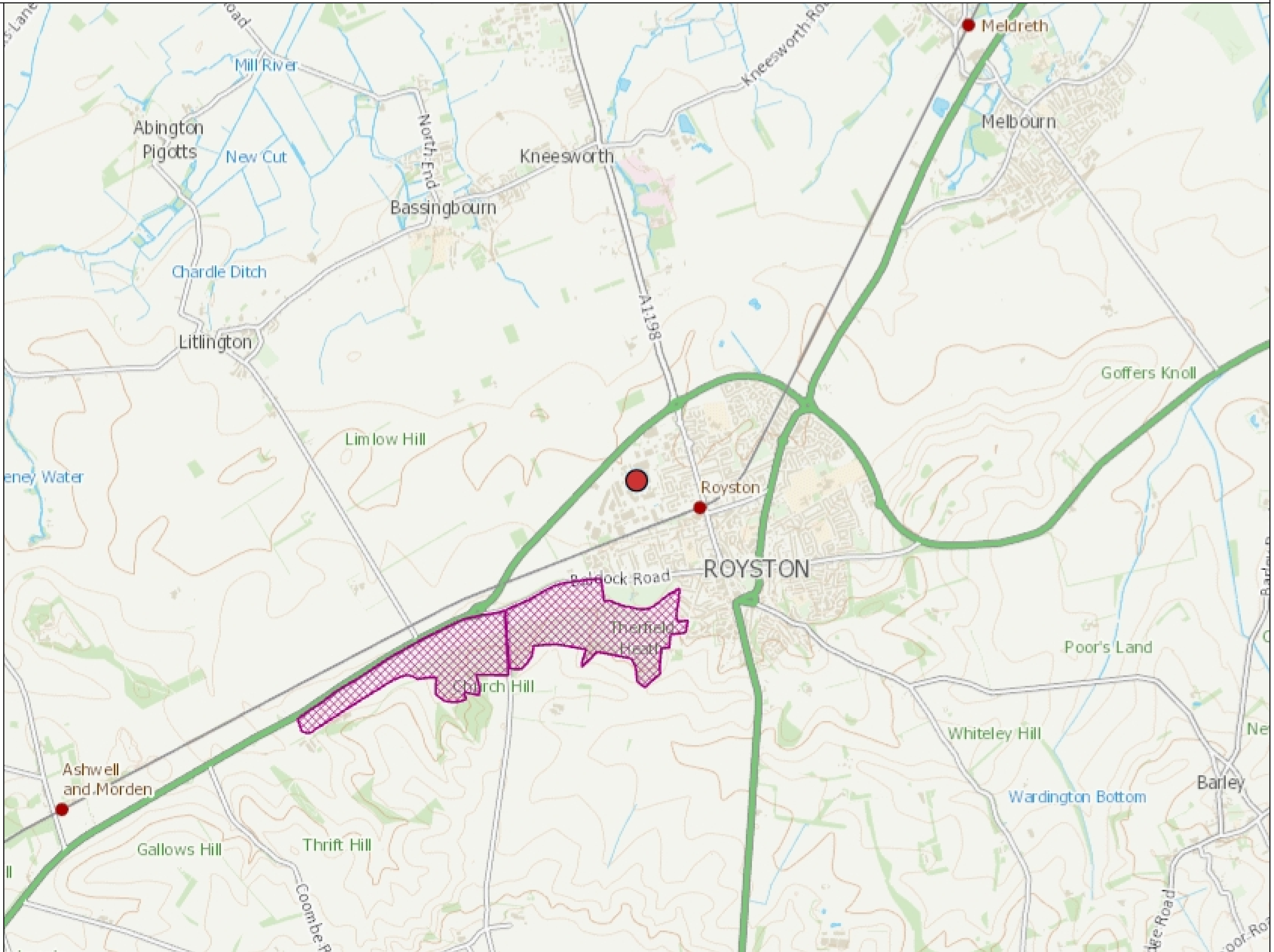
Local Nature Reserves

Legend

LNR (England)



1: 50,000

0 1,250

Metres

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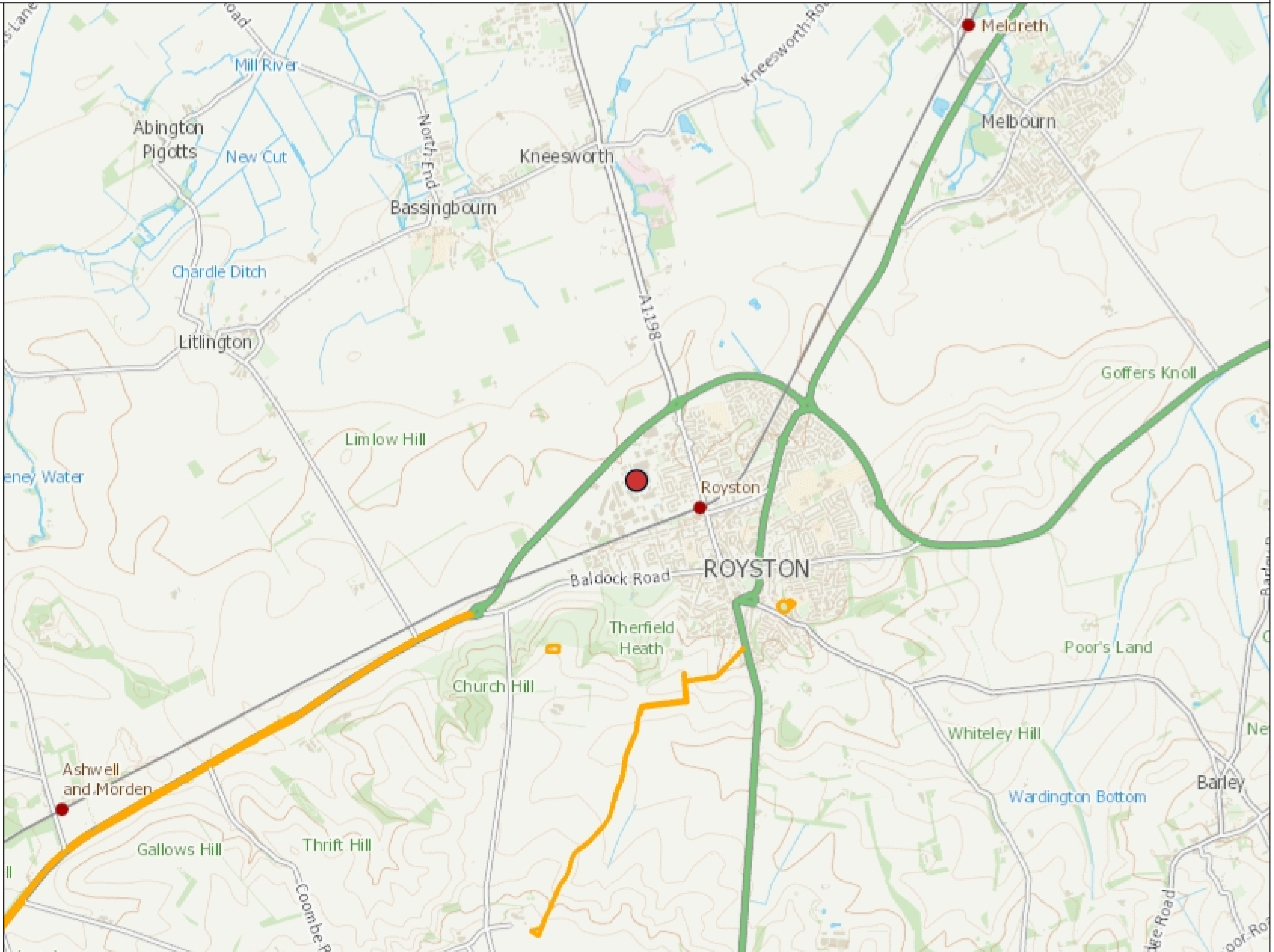
Local Wildlife Sites

Legend

Local Wildlife Sites



1: 50,000

0 1,250

Metres

N W E S

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APPENDIX 02

Air Emissions Risk Assessment

(model files submitted separately)

Cambridge
Environmental
Research
Consultants

Dispersion modelling of emissions to air from EPR regulated processes at Johnson Matthey, Royston, to support the permit variation for the Apollo and replacement boiler projects

Final report

Prepared for
Johnson Matthey PLC

15th February 2024

CERC

Report Information

CERC Job Number:	FM1374
Job Title:	Dispersion modelling of emissions to air from EPR regulated processes at Johnson Matthey, Royston, to support the permit variation for the Apollo and replacement boiler projects
Prepared for:	Johnson Matthey PLC
Report Status:	Final
Report Reference:	FM1374/R6/24
Issue Date:	15th February 2024

Author(s):	Sarah Strickland

Reviewer(s):	Rose Jackson

Issue	Date	Comments
1	21/10/22	Draft
2	26/10/22	Draft with amendment to NH_3 critical level
3	17/11/22	Draft with changes to A99
4	25/11/22	Final report (no changes)
5	14/02/24	Draft report after Agency feedback
6	15/02/24	Final report (minor correction)

Main File(s):	FM1374_JohnsonMatthey_CERC_R6_15Feb24.pdf

Contents

Glossary

APIS	UK Air Pollution Information System; a source of information for air pollution and its effects on habitats and species
AQMA	Air Quality Management Area; places designated by local authorities where statutory air quality objectives are not likely to be achieved
AQMAU	Air Quality Modelling and Assessment Unit (Environment Agency)
Cl_2	chlorine
CO	carbon monoxide
DMF	dimethyl formamide
EAL	Environmental Assessment Level; air quality standards set by the Environment Agency for pollutants for which no statutory air quality objective exists
IPA	propan-2-ol (*iso*-propyl alcohol)
LAQM	Local Air Quality Management; local authorities' process for assessing air quality
HCl	hydrogen chloride
LNR	Local Nature Reserve
MEK	butan-2-one (methyl ethyl ketone)
MIBK	methyl-*iso*-butyl ketone
NH_3	ammonia
NH_4Cl	ammonium chloride
NMVOC	(Non Methane) Volatile Organic Compound
NNR	National Nature Reserve
NO	nitric oxide
NO_2	nitrogen dioxide
NO_x	nitrogen oxides (nitrogen dioxide plus nitric oxide)
N_2O	nitrous oxide
PC	Process Contribution
PEC	Predicted Environmental Concentration (PC plus background concentration)
PGMR	Platinum Group Metals Refining
PM_{10}	particulates of less than 10µm effective diameter
$PM_{2.5}$	particulates of less than 2.5µm effective diameter
Ramsar	International Convention on Wetlands of International Importance especially as Waterfowl Habitat
SAC	Special Area of Conservation
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
TPM	Total Particulate Matter

1. Summary

This assessment was carried out in support of Johnson Matthey PLC's permitting arrangements with the Environment Agency for their Royston site.

In order to investigate the impact on air quality of all relevant processes at the Royston site, to support the permit variation for the Apollo and replacement boiler projects, dispersion modelling of emissions to air was carried out using the ADMS 6 model (version 6.0.1.0). Johnson Matthey PLC provided all site, stack and emissions data.

The proposed variation will result in the addition of a new stack, and the replacement of the three existing boiler stacks with three new boiler stacks.

An assessment against air quality standards for the protection of human health was carried out for all offsite locations. For nearby designated conservation areas, assessment against critical levels for the protection of vegetation and ecosystems and critical loads for nitrogen and acid deposition was carried out.

1.1 Objectives and EALs for the protection of human health

The maximum offsite concentrations of carbon monoxide, acetic acid, ammonia, hydrogen chloride, ammonium chloride, nitrous oxide and ethanal are screened out as insignificant for all years.

PCs to NO_2 and particulate concentrations are not screened out, but the PECs for both pollutants are below the air quality objectives.

Predicted concentrations of NMVOCs are compared against EALs for DMF, which has the most stringent standard. Annual average NMVOC concentrations are not screened out, but they are well below the long-term EAL for DMF. Hourly average offsite concentrations are screened out as insignificant for all years.

Chlorine concentrations are not screened out, but they are below the short-term EAL. There is no long-term EAL for chlorine.

1.2 Critical levels for the Protection of Vegetation and Ecosystems

The daily average NO_x PCs are not screened out for any of the designated conservation areas, but the annual average PCs are screened out for the six LWSs. The annual and daily average PECs are below the respective critical levels.

At all designated conservation areas except Therfield Heath, the annual average NH_3 concentrations are screened out as insignificant. At Therfield Heath, the more stringent critical level was used and the PCs are not screened out for two out of the five years of meteorological data considered. The background concentration, 1.6 $\mu g/m^3$, exceeds the critical level of 1 $\mu g/m^3$.

1.3 Critical loads for the Protection of Vegetation and Ecosystems

The maximum PCs to nitrogen and acid deposition are screened out at relevant habitats at all designated conservation areas.

2. Introduction

Cambridge Environmental Research Consultants Ltd (CERC) was commissioned by Johnson Matthey PLC to carry out a dispersion modelling assessment in support of Johnson Matthey's permitting arrangements with the Environment Agency.

In order to investigate the impact on air quality of all relevant processes at the Royston site, to support the permit variation for the Apollo (Phase 1 and Phase 2) and replacement boiler projects, dispersion modelling of emissions to air was carried out using the ADMS 6 model (version 6.0.1.0).

Section 3 presents the air quality standards with which the modelled results are to be compared. Details of the assessment area, including a description of the site, are given in Section 4, along with background and monitored concentrations for the area. Section 5 describes the site layout and emissions. The meteorological data input to the modelling are described in Section 6.

Section 7 presents predicted concentrations for comparison with objectives and EALs for the protection of human health. Predicted concentrations for comparison with critical levels for the Protection of Vegetation and Ecosystems are provided in Section 8, and Section 9 presents the results of the deposition modelling.

A discussion of all of the modelling results is provided in Section 10. Finally, a description of the ADMS model used in the assessment is given in Appendix A.

3. Air quality standards

3.1 Air quality standards for the protection of human health

UK air quality objectives for nitrogen dioxide (NO_2), particulate matter (PM_{10} and $PM_{2.5}$) and carbon monoxide (CO), set for the protection of human health, are summarised in Table 3.1. The objectives are taken from *The Air Quality Strategy for England, Scotland, Wales and Northern Ireland*, July 2007, and are the subject of Statutory Instrument 2000 No. 928, *The Air Quality (England) Regulations 2000*, which came into force on 6th April 2000. The objective values are set at a European level, and take into account the effects of each pollutant on the health of those who are most sensitive to air quality.

Table 3.1: UK Air Quality Objectives for the Protection of Human Health

Substance	Limit value ($\mu g/m^3$)	Reference period and allowed exceedences
NO_2	200	hourly mean not to be exceeded more than 18 times a year (modelled as 99.79th percentile)
	40	annual mean
PM_{10}	50	daily mean not to be exceeded more than 35 times a year (modelled as 90.41st percentile)
	40	annual mean
$PM_{2.5}$	20	annual mean
CO	10,000	maximum daily running 8-hour mean

A number of the air quality objectives are specified in terms of the number of times during a year that a concentration measured over a short period of time (for example, 15 minutes, 1 hour or 24 hours, as appropriate) is permitted to exceed a specified value. For example, the concentration of NO_2 measured as the average value recorded over a one-hour period is permitted to exceed the concentration of 200 $\mu g/m^3$ up to 18 times per year. Any more exceedences than this during a one-year period would represent a breach of the objective.

It is convenient to model objectives of this form in terms of the equivalent percentile concentration value. A percentile is the concentration below which lie a specified percentage of concentration measurements. For example, consider the 98th percentile of one-hour concentrations over a year. Taking all of the 8760 one-hour concentration values that occur in a year, the 98th percentile value is the concentration below which 98% of those concentrations lie. Or, in other words, it is the concentration exceeded by 2% (100 – 98) of those hours, that is, 175 hours per year. Taking the NO_2 objective considered above, allowing 18 exceedences per year is equivalent to not exceeding for 8742 hours or for 99.79% of the year. This is therefore equivalent to the 99.79th percentile value.

For some pollutants considered in this assessment, there are no air quality objectives, so Environmental Assessment Levels (EALs)[1] for the protection of human health were used, as presented in Table 3.2. Note that the table includes an additional short-term EAL for CO, which was considered, as well as the air quality objective presented in Table 3.1.

There are no published EALs for ammonium chloride (NH_4Cl) or nitrous oxide (N_2O).

- For NH_4Cl, the hierarchy set out in Environment Agency guidance on the derivation of new EALs to air [2] was followed. The long-term DNEL (Derived No Effect Level) for inhalation, for the General Population, was selected as a suitable long-term EAL.[3] No short-term hazard was identified.

- For N_2O, NOAEC values were found but it was not clear how uncertainty factors could be applied. Therefore, EALs were derived from the long-term Workplace Exposure Limit (WEL), using safety factors recommended in the withdrawn Environment Agency H1 guidance.

Table 3.2: Environmental Assessment Levels (EALs) (µg/m³)

	Long-term	Short-term (hourly)
Acetic acid	250	3,700
NH_3	180	2,500
N_2O [4]	1,830	54,900
NH_4Cl [5]	9,400	-
CO	-	30,000
Cl_2	-	290
HCl	-	750
Ethanal	370	9,200

[1] https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit
[2] https://consult.environment-agency.gov.uk/environment-and-business/new-air-environmental-assessment-levels/supporting_documents/2012%20consultation%20on%20derivation%20of%20new%20Environmental%20Assessment%20Levels%20to%20air.pdf
[3] https://echa.europa.eu/brief-profile/-/briefprofile/100.031.976
[4] EALs derived from WELs using withdrawn Environment Agency H1 guidance.
[5] DNEL

As there are no standards for VOCs as a group, the EALs for the emitted VOCs were considered, as presented in Table 3.3; the most stringent EALs, those for DMF, were used for comparison with predicted concentrations of all VOCs combined. Note that ethanal was considered separately.

Table 3.3: Environmental Assessment Levels (EALs) (µg/m^3) for individual VOCs

	Long-term	Short-term (hourly)
Acetone	18,100	362,000
Acetonitrile	680	10,200
Butan-2-one (methyl ethyl ketone, MEK)	6,000	89,900
Dimethylformamide (DMF)	300	6,100
n-Hexane (used for petroleum products)	720	21,600
Pentan-2-one or methyl propyl ketone (used for methyl iso-butyl ketone, MIBK)	7,160	89,500
2-Propanol (isopropyl alcohol, IPA)	9,990	125,000

3.2 Critical levels for the Protection of Vegetation and Ecosystems

The critical levels for the Protection of Vegetation and Ecosystems, as set out in the Environment Agency's guidance for environmental permits[1], are summarised in Table 3.4.

The guidance recommends the assessment of:

- Special Protection Areas (SPAs)[6], Special Areas of Conservation (SACs)[7] and Ramsar[8] sites within 10 km of the installation; and
- Sites of Special Scientific Interest (SSSI)[9], National Nature Reserves (NNR)[9], Local Nature Reserves (LNR)[10], local wildlife sites (LWS) and ancient woodland within 2 km of the installation.

Table 3.4: Critical levels for the Protection of Vegetation and Ecosystems

	Critical level ($\mu g/m^3$)	Comment
NH_3	1	annual mean (for sensitive lichen & bryophytes communities and ecosystems where lichens & bryophytes are an important part of the ecosystem's integrity)
	3	annual mean (for all higher plants - all other ecosystems)
NO_x	30	annual mean
	75	daily mean

[6] Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora
[7] Council Directive 79/409/EEC on the conservation of wild birds
[8] International Convention on Wetlands of International Importance especially as Waterfowl Habitat
[9] Declared by the statutory country conservation agencies, which have a duty under the Wildlife and Countryside Act 1981
[10] Declared under the National Parks and Access to the Countryside Act 1949 by local authorities after consultation with the relevant statutory nature conservation agency

4. Assessment area

4.1 Site location and surrounding area

The Johnson Matthey site is located on the north west edge of Royston, within the A505 Royston bypass. In the vicinity of the site, there are residential and other areas where the public may be exposed to the impact of emissions from the site. The location of the site is shown in Figure 4.1.

There are no SPAs, SACs or Ramsar sites within 10 km of the Johnson Matthey site. There are two SSSIs within 2 km of the site: Therfield Heath, to the south west of Royston; and Holland Hall (Melbourn) railway cutting, 1 km north east of Royston. Therfield Heath is also a Local Nature Reserve (LNR). The Environment Agency also requested that impacts be assessed at six Local Wildlife Sites (LWS):

1. Royston Chalk Pit;
2. Therfield, South of Tumulus;
3. Green Lane South of Royston;
4. Icknield Way, A505 North of Gallows Hill;
5. Therfield Green Lane; and
6. Shaftesbury Green.

The two SSSIs and six LWSs are shown on Figure 4.1.

The dispersion modelling has concentrated on an output grid of 3 km by 3 km, approximately centred on the site, with concentration values calculated at points 30 m apart within this grid.

A surface roughness length is used in the model to characterise the surrounding area in terms of the effects it will have on wind speed and turbulence, which are key components of the modelling. A value of 0.5 metres was used in this assessment, which represents open suburbia, and is therefore appropriate for the surrounding land use. A different surface roughness value was used for the Andrewsfield meteorological site, as described in Section 6.

In urban and suburban areas, a significant amount of heat is emitted by buildings and traffic, which warms the air within and above the area. This is known as the urban heat island and its effect is to prevent the atmosphere from becoming very stable. In general, the larger the urban area, the more heat is generated and the stronger the effect becomes. In the ADMS model, the stability of the atmosphere is represented by the Monin-Obukhov parameter, which has the dimension of length. The effect of the urban heat island is that, in stable conditions, the Monin-Obukhov length will never fall below some minimum value; the larger the urban area, the larger the minimum value. A value of 10 metres was used in this modelling, which is suitable for a small town. The model default value of 1 m was used for the Met Office Andrewsfield site.

4.2 Terrain data

The site is situated at a height of approximately 55 m above sea level, on a shallow slope rising from about 25 m in the north to 135 m in the south. The effects of the local terrain on dispersion may be significant and so were included in the modelling. Figure 4.2 shows a diagram of the local terrain. Note that the height scale shown on this plot is exaggerated.

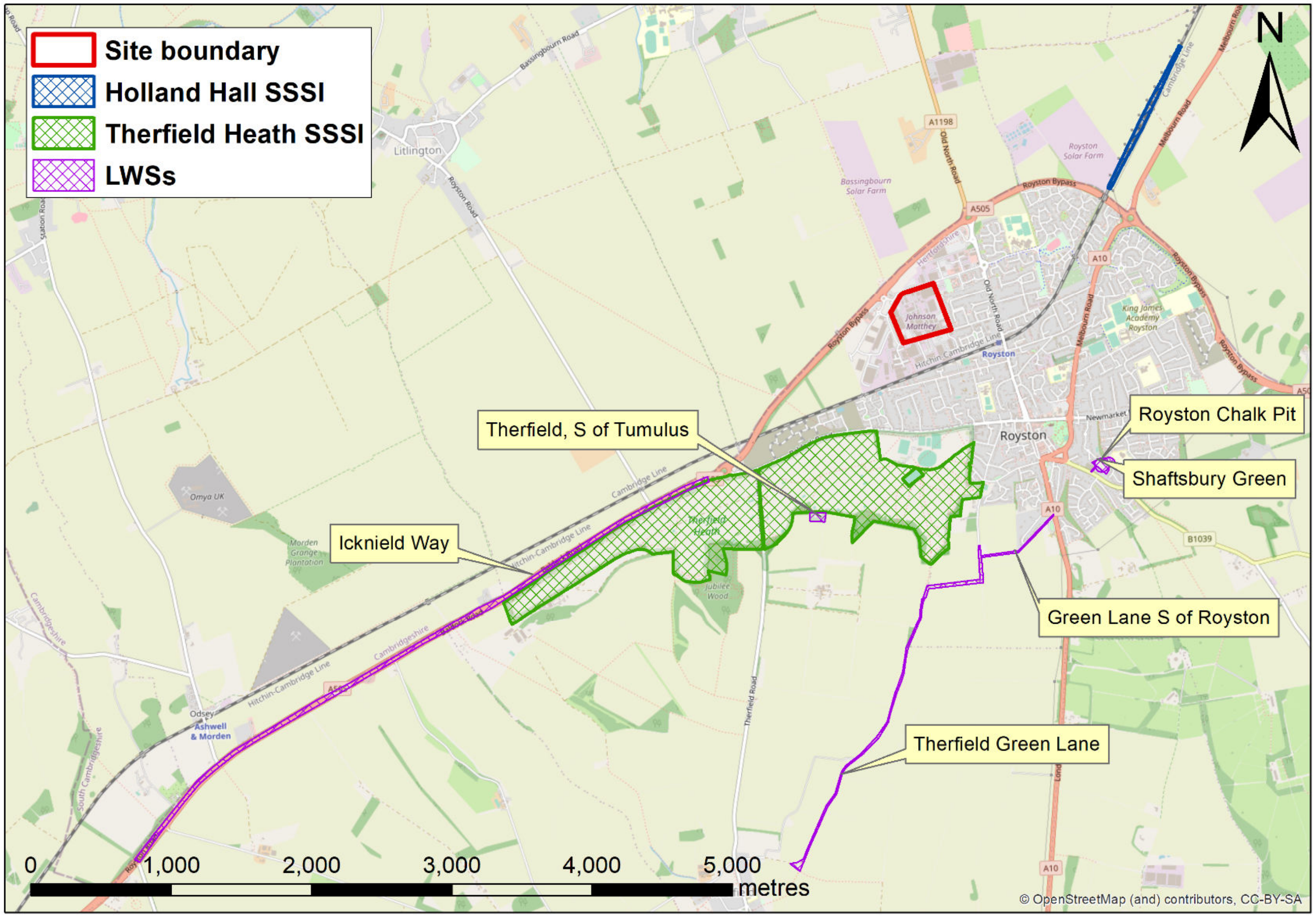

Figure 4.1: Site location

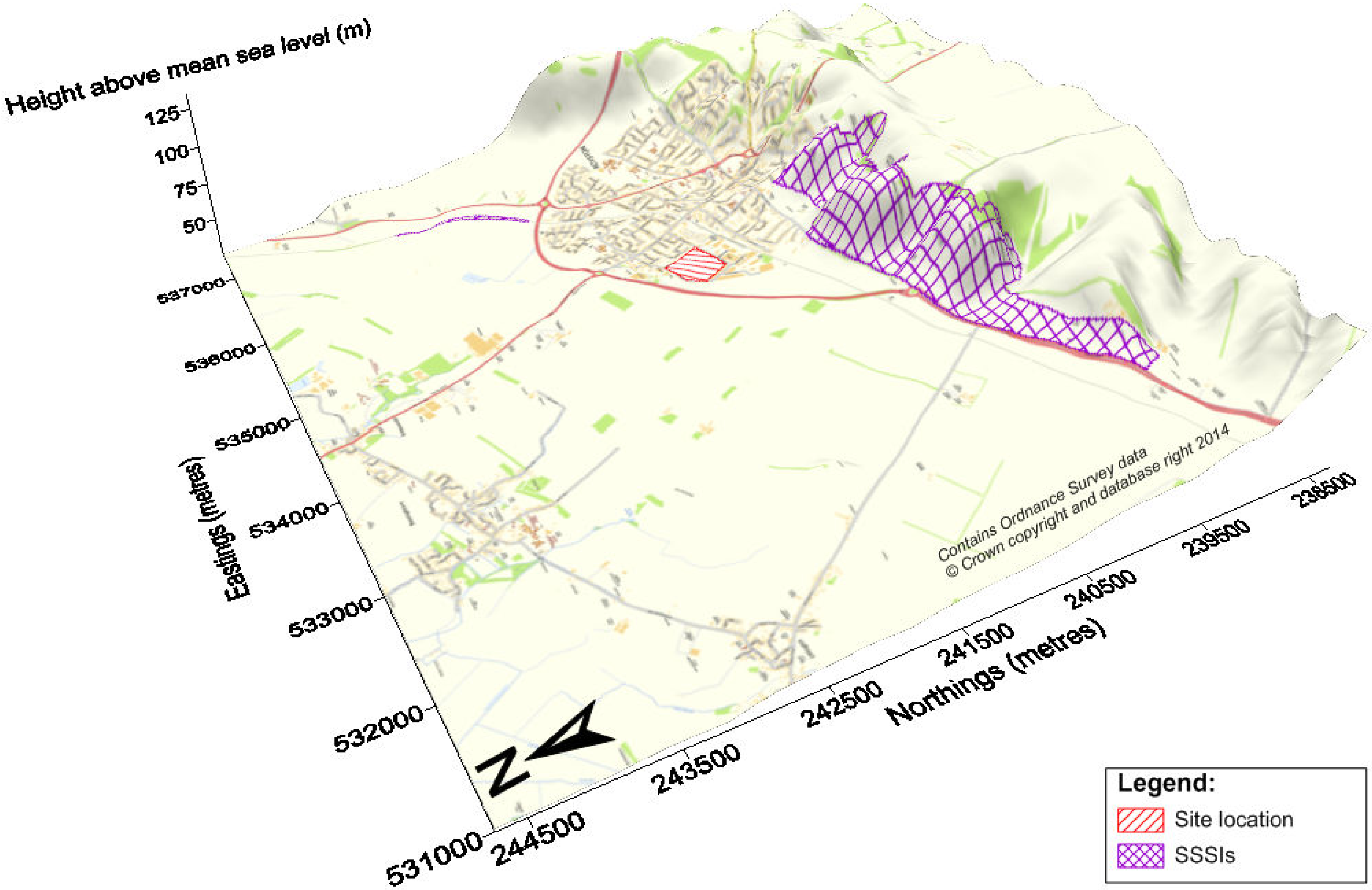

Figure 4.2: Local terrain (note: height scale exaggerated)

4.3 Local air quality

4.3.1 AQMAs and monitoring data

There are no Air Quality Management Areas (AQMAs) close to the Johnson Matthey site; the nearest AQMAs are approximately 20 km away, in Hitchin, and are therefore unlikely to be affected by emissions from the Johnson Matthey site.

NO_2 concentrations in Royston are monitored by North Hertfordshire District Council using diffusion tubes at two roadside locations. Annual average concentrations for the years 2020 to 2022 were taken from North Hertfordshire District Council's air quality report[11] and are presented in Table 4.1. Monitored concentrations are well below the air quality objective of 40 µg/m^3 for annual average NO_2 concentrations.

Table 4.1: NO_2 diffusion tube monitoring in Royston (µg/m^3)

Monitor ref	Location (from JM site)	Grid ref (m)	Type	2020	2021	2022
NH06	Melbourn Road opposite Town Hall (1 km south east)	535906, 240794	Roadside	21.7	20.5	27.4
NH115	Old North Road (300 m east)	535373, 241466	Roadside	21.5	17.5	19.2

4.3.2 Mapped background data

Background concentrations of carbon monoxide (CO) for the year 2010 and nitrogen dioxide (NO_2) and particulates (PM_{10} and $PM_{2.5}$) for the year 2022 were obtained from the UK AIR Air Information Resource background mapping [12].

These values are provided on a 1 km grid basis; Table 4.2 presents annual average concentrations for the grid square containing the Johnson Matthey site.

Table 4.2: Background concentrations from Defra background maps (µg/m^3)

Location (x,y) of grid square centre	NO_2	PM_{10}	$PM_{2.5}$	CO
534500, 241500	12.2	15.6	8.9	226

[11] https://www.north-herts.gov.uk/home/environmental-health/pollution/air-quality/air-quality-reports
[12] https://uk-air.defra.gov.uk/data/gis-mapping/

Mapped background data for NH_3 and NO_x at the location of each SSSI and LWS, taken from the Air Pollution Information System (APIS) website,[13] are shown in Table 4.3. These values represent three year averages, over the period 2019 to 2021, at 1 km grid resolution.

Table 4.3: Background concentrations for SSSI / LWS from APIS website (µg/m³)

Sensitive site	Designation	Location (x,y)	NH_3	NO_x
Therfield Heath	SSSI	534500, 240500	1.6	10.8
Holland Hall	SSSI	536500, 242500	1.6	11.0
Royston Chalk Pit	LWS	536500, 240500	1.5	11.2
Therfield, South of Tumulus	LWS	534500, 240500	1.6	10.8
Green Lane South of Royston	LWS	535500, 239500	1.5	10.0
Icknield Way, A505 North of Gallows Hill	LWS	531500, 239500	1.6	11.2
Therfield Green Lane	LWS	534500, 238500	1.5	9.7
Shaftesbury Green	LWS	536500, 240500	1.5	11.2

4.3.3 Other background data

NH_3 and HCl are measured as part of Defra's National Ammonia Monitoring Network [14] and Acid Gases and Aerosol Network[15], respectively. For both networks, the nearest monitoring location to the Johnson Matthey site is Rothamsted, 35 km south west of Royston. Annual average concentrations of both pollutants for the most recent year of measurement in each case are presented in Table 4.4.

Table 4.4: Monitored HCl and NH_3 concentrations at Rothamsted (µg/m³)

Pollutant	Concentration	Year
HCl	0.28	2015
NH_3	0.78	2023

No background data were available for the other modelled pollutants.

[13] http://www.apis.ac.uk/srcl
[14] https://uk-air.defra.gov.uk/networks/network-info?view=nh3
[15] https://uk-air.defra.gov.uk/networks/network-info?view=aganet

5. Site layout and source data

5.1 Modelled sources

A total of 27 stacks was considered. Table 5.1 sets out the stack information for all modelled sources, based on data provided by Johnson Matthey. Note that two phases of the Project Apollo were assessed.

The locations of the modelled stacks and site buildings are shown in Figure 5.1.

As efflux temperatures are measured at the sampling point rather than stack exit, efflux temperatures stated as being over 60°C [16] were reduced, assuming that the temperature will be reduced by 50% of the stack temperature in excess of an ambient temperature of 20°C. The efflux velocity was recalculated accordingly.

Typical and peak pollutant emission rates provided by Johnson Matthey are presented in Table 5.2 and Table 5.3. Due to the batch nature of many processes and the consequent variability in emissions, the calculation of 'typical' and 'peak' values is complex. Typical emission rates were used in the assessment against long-term air quality standards and peak emission rates were used in the assessment against short-term air quality standards.

Typical emissions were calculated based upon one of three input data sources.

1. For existing stacks with periodic monitoring data, mass emissions (g/s) were calculated from the most recent monitored data.
2. For stack A197, the annual mass emission limit was used to calculate mass emissions (g/s).
3. For new emission point (A286) and the boiler replacement stacks, emissions were derived from design information.

Peak emissions were derived from the stack emission limits and the most recent stack flow monitoring data or, where no emission limit exists, the highest hourly emissions recorded over the last three years.

Table 5.4 provides details of the breakdown of non-methane VOC (NMVOC) emissions, as estimated by Johnson Matthey. Predicted concentrations were compared against EALs for dimethyl formamide (DMF), the VOC with the most stringent standard. DMF is a minor component of the VOC emissions from just one stack, therefore a comparison against the EALs for this pollutant is a worst case assessment.

Note that ethanal (emitted by Project Apollo, stack A286 only) was considered separately.

Emission rates provided for total particulate matter (TPM) were used as conservative values for both PM_{10} and $PM_{2.5}$.

[16] A230, A231, A8a, A8b and A3

Table 5.1: Stack parameters

Process	Stack	Height (m)	Diameter (m)	Exit velocity (m/s)	Actual volumetric flow rate (m^3/s)	Normal volumetric flow rate at STP (Nm^3/s)	Temperature (°C)	Location (m)	
								x	y
Fastcat	A207	21.5	0.9	20.4	12.99	11.59	31.5	534899	241580
CSF1	A230	21.5	0.9	11.7	8.91	5.58	90.2	534883	241575
CSF2	A231	25	1.32	7.4	11.09	7.98	62.4	534879	241546
Procat 1	A182	6.5	0.34 [17]	0.1 [18]	0.28	0.27	16.9	534757	241519
AgT	A57	12.5	0.5	8.6	1.69	1.58	20.2	534788	241602
AgT	A228	12	0.5	3.3	0.65	0.61	17.7	534741	241600
AgT	A109	8.6	0.4	7.8	0.98	0.92	19.2	534782	241620
F/C Inorganics	A11	17.6	0.78	9.4	4.44	4.23	15.1	534751	241525
F/C Inorganics	A4	30	0.8	8.5	4.28	3.98	22.0	534719	241507
HCP	A197	12	0.15	20.3	0.36	0.0001	15.0	534739	241400
PGMR	A28	44.7	0.8	16.9	8.50	7.77	25.5	534811	241438
PGMR	A30	44.7	0.8	16.0	8.04	7.47	21.3	534813	241439
PGMR	A31	44.7	0.8	16.2	8.16	7.55	22.5	534812	241441
PGMR	A35	8.01	0.3	3.0	0.21	0.19	23.0	534800	241473
PGMR	A80	6.1	0.2	7.2	0.23	0.22	13.0	534778	241447
Noble Metals	A225	9.5	0.25	2.1	0.10	0.09	27.3	534715	241392.5
Noble Metals	A226	10	0.5	9.7	1.90	1.74	25.0	534714	241393
CHP	A8a	15	0.6	8.3	2.64	2.67	61.6	534699	241613
CHP	A8b	15	0.6	8.5	2.82	3.17	81.5	534700	241610
VRP	A27	18.9	0.56	4.0	0.99	0.90	27.2	534745	241558
CA TC	A3	21	0.9	14.8	10.09	8.35	43.0	534923.5	241397
PU12	A97	24	0.25	5.7	0.28	0.26	29.5	534745	241441.5
PU12	A98	24	0.2	11.0	0.35	0.32	18.3	534742.5	241440.5
Project Apollo - Phase 1	A286	25	1.25	5.7	6.94	4.95	110.0	534870.5	241562
Project Apollo - Phase 2	A286	25	1.25	6.8	8.33	5.94	110.0	534870.5	241562
Boiler Replacement	A13	9.9	0.35	12.7	1.22	0.71	194.0	534868	241366
Boiler Replacement	A15	9.9	0.35	12.7	1.22	0.71	194.0	534870	241362
Boiler Replacement	A16	9.9	0.35	12.7	1.22	0.71	194.0	534871	241358

[17] Effective diameter calculated for square duct 0.3 m diameter
[18] Horizontal release so minimum vertical exit velocity assumed

Table 5.2: Typical emission rates (g/s)

Stack	HCl	Cl_2	NO_x	CO	TPM	NH_3	NH_4Cl	NMVOC	Ethanal	Acetic acid	N_2O
A207	-	-	0.0713	0.0048	-	0.0214	-	-	-	-	-
A230	-	-	0.0605	0.0173	-	0.0061	-	-	-	-	-
A231	-	-	0.0273	0.0336	-	0.0145	-	-	-	-	-
A182	-	-	-	-	0.0030	-	-	-	-	-	-
A57	-	-	-	-	-	-	-	0.1988	-	-	-
A228	-	-	-	-	-	-	-	0.0028	-	-	-
A109	-	-	-	-	-	-	-	0.0047	-	-	-
A11	-	-	0.2220	-	-	-	-	-	-	0.0060	0.0016
A4	0.0213	0.0015	0.0032	-	0.0043	0.0007	-	-	-	-	-
A197	-	-	-	-	-	-	-	0.0686	-	-	-
A28	0.0264	0.0013	-	-	-	-	0.0014	-	-	-	-
A30	0.0240	0.0045	-	-	-	-	0.0006	-	-	-	-
A31	0.0594	0.0004	-	-	-	-	0.0007	-	-	-	-
A35	0.0001	0.0004	-	-	-	-	-	-	-	-	-
A80	0.0013	-	-	-	-	-	-	0.0118	-	-	-
A225	0.0002	0.00003	-	-	-	-	-	-	-	-	-
A226	0.0162	-	0.0008	-	-	-	-	-	-	-	-
A8a	-	-	0.2058	0.4050	-	-	-	-	-	-	-
A8b	-	-	0.0944	0.6776	-	-	-	-	-	-	-
A27	0.0004	-	-	-	-	0.0090	-	0.0051	-	-	-
A3	-	-	0.0133	-	-	-	-	-	-	-	-
A97	0.00004	0.00009	-	-	-	-	-	-	-	-	-
A98	-	-	-	-	-	0.00003	-	-	-	-	-
A286 Phase 1	-	-	0.1485	0.2475	-	-	-	-	0.0990	-	-
A286 Phase 2	-	-	0.1782	0.2970	-	-	-	-	0.1188	-	-
A13	-	-	0.0444	-	-	-	-	-	-	-	-
A15	-	-	0.0444	-	-	-	-	-	-	-	-
A16	-	-	0.0444	-	-	-	-	-	-	-	-

Table 5.3: Peak emission rates (g/s)

Stack	HCl	Cl_2	NO_x	CO	TPM	NH_3	NH_4Cl	NMVOC	Ethanal	Acetic acid	N_2O
A207	-	-	0.5793	1.1585	-	0.1738	-	-	-	-	-
A230	-	-	0.2788	0.5576	-	0.0836	-	-	-	-	-
A231	-	-	0.3990	0.7980	-	0.1197	-	-	-	-	-
A182	-	-	-	-	0.0053	-	-	-	-	-	-
A57	-	-	-	-	-	-	-	0.2069	-	-	-
A228	-	-	-	-	-	-	-	0.0456	-	-	-
A109	-	-	-	-	-	-	-	0.0102	-	-	-
A11	-	-	0.8463	-	-	-	-	-	-	0.2116	0.8463
A4	0.0398	0.0398	0.7958	-	0.0796	0.0597	-	-	-	-	-
A197	-	-	-	-	-	-	-	0.1586	-	-	-
A28	0.0777	0.5442	-	-	-	-	0.0777	-	-	-	-
A30	0.0747	0.5232	-	-	-	-	0.0747	-	-	-	-
A31	0.0755	0.5288	-	-	-	-	0.0755	-	-	-	-
A35	0.0019	0.0010	-	-	-	-	-	-	-	-	-
A80	0.0022	-	-	-	-	-	-	0.0163	-	-	-
A225	0.0009	0.0009	-	-	-	-	-	-	-	-	-
A226	0.0174	-	0.2615	-	-	-	-	-	-	-	-
A8a	-	-	0.5342	0.6143	-	-	-	-	-	-	-
A8b	-	-	0.6345	0.8537	-	-	-	-	-	-	-
A27	0.0090	-	-	-	-	0.0090	-	0.0897	-	-	-
A3	-	-	0.0300	-	-	-	-	-	-	-	-
A97	0.0008	0.0008	-	-	-	-	-	-	-	-	-
A98	-	-	0.0649	-	-	0.0004	-	-	-	-	-
A286 Phase 1	-	-	0.1485	0.2475	-	-	-	-	0.0990	-	-
A286 Phase 2	-	-	0.1782	0.2970	-	-	-	-	0.1188	-	-
A13	-	-	0.1070	-	-	-	-	-	-	-	-
A15	-	-	0.1070	-	-	-	-	-	-	-	-
A16	-	-	0.1070	-	-	-	-	-	-	-	-

Table 5.4: Breakdown of NMVOC emissions

Stack	Total NMVOC emissions (g/s)		Details of NMVOC components (% breakdown, where available)							
	Typical	Peak	Acetone	Acetonitrile	MEK	DMF	Petroleum products	MIBK	IPA	Other (components with no EALs)
A57	0.1988	0.2069	-	-	-	-	Exxsol D40 Exxsol D80 Surfynol 440	-	80%	Carbitol acetate Butyl cellosolve acetate Butyl carbitol acetate Priolene 6910 Pine Oil Proglyde DMM glycol diether
A228	0.0028	0.0456	-	-	-	-	10% White spirit	-	90%	-
A109	0.0047	0.0102	-	-	-	-	10% White spirit	-	90%	-
A197	0.0686	0.1586	Yes	Yes	60%	Yes	Petroleum ether	-	Yes	Methylated spirits
A80	0.0118	0.0163	-	-	-	-	50% Shellsol D70	-	-	30% Tributyl phosphate 20% Nitta N-iso tridecyl N-iso tridecanamide
A27	0.0051	0.0897	-	-	-	-	-	100%	-	-

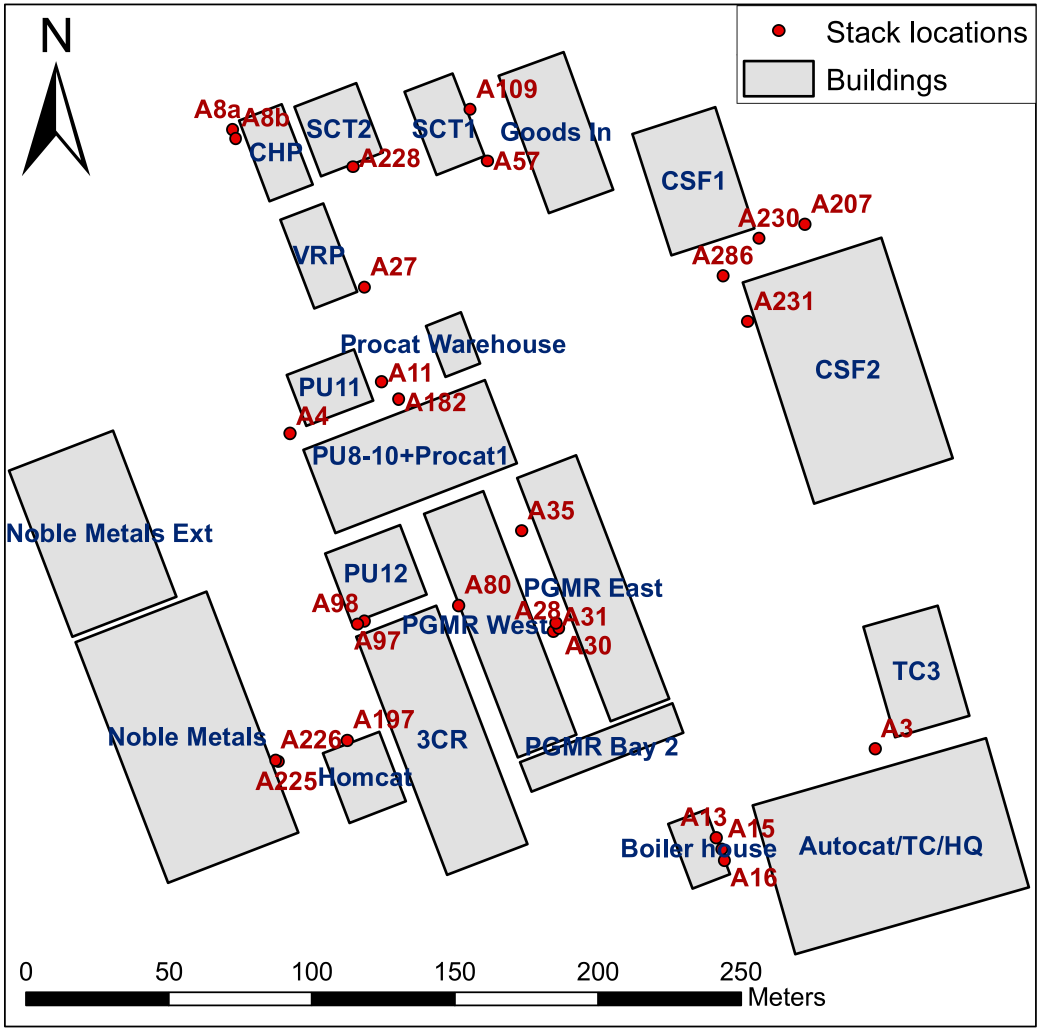

Figure 5.1: Modelled buildings and sources

5.2 Modelled buildings

Table 5.5 summarises the dimensions of the site buildings shown in Figure 5.1, as provided by Johnson Matthey.

ADMS 6 offers a facility to allow the model to select the most significant building for impacts on dispersion from each stack, for each hour of meteorological data. This facility was used to generate the final results.

Table 5.5: Site buildings

Name	Coordinates of building centre		Height (m)	Length (m)	Width (m)	Angle of length from north (°)
	x	y				
3CR	534772	241400	18	89	30	159
Autocat/TC/HQ	534929	241363	13.2	54	85	164
Boiler house	534862	241362	6.8	24	14	159
CHP	534714	241605	9.2	30	16	159
CSF1	534860	241595	17.5	44.5	30.5	162
CSF2	534914	241529	18.6	81	51	162
Goods In	534812	241612	10	51	24	160
Homcat	534745	241387	9.5	26	21	159
Noble Metals	534683	241401	8.1	90	49	159
Noble Metals Extension	534650	241472	10.4	62	39	159
PGMR Bay 2	534828	241397.5	18.9	57	11	69
PGMR East	534825	241453	9.8	91	22	159
PGMR West	53472.5	241440.5	9.8	91	21	159
Procat Warehouse	534776	241538	9.1	19	13	159
PU11	534733	241523	10.2	25	19	69
PU12	534749	241458	24.5	28	26	69
PU8-10 & Procat1	534761	241499	7	68	31	69
SCT1	534773	241615	6	31	18	159
SCT2	534736	241613	11	26	23	159
TC3	534938	241424	17	40	27	164
VRP	534729	241569	15.7	33	16	159

6. Meteorological data

Modelling was carried out using hourly sequential meteorological data obtained from Andrewsfield meteorological station for the years 2016 to 2020 inclusive. Andrewsfield is located about 40 km to the south east of the Royston site.

A surface roughness length of 0.2 metres was used to characterise the Andrewsfield meteorological station. The value is representative of agricultural areas, considered appropriate for the surrounding land use.

The hours of meteorological data used in the analysis exclude hours of calm, hours of variable wind direction and unavailable data, for example due to issues with the instrumentation. A summary of the data used is given in Table 6.1. The ADMS meteorological pre-processor, written by the Met Office, uses the meteorological data to calculate the parameters required by the model.

Figure 6.1 shows wind roses for Andrewsfield, giving the frequency of occurrence of wind from different directions for a number of wind speed ranges, for the five years 2016 to 2020.

Table 6.1: Summary of meteorological data used

	Percentage used	Parameter	Minimum	Maximum	Mean
2016	93.8	Temperature (°C)	-3.7	32.0	10.5
		Wind speed (m/s)	0	19.5	4.1
		Cloud cover (oktas)	0	8	4.5
		Relative humidity (%)	25.6	100	82.3
		Annual rainfall (mm)	512		
2017	95.3	Temperature (°C)	-5.0	29.6	10.7
		Wind speed (m/s)	0	19.5	4.2
		Cloud cover (oktas)	0	8	4.8
		Relative humidity (%)	25.4	100	82.4
		Annual rainfall (mm)	541		
2018	91.6	Temperature (°C)	-6.2	32.2	11.0
		Wind speed (m/s)	0	19.5	4.0
		Cloud cover (oktas)	0	8	4.6
		Relative humidity (%)	25.3	100	80.8
		Annual rainfall (mm)	508		
2019	93.3	Temperature (°C)	-6.2	34.5	10.6
		Wind speed (m/s)	0	17.5	4.1
		Cloud cover (oktas)	0	8	4.5
		Relative humidity (%)	27	100	82.0
		Annual rainfall (mm)	573		
2020	95.2	Temperature (°C)	-2.4	33.7	11.1
		Wind speed (m/s)	0	17.5	4.5
		Cloud cover (oktas)	0	8	4.3
		Relative humidity (%)	23	100	79.9
		Annual rainfall (mm)	636		

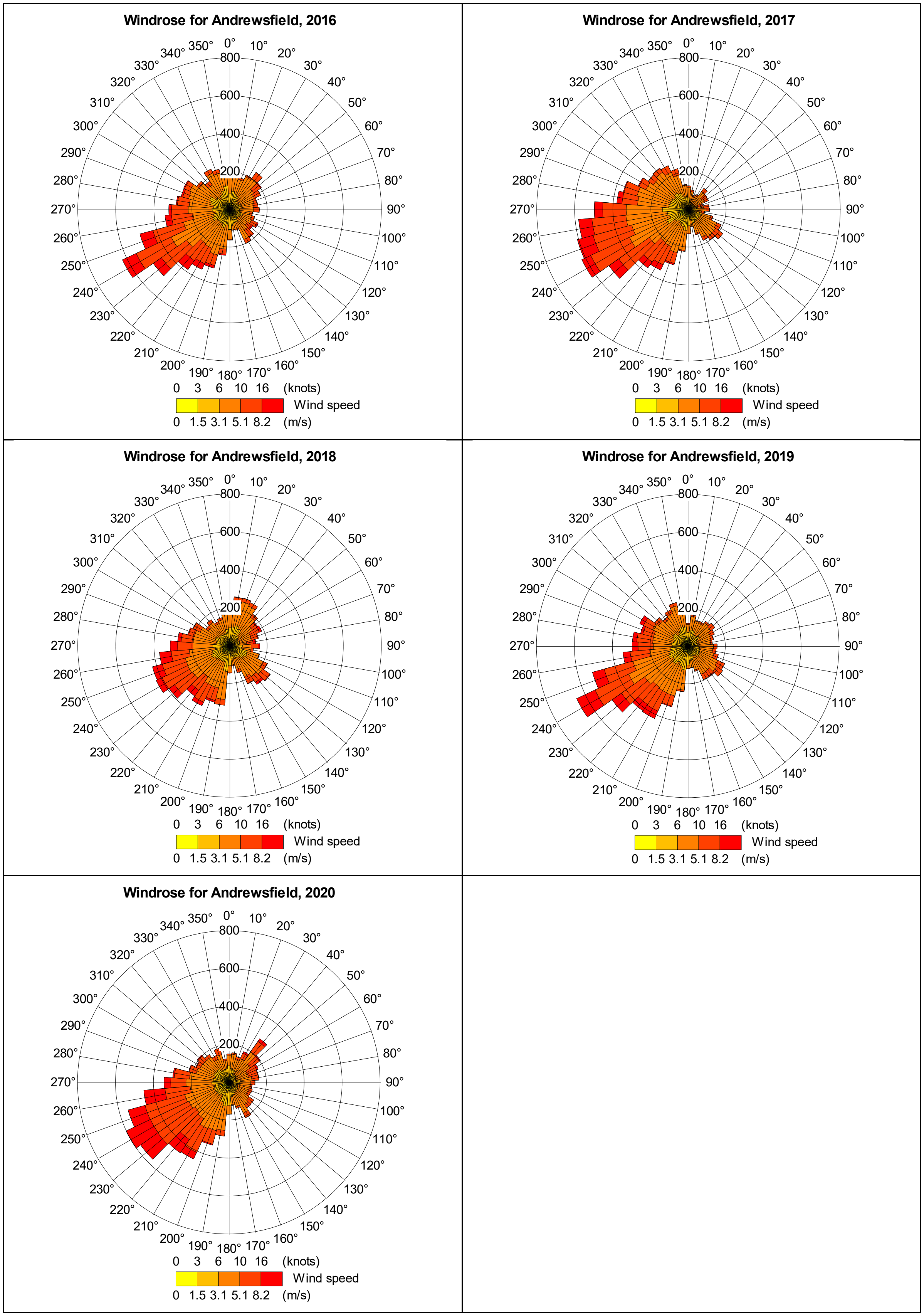

Figure 6.1: Wind roses for Andrewsfield, 2016-2020

7. Consideration of objectives and EALs for the protection of human health

Modelling was carried out to predict the Process Contribution (PC) to ground level concentrations of each relevant pollutant from the Johnson Matthey Royston site. The significance of the total pollutant release was assessed by comparing the PC to the relevant air quality objective or EAL. For long-term standards, the Environment Agency considers the release to be insignificant if the PC is less than 1% of the air quality standard.[1] For short-term standards, including percentiles, the Agency considers the release to be insignificant if the PC is less than 10% of the air quality standard.[1] Where a release is insignificant, the pollutant is screened out and no further assessment of levels of that pollutant undertaken.

Where a release is significant, the Predicted Environmental Concentration (PEC) for that substance is calculated. For long-term standards, the PEC is calculated by adding the PC to the estimated background concentration of the pollutant. For short-term standards, including percentiles, the PEC is calculated by adding the PC to twice the estimated background concentration of the pollutant.

For the assessment of human health effects, all maximum concentrations represent the maximum offsite concentrations; that is, concentrations within the site boundary were excluded.

7.1 Predicted concentrations of nitrogen dioxide

Nitrogen oxides (NO_x) comprise nitric oxide (NO) and nitrogen dioxide (NO_2). Only NO_2 is considered in statutory air quality objectives for the protection of human health; the NO_x critical levels for the Protection of Vegetation and Ecosystems are considered in Section 8.1.

The PC to NO_2 concentrations depends on the concentrations of NO_x due to other sources in the area and the chemical reactions taking place between NO and NO_2.

For direct comparison against the objectives for NO_2, an empirical relationship defined by the Environment Agency was therefore used to calculate the NO_2 PEC. This method assumes that a fixed proportion of the PC of NO_x is NO_2 (70% for the annual average and 35% for the 99.79th percentile of hourly averages). The NO_2 PEC is calculated by adding the annual average NO_2 background concentration to the annual average concentration, and twice the annual average background concentration of NO_2 to the 99.79th percentile of hourly average concentrations.

7.1.1 Apollo Phase 1

Table 7.1 shows the maximum predicted offsite concentrations of NO_2 with Apollo Phase 1, calculated using meteorological data for the five years 2016 to 2020.

The maximum annual average offsite NO_2 PC is 4.1 µg/m^3, 10% of the air quality objective of 40 µg/m^3, calculated using meteorological data for the year 2020. Including the background concentration of 12.2 µg/m^3, maximum predicted offsite PECs are below the air quality objective.

Figure 7.1 shows a contour plot of annual average NO_2 PC concentrations, based on meteorological data for the year 2020, the year giving the highest predicted annual average concentrations.

The maximum offsite 99.79th percentile of hourly average NO_2 PC concentration is 86 µg/m^3, 43% of the air quality objective of 200 µg/m^3, calculated using meteorological data for the year 2018. Including the background concentration of 24.4 µg/m^3, maximum predicted offsite PECs are below the air quality objective.

Figure 7.2 shows a contour plot of the 99.79th percentile of hourly average NO_2 PC concentrations, based on meteorological data for the year 2018, the year giving the highest predicted hourly average concentrations.

Table 7.1: Maximum predicted offsite concentrations of NO_2 (µg/m^3), Apollo Phase 1

Year	Standard	Measured as	Objective value	PC (NO_x)	PC (NO_2)[19]	PC % of objective	Background NO_2[20]	PEC (NO_2)	PEC % of objective	Location	
										x	y
2016	Short-term AQO	99.79th percentile of hourly averages	200	243	85	43	24.4	109	55	534680	241320
	Long-term AQO	Annual average	40	5.5	3.9	10	12.2	16	40	534770	241650
2017	Short-term AQO	99.79th percentile of hourly averages	200	241	84	42	24.4	108	54	534650	241650
	Long-term AQO	Annual average	40	5.7	4.0	10	12.2	16	40	534770	241650
2018	Short-term AQO	99.79th percentile of hourly averages	200	247	86	43	24.4	110	55	534680	241320
	Long-term AQO	Annual average	40	4.9	3.4	9	12.2	16	39	534770	241650
2019	Short-term AQO	99.79th percentile of hourly averages	200	236	83	42	24.4	107	54	534650	241650
	Long-term AQO	Annual average	40	5.7	4.0	10	12.2	16	40	534770	241650
2020	Short-term AQO	99.79th percentile of hourly averages	200	241	84	42	24.4	108	54	534650	241650
	Long-term AQO	Annual average	40	5.8	4.1	10	12.2	16	41	534770	241650

[19] 35% of short-term NO_x PC and 70% of long term NO_x PC
[20] Adding double the annual average background concentration to the 99.79th percentile of hourly averages

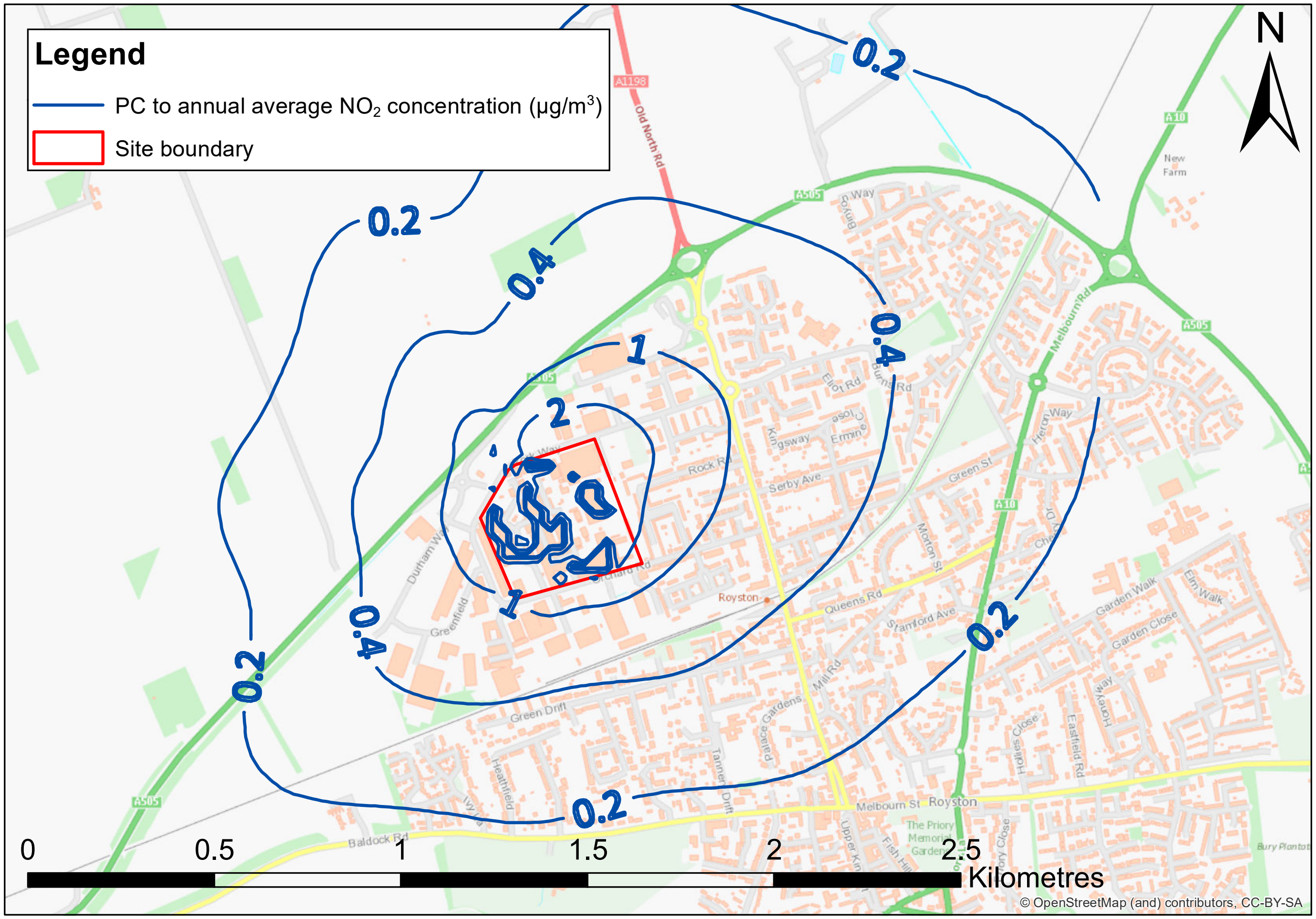

Figure 7.1: Contour plot of the PC to annual average NO_2 concentration, Apollo Phase 1, using meteorological data for the year 2020

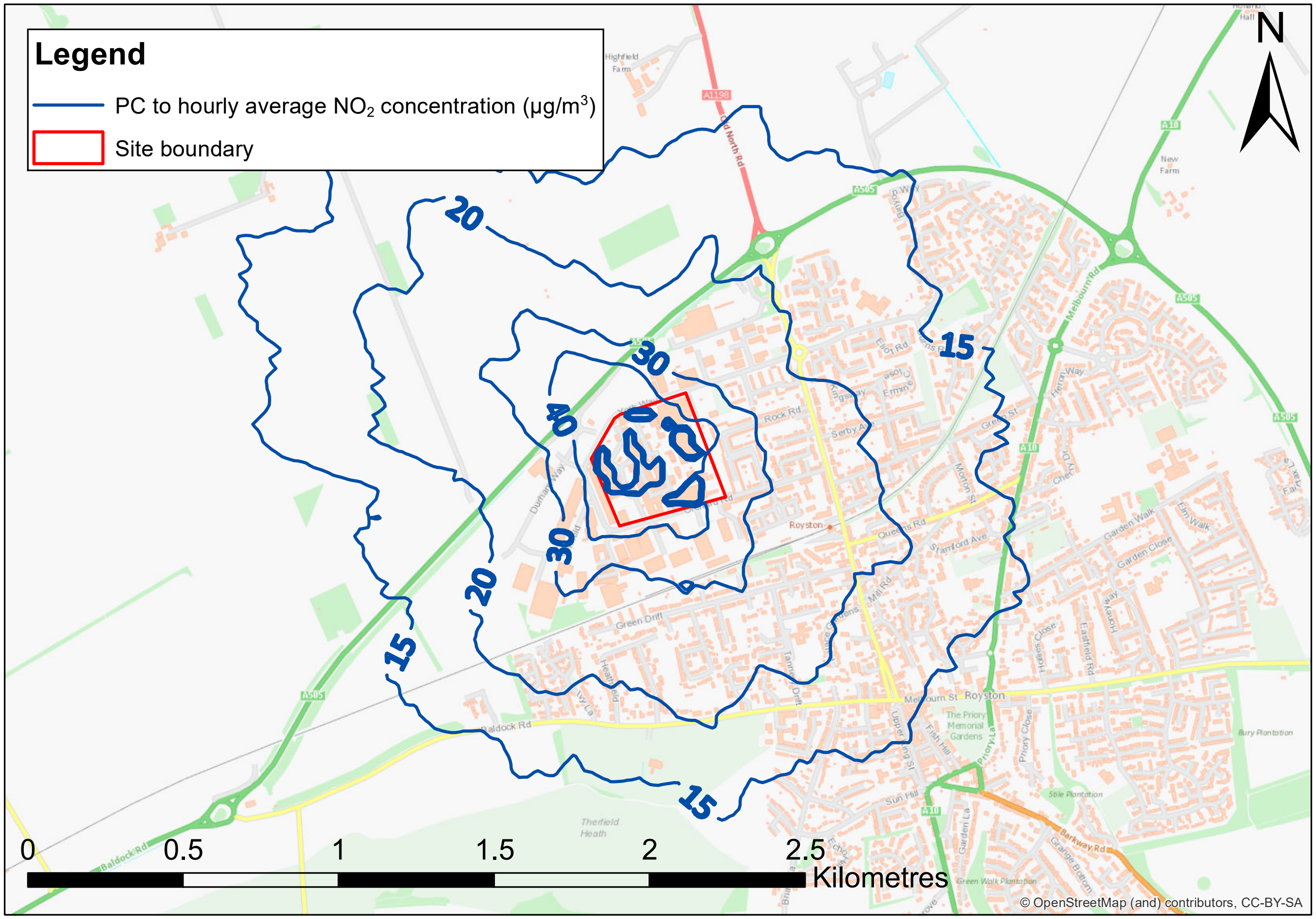

Figure 7.2: Contour plot of the PC to 99.79th percentile of hourly average NO_2 concentration, Apollo Phase 1, using meteorological data for the year 2018

7.1.2 Apollo Phase 2

Table 7.4 shows the maximum predicted offsite concentrations of NO_2 with Apollo Phase 2, calculated using meteorological data for the five years 2016 to 2020.

The results are almost identical to those for Phase 1; the maximum values are the same.

Table 7.2: Maximum predicted offsite concentrations of NO_2 ($\mu g/m^3$), Apollo Phase 2

Year	Standard	Measured as	Objective value	PC (NO_x)	PC (NO_2)[21]	PC % of objective	Background NO_2[22]	PEC (NO_2)	PEC % of objective	Location	
										x	y
2016	Short-term AQO	99.79th percentile of hourly averages	200	243	85	43	24.4	109	55	534680	241320
	Long-term AQO	Annual average	40	5.5	3.9	10	12.2	16	40	534770	241650
2017	Short-term AQO	99.79th percentile of hourly averages	200	242	85	43	24.4	109	55	534650	241650
	Long-term AQO	Annual average	40	5.7	4.0	10	12.2	16	40	534770	241650
2018	Short-term AQO	99.79th percentile of hourly averages	200	247	86	43	24.4	110	55	534680	241320
	Long-term AQO	Annual average	40	4.9	3.4	9	12.2	16	39	534770	241650
2019	Short-term AQO	99.79th percentile of hourly averages	200	236	83	42	24.4	107	54	534650	241650
	Long-term AQO	Annual average	40	5.7	4.0	10	12.2	16	40	534770	241650
2020	Short-term AQO	99.79th percentile of hourly averages	200	241	84	42	24.4	108	54	534650	241650
	Long-term AQO	Annual average	40	5.8	4.1	10	12.2	16	41	534770	241650

[21] 35% of short-term NO_x PC and 70% of long term NO_x PC
[22] Adding double the annual average background concentration to the 99.79th percentile of hourly averages

7.2 Predicted concentrations of carbon monoxide

7.2.1 Apollo Phase 1

Table 7.3 shows the maximum predicted PC to ground level concentrations of CO for Apollo Phase 1, using meteorological data for the five years 2016 to 2020. The maximum offsite concentrations are screened out as insignificant for all years.

Table 7.3: Maximum predicted offsite CO concentrations (µg/m^3), Apollo Phase 1

Year	Standard	Measured as	Objective value	PC	PC % of objective	Significant release?	Location	
							x	y
2016	Short-term AQO	Maximum 8 hour rolling average	10,000	212	2	No	534650	241650
	Short-term EAL	Maximum hourly average	30,000	281	1	No	534770	241650
2017	Short-term AQO	Maximum 8 hour rolling average	10,000	219	2	No	534650	241650
	Short-term EAL	Maximum hourly average	30,000	288	1	No	534770	241650
2018	Short-term AQO	Maximum 8 hour rolling average	10,000	232	2	No	534620	241650
	Short-term EAL	Maximum hourly average	30,000	273	1	No	534980	241560
2019	Short-term AQO	Maximum 8 hour rolling average	10,000	223	2	No	534650	241650
	Short-term EAL	Maximum hourly average	30,000	333	1	No	534680	241650
2020	Short-term AQO	Maximum 8 hour rolling average	10,000	224	2	No	534650	241650
	Short-term EAL	Maximum hourly average	30,000	267	1	No	534620	241650

7.2.2 Apollo Phase 2

Table 7.6 shows the maximum predicted PC to ground level concentrations of CO for Apollo Phase 2, using meteorological data for the five years 2016 to 2020. The results are almost identical to those for Phase 1; the maximum offsite concentrations are screened out as insignificant for all years.

Table 7.4: Maximum predicted offsite CO concentrations (μg/m^3), Apollo Phase 2

Year	Standard	Measured as	Objective value	PC	PC % of objective	Significant release?	Location	
							x	y
2016	Short-term AQO	Maximum 8 hour rolling average	10,000	213	2	No	534650	241650
	Short-term EAL	Maximum hourly average	30,000	281	1	No	534770	241650
2017	Short-term AQO	Maximum 8 hour rolling average	10,000	219	2	No	534650	241650
	Short-term EAL	Maximum hourly average	30,000	288	1	No	534770	241650
2018	Short-term AQO	Maximum 8 hour rolling average	10,000	232	2	No	534620	241650
	Short-term EAL	Maximum hourly average	30,000	275	1	No	534980	241560
2019	Short-term AQO	Maximum 8 hour rolling average	10,000	224	2	No	534650	241650
	Short-term EAL	Maximum hourly average	30,000	334	1	No	534680	241650
2020	Short-term AQO	Maximum 8 hour rolling average	10,000	225	2	No	534650	241650
	Short-term EAL	Maximum hourly average	30,000	267	1	No	534620	241650

7.3 Predicted concentrations of particulates

For a worst case assessment of PM_{10} and $PM_{2.5}$ impacts, 100% of the emissions of total particulate matter (TPM) was assumed to be PM_{10} and $PM_{2.5}$ in each case.

Table 7.5 and Table 7.6 show the maximum predicted PCs to ground level concentrations of PM_{10} and $PM_{2.5}$, respectively, using meteorological data for the five years 2016 to 2020.

The maximum annual average offsite PM PC is 0.7 $\mu g/m^3$, calculated using meteorological data for the year 2018. This is 1.8% of the PM_{10} air quality objective of 40 $\mu g/m^3$, and 4% of the $PM_{2.5}$ air quality objective of 20 $\mu g/m^3$. Including the respective background concentrations, maximum predicted offsite PECs of both PM_{10} and $PM_{2.5}$ are below the air quality objective.

Figure 7.3 shows a contour plot of annual average PM PC concentrations, based on meteorological data for the year 2018, the year giving the highest predicted annual average concentrations.

The maximum offsite 90.41^{st} percentile of 24-hour average PM_{10} PC concentration is 5.9 $\mu g/m^3$, 11.8% of the air quality objective of 50 $\mu g/m^3$, calculated using meteorological data for the year 2018. Including the background concentration of 15.6 $\mu g/m^3$, maximum predicted offsite PECs are below the air quality objective. The maximum offsite 90.41^{st} percentile of 24-hour average PM_{10} PC concentrations for the other four years of meteorological data are screened out.

Figure 7.4 shows a contour plot of the 90.41^{st} percentile of 24-hour average PM_{10} PC concentrations, based on meteorological data for the year 2018, the year giving the highest predicted hourly average concentrations.

Table 7.5: Maximum predicted offsite PM_{10} concentrations (µg/m³)

Year	Standard	Measured as	Objective value	PC	PC % of objective	Significant release?	Background	PEC	PEC % of objective	Location	
										x	y
2016	Short-term PM_{10} AQO	90.41st percentile of 24-hour averages	50	3.7	7.4	No	-	-	-	534680	241620
	Long-term PM_{10} AQO	Annual average	40	0.5	1.3	Yes	15.6	16.1	40	534680	241620
2017	Short-term PM_{10} AQO	90.41st percentile of 24-hour averages	50	4.2	8.4	No	-	-	-	534920	241320
	Long-term PM_{10} AQO	Annual average	40	0.6	1.5	Yes	15.6	16.2	40	534920	241320
2018	Short-term PM_{10} AQO	90.41st percentile of 24-hour averages	50	5.9	11.8	Yes	15.6	21.5	43	534680	241620
	Long-term PM_{10} AQO	Annual average	40	0.7	1.8	Yes	15.6	16.3	41	534680	241620
2019	Short-term PM_{10} AQO	90.41st percentile of 24-hour averages	50	4.8	9.6	No	-	-	-	534680	241620
	Long-term PM_{10} AQO	Annual average	40	0.6	1.5	Yes	15.6	16.2	41	534680	241620
2020	Short-term PM_{10} AQO	90.41st percentile of 24-hour averages	50	3.9	7.8	No	-	-	-	534680	241620
	Long-term PM_{10} AQO	Annual average	40	0.5	1.3	Yes	15.6	16.1	40	534680	241620

Table 7.6: Maximum predicted offsite $PM_{2.5}$ concentrations (μg/m³)

Year	Standard	Measured as	Objective value	PC	PC % of objective	Significant release?	Background	PEC	PEC % of objective	Location	
										x	y
2016	Long-term $PM_{2.5}$ AQO	Annual average	20	0.5	3	Yes	8.9	9.4	47	534680	241620
2017				0.6	3			9.5	48	534920	241320
2018				0.7	4			9.6	48	534680	241620
2019				0.6	3			9.5	48	534680	241620
2020				0.5	3			9.4	47	534680	241620

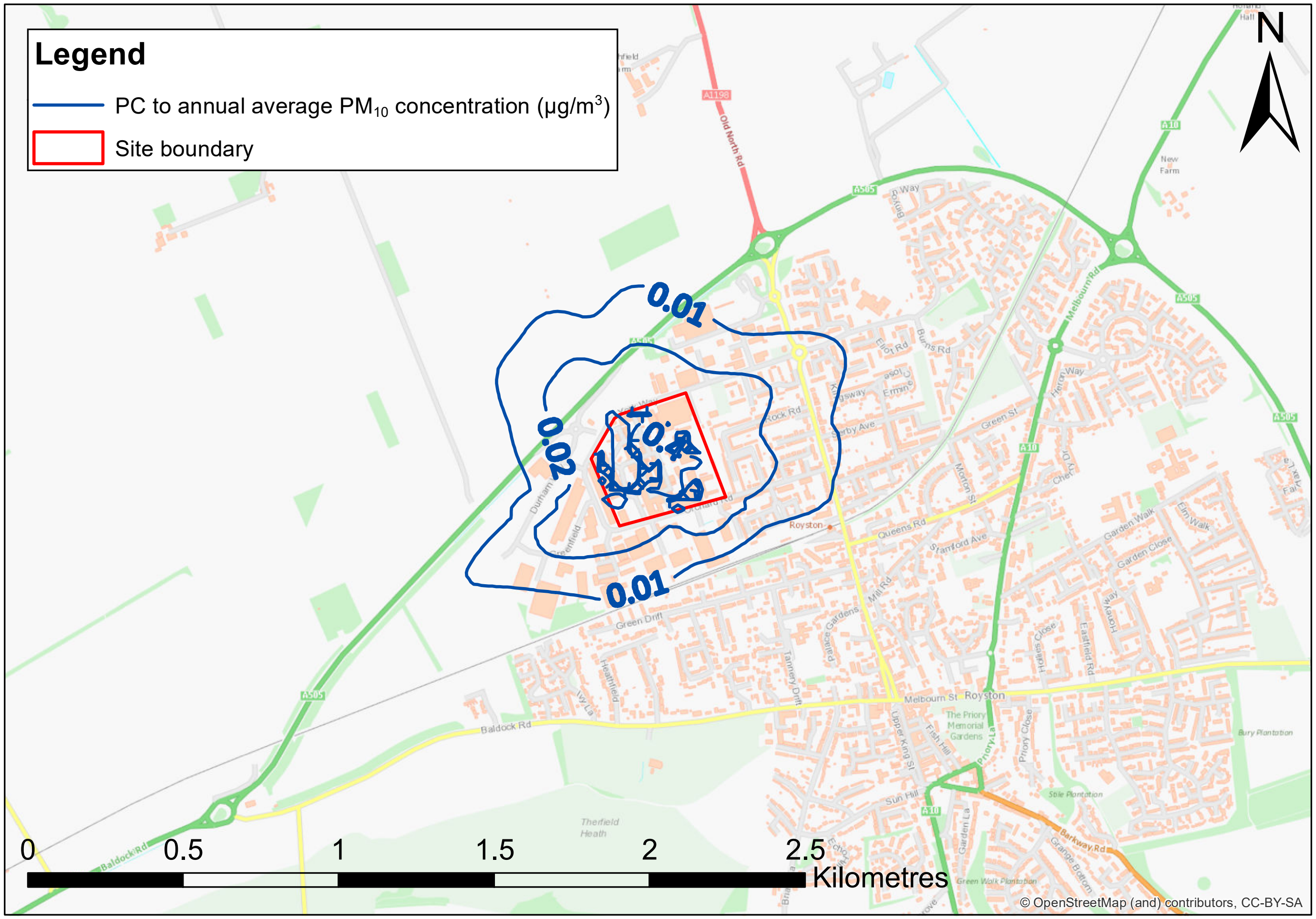

Figure 7.3: Contour plot of the PC to annual average PM concentration, using meteorological data for the year 2018

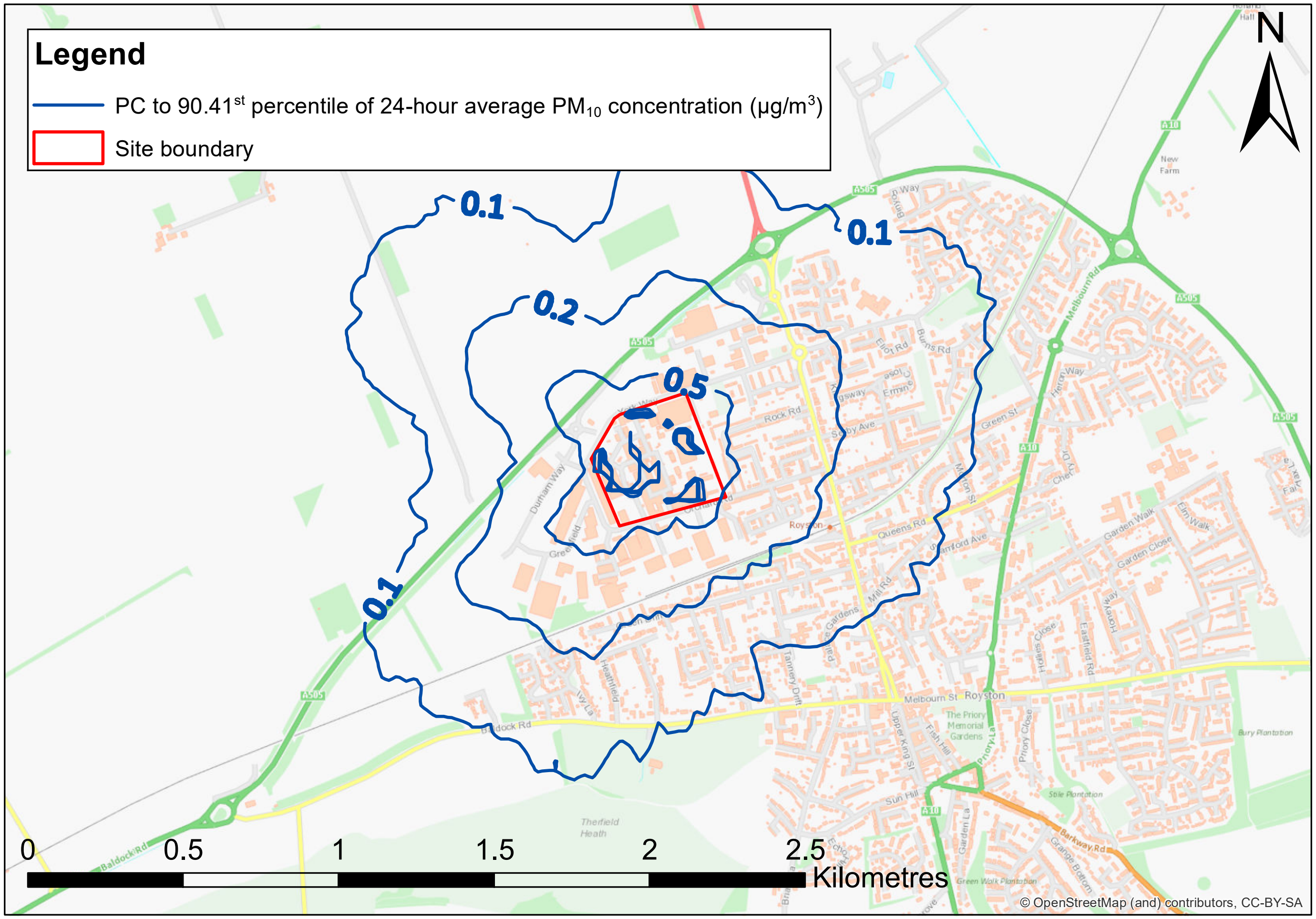

Figure 7.4: Contour plot of the PC to 90.41st percentile of 24-hour average PM_{10} concentration, using meteorological data for the year 2018

7.4 Predicted concentrations of acetic acid

Table 7.7 shows the maximum predicted PC to ground level concentrations of acetic acid, using meteorological data for the five years 2016 to 2020. The maximum offsite concentrations are screened out as insignificant for all years.

Table 7.7: Maximum predicted offsite acetic acid concentrations (µg/m³)

Year	Standard	Measured as	EAL value	PC	PC % of EAL	Significant release?	Location	
							x	y
2016	Short-term EAL	Maximum hourly average	3,700	72	1.9	No	534740	241650
	Long-term EAL	Annual average	250	0.04	< 0.1	No	534950	241620
2017	Short-term EAL	Maximum hourly average	3,700	54	1.5	No	534680	241620
	Long-term EAL	Annual average	250	0.05	< 0.1	No	534950	241620
2018	Short-term EAL	Maximum hourly average	3,700	63	1.7	No	534740	241650
	Long-term EAL	Annual average	250	0.03	< 0.1	No	534950	241620
2019	Short-term EAL	Maximum hourly average	3,700	55	1.5	No	534740	241650
	Long-term EAL	Annual average	250	0.04	< 0.1	No	534950	241620
2020	Short-term EAL	Maximum hourly average	3,700	60	1.6	No	534740	241650
	Long-term EAL	Annual average	250	0.04	< 0.1	No	534860	241680

7.5 Predicted concentrations of ammonia

Table 7.8 shows the maximum predicted PC to ground level concentrations of ammonia, using meteorological data for the five years 2016 to 2020. The maximum offsite concentrations are screened out as insignificant for all years.

Table 7.8: Maximum predicted offsite NH_3 concentrations (µg/m^3)

Year	Standard	Measured as	EAL value	PC	PC % of EAL	Significant release?	Location	
							x	y
2016	Short-term EAL	Maximum hourly average	2,500	31.8	1.3	No	534980	241560
	Long-term EAL	Annual average	180	0.2	0.1	No	535010	241650
2017	Short-term EAL	Maximum hourly average	2,500	37.5	1.5	No	534980	241560
	Long-term EAL	Annual average	180	0.3	0.2	No	535010	241620
2018	Short-term EAL	Maximum hourly average	2,500	32.7	1.3	No	534980	241560
	Long-term EAL	Annual average	180	0.2	0.1	No	534950	241680
2019	Short-term EAL	Maximum hourly average	2,500	36.9	1.5	No	534980	241560
	Long-term EAL	Annual average	180	0.2	0.1	No	535010	241650
2020	Short-term EAL	Maximum hourly average	2,500	26.9	1.1	No	534980	241560
	Long-term EAL	Annual average	180	0.3	0.2	No	534980	241650

7.6 Predicted concentrations of hydrogen chloride

Table 7.9 shows the maximum predicted PC to ground level concentrations of HCl, using meteorological data for the five years 2016 to 2020. The maximum offsite concentrations are screened out as insignificant for all years. Note that there is no long-term EAL for HCl.

Table 7.9: Maximum predicted offsite HCl concentrations (µg/m^3)

Year	Standard	Measured as	EAL value	PC	PC % of EAL	Significant release?	Location	
							x	y
2016	Short-term EAL	Maximum hourly average	750	35	5	No	534950	241320
2017				55	7	No	534950	241290
2018				37	5	No	534620	241440
2019				34	5	No	534980	241320
2020				39	5	No	534620	241440

7.7 Predicted concentrations of chlorine

Background concentrations of chlorine (Cl_2) are assumed to be zero, therefore the predicted PC is assumed to be equal to the PEC. Note that there is no long-term EAL for Cl_2.

Table 7.10 shows the maximum predicted offsite concentrations of Cl_2, calculated using meteorological data for the five years 2016 to 2020. The maximum hourly average offsite PC is 99 µg/m^3, 34% of the short term EAL of 290 µg/m^3, calculated using meteorological data for the year 2018.

Figure 7.5 shows a contour plot of the maximum hourly average chlorine concentrations, based on meteorological data for the year 2018.

Table 7.10: Maximum predicted offsite Cl_2 concentrations (µg/m^3)

Year	Standard	Measured as	EAL value	PC = PEC	PC % of EAL	Significant release?	Location	
							x	y
2016	Short-term EAL	Maximum hourly average	290	81	28	Yes	534860	241290
2017				93	32	Yes	534800	241290
2018				99	34	Yes	534800	241290
2019				80	28	Yes	534800	241290
2020				79	27	Yes	534980	241110

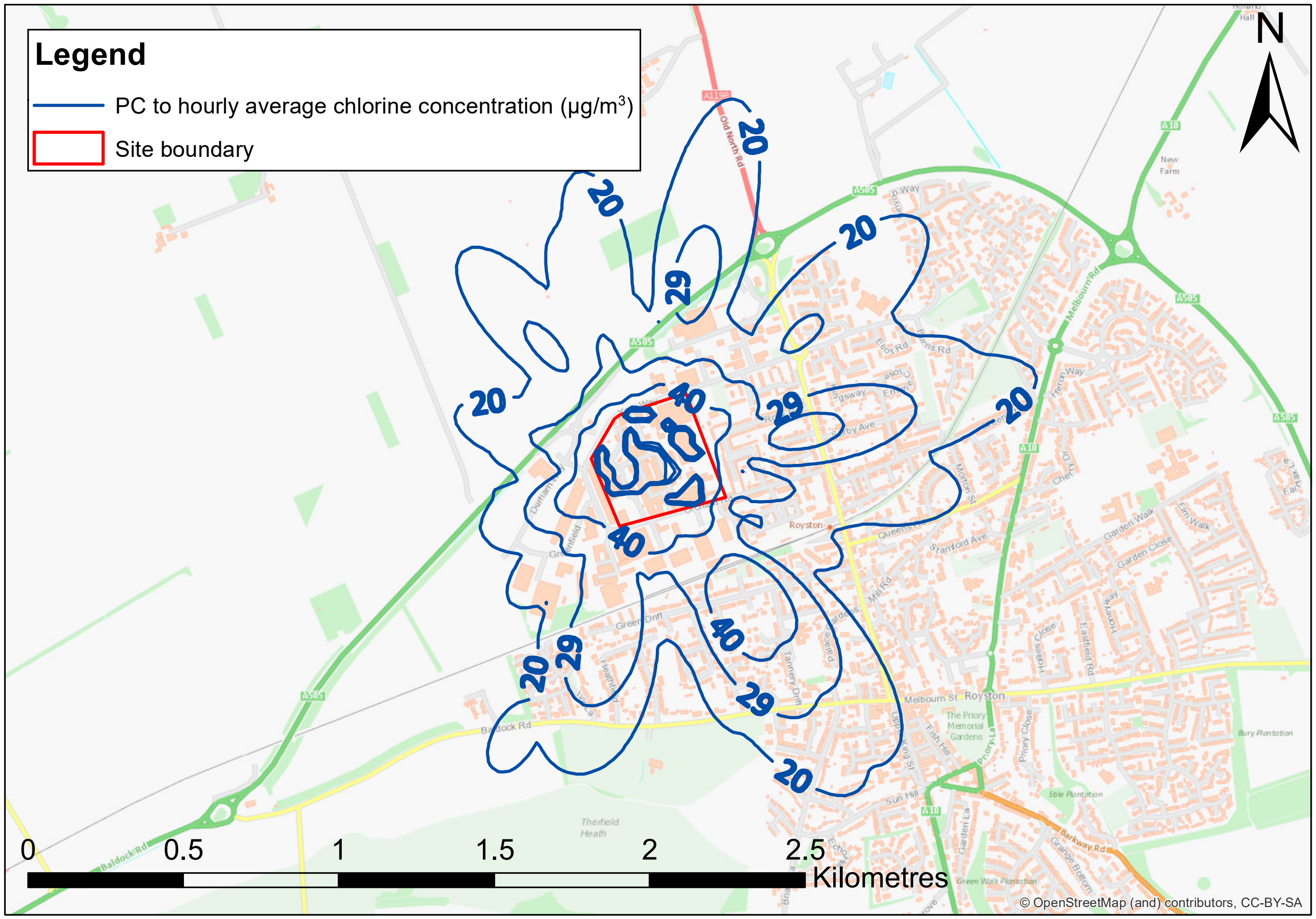

Figure 7.5: Contour plot of the PC to hourly average chlorine concentrations, using meteorological data for the year 2018

7.8 Predicted concentrations of NH4Cl

Background concentrations of ammonium chloride (NH_4Cl) are assumed to be zero, therefore the predicted PC is assumed to be equal to the PEC. Note that there is no short-term EAL for NH_4Cl.

Table 7.11 shows the maximum predicted offsite concentrations of NH_4Cl, calculated using meteorological data for the five years 2016 to 2020. The maximum offsite concentrations are screened out as insignificant for all years.

Table 7.11: Maximum predicted offsite NH_4Cl concentrations (μg/m^3)

Year	Standard	Measured as	EAL value	PC = PEC	PC % of EAL	Significant release?	Location	
							x	y
2016	Long-term EAL	Annual average	9,400	0.004	< 0.1	No	535040	241590
2017				0.004			535070	241590
2018				0.003			535040	241590
2019				0.004			535040	241590
2020				0.004			535040	241590

7.9 Predicted concentrations of NMVOCs

The predicted concentrations of NMVOCs are compared against EALs for DMF, the emitted VOC with the most stringent standard. Background concentrations of DMF are assumed to be zero, therefore the predicted PC concentrations presented in the tables are assumed to be equal to the PEC.

Table 7.12 shows the maximum predicted offsite concentrations of NMVOCs using meteorological data for the five years 2016 to 2020.

The maximum annual average offsite PC is 5.7 µg/m^3, 2% of the long-term EAL for DMF of 300 µg/m^3, calculated using meteorological data for the years 2019 and 2020. These maximum offsite concentrations are not considered significant in comparison against the EALs for any of the other VOCs.

Figure 7.6 shows a contour plot of the PC to annual average NMVOC concentration, based on meteorological data for the year 2019.

The maximum hourly average offsite NMVOC concentrations are screened out as insignificant for all years.

Table 7.12: Maximum predicted offsite NMVOC concentrations (µg/m^3) [compared against the EALs for DMF]

Year	Standard	Measured as	EAL value	PC =PEC	PC % of EAL	Significant release?	Location	
							x	y
2016	Short-term EAL	Maximum hourly average	6,100	270	4	No	534950	241320
	Long-term EAL	Annual average	300	5.3	2	Yes	534860	241680
2017	Short-term EAL	Maximum hourly average	6,100	424	7	No	534920	241320
	Long-term EAL	Annual average	300	5.3	2	Yes	534860	241680
2018	Short-term EAL	Maximum hourly average	6,100	282	5	No	534680	241320
	Long-term EAL	Annual average	300	4.8	2	Yes	534830	241680
2019	Short-term EAL	Maximum hourly average	6,100	263	4	No	534980	241320
	Long-term EAL	Annual average	300	5.7	2	Yes	534860	241680
2020	Short-term EAL	Maximum hourly average	6,100	286	5	No	534620	241440
	Long-term EAL	Annual average	300	5.7	2	Yes	534860	241680

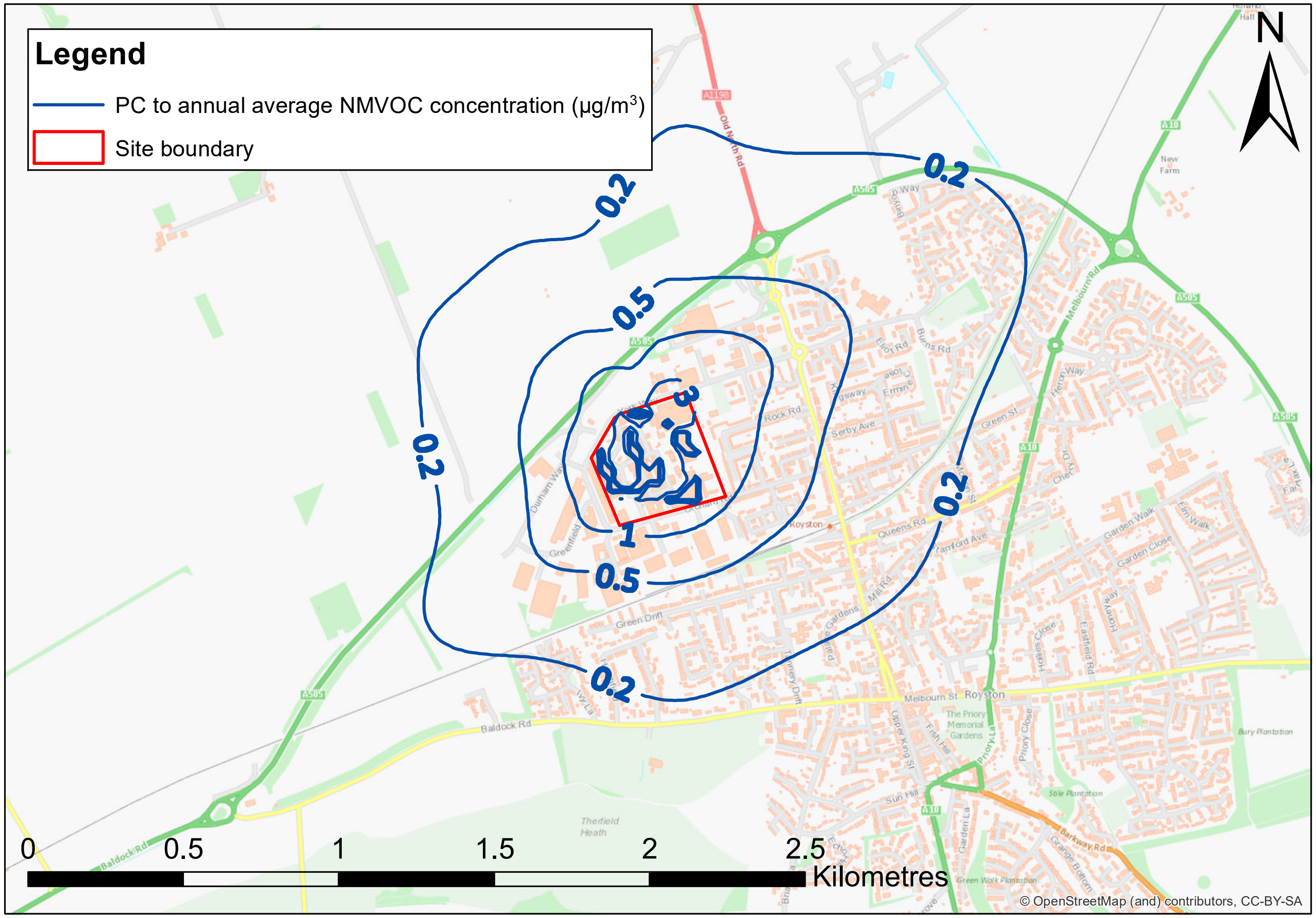

Figure 7.6: Contour plot of the PC to annual average NMVOC concentrations, using meteorological data for the year 2019

7.10 Predicted concentrations of nitrous oxide

Table 7.13 shows the maximum predicted PC to ground level concentrations of N_2O, using meteorological data for the five years 2016 to 2020. The maximum offsite concentrations are screened out as insignificant for all years.

Table 7.13: Maximum predicted offsite N_2O concentrations (µg/m^3)

Year	Standard	Measured as	EAL value	PC	PC % of EAL	Significant release?	Location	
							x	y
2016	Short-term EAL	Maximum hourly average	54,900	289	0.5	No	534740	241650
	Long-term EAL	Annual average	1,830	0.01	< 0.1	No	534950	241620
2017	Short-term EAL	Maximum hourly average	54,900	217	0.4	No	534680	241620
	Long-term EAL	Annual average	1,830	0.01	< 0.1	No	534950	241620
2018	Short-term EAL	Maximum hourly average	54,900	254	0.5	No	534740	241650
	Long-term EAL	Annual average	1,830	0.01	< 0.1	No	534950	241620
2019	Short-term EAL	Maximum hourly average	54,900	218	0.4	No	534740	241650
	Long-term EAL	Annual average	1,830	0.01	< 0.1	No	534950	241620
2020	Short-term EAL	Maximum hourly average	54,900	239	0.4	No	534740	241650
	Long-term EAL	Annual average	1,830	0.01	< 0.1	No	534860	241680

7.11 Predicted concentrations of ethanal

7.11.1 Apollo Phase 1

Table 7.14 shows the maximum predicted PC to ground level concentrations of ethanal for Apollo Phase 1, using meteorological data for the five years 2016 to 2020.

The maximum offsite concentrations for Apollo Phase 1 are screened out as insignificant for all years.

Table 7.14: Maximum predicted offsite ethanal concentrations (µg/m³), Apollo Phase 1

Year	Standard	Measured as	EAL value	PC	PC % of EAL	Significant release?	Location	
							x	y
2016	Short-term EAL	Maximum hourly average	9,200	7.7	0.1	No	534980	241560
	Long-term EAL	Annual average	370	0.3	0.1	No	534980	241560
2017	Short-term EAL	Maximum hourly average	9,200	8.1	0.1	No	534980	241560
	Long-term EAL	Annual average	370	0.4	0.1	No	534980	241560
2018	Short-term EAL	Maximum hourly average	9,200	7.6	0.1	No	534980	241560
	Long-term EAL	Annual average	370	0.3	0.1	No	534980	241560
2019	Short-term EAL	Maximum hourly average	9,200	8.0	0.1	No	534980	241560
	Long-term EAL	Annual average	370	0.6	0.2	No	534680	241620
2020	Short-term EAL	Maximum hourly average	9,200	6.9	0.1	No	534800	241680
	Long-term EAL	Annual average	370	0.5	0.1	No	534680	241620

7.11.2 Apollo Phase 2

Table 7.14 shows the maximum predicted PC to ground level concentrations of ethanal for Apollo Phase 2, using meteorological data for the five years 2016 to 2020.

The maximum offsite concentrations for Apollo Phase 2 are screened out as insignificant for all years.

Table 7.15: Maximum predicted offsite ethanal concentrations (µg/m³), Apollo Phase 2

Year	Standard	Measured as	EAL value	PC	PC % of EAL	Significant release?	Location	
							x	y
2016	Short-term EAL	Maximum hourly average	9,200	8.7	0.1	No	534980	534980
	Long-term EAL	Annual average	370	0.3	0.1	No	535010	241650
2017	Short-term EAL	Maximum hourly average	9,200	9.0	0.1	No	534980	241560
	Long-term EAL	Annual average	370	0.5	0.1	No	534980	241560
2018	Short-term EAL	Maximum hourly average	9,200	8.1	0.1	No	534980	241560
	Long-term EAL	Annual average	370	0.3	0.1	No	534980	241560
2019	Short-term EAL	Maximum hourly average	9,200	8.9	0.1	No	534980	241560
	Long-term EAL	Annual average	370	0.3	0.1	No	535010	241650
2020	Short-term EAL	Maximum hourly average	9,200	7.6	0.1	No	534800	241680
	Long-term EAL	Annual average	370	0.4	0.1	No	534980	241560

8. Consideration of critical levels for the Protection of Vegetation and Ecosystems

Modelling was carried out to predict the Process Contribution (PC) to ground level concentrations of each relevant pollutant from the Johnson Matthey Royston site, at each of the designated conservation areas. Note that the maximum concentrations quoted for each pollutant are the maximum values occurring at locations relevant to the standard under consideration. This means that, for comparison against critical levels for the Protection of Vegetation and Ecosystems, only those values predicted within designated conservation areas were included.

The significance of the total pollutant release was assessed by comparing the PC to the relevant critical level. For long-term critical levels, the Environment Agency considers the release to be insignificant if the PC is less than 1% of the critical level.[1] Where a release is insignificant the pollutant is screened out and no further assessment undertaken.

Where a release is significant, the Predicted Environmental Concentration (PEC) for that substance is calculated. For long-term critical levels, the PEC is calculated by adding the PC to the estimated background concentration of the pollutant.

8.1 Predicted concentrations of nitrogen oxides

8.1.1 Apollo Phase 1

Table 8.1 and Table 8.2 show the maximum predicted daily average and annual average PCs to ground level concentrations of nitrogen oxides (NO_x) at each of the designated conservation areas, for Apollo Phase 1, using meteorological data for the five years 2016 to 2020.

As advised by the Environment Agency, the background concentration of NO_x has not been added to the daily average PC.

The daily average PCs are not screened out for any of the designated conservation areas, but the annual average PCs are screened out for the six LWSs. There are no exceedences of either of the critical levels.

Table 8.1: Predicted daily average NO_x concentrations ($\mu g/m^3$) at designated conservation areas, Apollo Phase 1

Site name	Critical level	Year	PC	PC / PEC % of critical level	Significant release?
Therfield Heath SSSI	75	2016	20	27	Yes
		2017	18	24	
		2018	19	25	
		2019	21	28	
		2020	19	25	
Holland Hall SSSI	75	2016	11	15	Yes
		2017	11	15	
		2018	9	12	
		2019	10	13	
		2020	8	11	
Therfield, South of Tumulus LWS	75	2016	8	11	Yes
		2017	6	8	No
		2018	9	12	Yes
		2019	10	13	
		2020	7	9	No
Royston Chalk Pit LWS	75	2016	8	11	Yes
		2017	8	11	
		2018	8	11	
		2019	13	17	
		2020	8	11	
Shaftsbury Green LWS	75	2016	9	12	Yes
		2017	8	11	
		2018	8	11	
		2019	13	17	
		2020	9	12	
Icknield Way, A505 North of Gallows Hill LWS	75	2016	8	11	Yes
		2017	10	13	
		2018	6	8	No
		2019	7	9	
		2020	6	8	
Green Lane South of Royston LWS	75	2016	12	16	Yes
		2017	9	12	
		2018	10	13	
		2019	12	16	
		2020	11	15	

Table 8.1: continued

Site name	Critical level	Year	PC	PC / PEC % of critical level	Significant release?
Therfield Green Lane LWS	75	2016	8	11	Yes
		2017	6	8	No
		2018	9	12	Yes
		2019	7	9	No
		2020	8	11	Yes

Table 8.2: Predicted annual average NO_x concentrations (µg/m^3) at designated conservation areas, Apollo Phase 1

Site name	Critical level	Year	PC	% PC of critical level	Significant release?	Background	PEC	% PEC of critical level
Therfield Heath SSSI	30	2016	0.33	1.1	Yes	10.8	11.1	37
		2017	0.25	0.8	No	-	-	-
		2018	0.40	1.3	Yes	10.8	11.2	37
		2019	0.27	0.9	No	-	-	-
		2020	0.25	0.8				
Holland Hall SSSI	30	2016	0.31	1.0	Yes	11.0	12.0	40
		2017	0.36	1.2	Yes	11.0	12.2	41
		2018	0.28	0.9	No	-	-	-
		2019	0.35	1.2	Yes	11.0	12.2	41
		2020	0.30	1.0	No	-	-	-
Therfield, South of Tumulus LWS	30	2016	0.13	0.4	No	-	-	-
		2017	0.06	0.2				
		2018	0.17	0.6				
		2019	0.11	0.4				
		2020	0.10	0.3				
Royston Chalk Pit LWS	30	2016	0.16	0.5	No	-	-	-
		2017	0.19	0.6				
		2018	0.13	0.4				
		2019	0.16	0.5				
		2020	0.14	0.5				

Table 8.2: continued

Site name	Critical level	Year	PC	% PC of critical level	Significant release?	Background	PEC	% PEC of critical level
Shaftsbury Green LWS	30	2016	0.16	0.5	No	-	-	-
		2017	0.19	0.6				
		2018	0.13	0.4				
		2019	0.16	0.5				
		2020	0.14	0.5				
Icknield Way, A505 North of Gallows Hill LWS	30	2016	0.13	0.4	No	-	-	-
		2017	0.07	0.2				
		2018	0.12	0.4				
		2019	0.12	0.4				
		2020	0.11	0.4				
Green Lane South of Royston LWS	30	2016	0.14	0.5	No	-	-	-
		2017	0.15	0.5				
		2018	0.12	0.4				
		2019	0.14	0.5				
		2020	0.11	0.4				
Therfield Green Lane LWS	30	2016	0.12	0.4	No	-	-	-
		2017	0.06	0.2				
		2018	0.12	0.4				
		2019	0.09	0.3				
		2020	0.08	0.3				

8.1.2 Apollo Phase 2

Table 8.3 and Table 8.4 show the maximum predicted daily average and annual average PCs to ground level concentrations of nitrogen oxides (NO_x) at each of the designated conservation areas, using meteorological data for the five years 2016 to 2020.

As advised by the Environment Agency, the background concentration of NO_x has not been added to the daily average PC.

The results are very similar to those for Phase 1.

Table 8.3: Predicted daily average NO_x concentrations ($\mu g/m^3$) at designated conservation areas, Apollo Phase 2

Site name	Critical level	Year	PC	PC / PEC % of critical level	Significant release?
Therfield Heath SSSI	75	2016	20	27	Yes
		2017	18	24	
		2018	19	25	
		2019	21	28	
		2020	19	25	
Holland Hall SSSI	75	2016	11	15	Yes
		2017	11	15	
		2018	9	12	
		2019	10	13	
		2020	8	11	
Therfield, South of Tumulus LWS	75	2016	8	11	Yes
		2017	6	8	No
		2018	9	12	Yes
		2019	10	13	
		2020	7	9	No
Royston Chalk Pit LWS	75	2016	8	11	Yes
		2017	8	11	
		2018	8	11	
		2019	13	17	
		2020	8	11	
Shaftsbury Green LWS	75	2016	9	12	Yes
		2017	8	11	
		2018	8	11	
		2019	13	17	
		2020	9	12	
Icknield Way, A505 North of Gallows Hill LWS	75	2016	8	11	Yes
		2017	10	13	
		2018	6	8	No
		2019	7	9	
		2020	6	8	
Green Lane South of Royston LWS	75	2016	12	16	Yes
		2017	9	12	
		2018	10	13	
		2019	12	16	
		2020	11	15	

Table 8.3: continued

Site name	Critical level	Year	PC	PC / PEC % of critical level	Significant release?
Therfield Green Lane LWS	75	2016	8	11	Yes
		2017	6	8	No
		2018	9	12	Yes
		2019	7	9	No
		2020	8	11	Yes

Table 8.4: Predicted annual average NO_x concentrations ($\mu g/m^3$) at designated conservation areas, Apollo Phase 2

Site name	Critical level	Year	PC	% PC of critical level	Significant release?	Background	PEC	% PEC of critical level
Therfield Heath SSSI	30	2016	0.33	1.1	Yes	10.8	11.1	37
		2017	0.26	0.9	No	-	-	-
		2018	0.41	1.4	Yes	10.8	11.2	37
		2019	0.28	0.9	No	-	-	-
		2020	0.25	0.8				
Holland Hall SSSI	30	2016	0.32	1.1	Yes	11.0	11.3	38
		2017	0.36	1.2			11.4	
		2018	0.29	1.0	No	-	-	-
		2019	0.36	1.2	Yes	11.0	11.4	38
		2020	0.31	1.0			11.3	
Therfield, South of Tumulus LWS	30	2016	0.13	0.4	No	-	-	-
		2017	0.06	0.2				
		2018	0.17	0.6				
		2019	0.11	0.4				
		2020	0.11	0.4				
Royston Chalk Pit LWS	30	2016	0.16	0.5	No	-	-	-
		2017	0.20	0.7				
		2018	0.13	0.4				
		2019	0.16	0.5				
		2020	0.14	0.5				

Table 8.4: continued

Site name	Critical level	Year	PC	% PC of critical level	Significant release?	Background	PEC	% PEC of critical level
Shaftsbury Green LWS	30	2016	0.16	0.5	No	-	-	-
		2017	0.20	0.7				
		2018	0.13	0.4				
		2019	0.16	0.5				
		2020	0.14	0.5				
Icknield Way, A505 North of Gallows Hill LWS	30	2016	0.13	0.4	No	-	-	-
		2017	0.07	0.2				
		2018	0.12	0.4				
		2019	0.12	0.4				
		2020	0.11	0.4				
Green Lane South of Royston LWS	30	2016	0.14	0.5	No	-	-	-
		2017	0.15	0.5				
		2018	0.12	0.4				
		2019	0.14	0.5				
		2020	0.11	0.4				
Therfield Green Lane LWS	30	2016	0.12	0.4	No	-	-	-
		2017	0.06	0.2				
		2018	0.12	0.4				
		2019	0.09	0.3				
		2020	0.08	0.3				

8.2 Predicted concentrations of ammonia

Table 8.5 shows the maximum predicted PC to annual average ammonia (NH_3) concentrations at each of the designated conservation areas, using meteorological data for the five years 2016 to 2020.

For all designated conservation areas except Therfield Heath, the annual average NH_3 concentrations are screened out as insignificant. At these areas, the less stringent critical level of 3 µg/m^3 is used.

At Therfield Heath, the woodland habitat may include sensitive lichen and bryophytes communities, so the more stringent critical level has been used and the PCs are not screened out for two out of the five years of meteorological data. The background concentration, 1.6 µg/m^3, exceeds the critical level of 1 µg/m^3.

Table 8.5: Predicted annual average NH_3 concentrations (µg/m³) at designated conservation areas

Site name	Critical level	Year	PC	% PC of critical level	Significant release?	Background	PEC	% PEC of critical level
Therfield Heath SSSI	1	2016	0.014	1.4	Yes	1.6	1.6	160
		2017	0.010	1.0	No	-	-	-
		2018	0.017	1.7	Yes	1.6	1.6	160
		2019	0.011	1.1				
		2020	0.011	1.1				
Holland Hall SSSI	3	2016	0.015	0.5	No	-	-	-
		2017	0.017	0.6				
		2018	0.013	0.4				
		2019	0.016	0.5				
		2020	0.014	0.5				
Therfield, south of Tumulus LWS	3	2016	0.006	0.2	No	-	-	-
		2017	0.002	0.1				
		2018	0.008	0.3				
		2019	0.005	0.2				
		2020	0.005	0.2				
Royston Chalk Pit LWS	3	2016	0.007	0.2	No	-	-	-
		2017	0.008	0.3				
		2018	0.005	0.2				
		2019	0.007	0.2				
		2020	0.006	0.2				

Table 8.5: continued

Site name	Critical level	Year	PC	% PC of critical level	Significant release?	Background	PEC	% PEC of critical level
Shaftsbury Green LWS	3	2016	0.007	0.2	No	-	-	-
		2017	0.008	0.3				
		2018	0.005	0.2				
		2019	0.007	0.2				
		2020	0.006	0.2				
Icknield Way, A505 North of Gallows Hill LWS	3	2016	0.005	0.2	No	-	-	-
		2017	0.003	0.1				
		2018	0.005	0.2				
		2019	0.005	0.2				
		2020	0.005	0.2				
Green Lane South of Royston LWS	3	2016	0.006	0.2	No	-	-	-
		2017	0.006	0.2				
		2018	0.005	0.2				
		2019	0.006	0.2				
		2020	0.004	0.1				
Therfield Green Lane LWS	3	2016	0.005	0.2	No	-	-	-
		2017	0.003	0.1				
		2018	0.005	0.2				
		2019	0.004	0.1				
		2020	0.004	0.1				

9. Nitrogen and acid deposition

Material from a plume can be lost to the ground, at the surface of the ground (dry deposition), and through wash out with precipitation (wet deposition). Deposition of pollutants may lead to detrimental effects at sensitive habitats due to acidification and nitrogen eutrophication.

Modelling was carried out to predict the Process Contribution (PC) to the nitrogen and acid deposition rates from the Johnson Matthey Royston site over the designated conservation areas. The significance of the total pollutant release was assessed by comparing the PC to the relevant critical loads. For long-term impacts, as in the case of deposition, the Environment Agency considers the release to be insignificant if the PC is less than 1% of the critical load. Where a release is insignificant the impact is screened out and no further assessment undertaken.

9.1 Deposition of nitrogen

9.1.1 Critical loads and existing levels of nitrogen deposition

The Air Pollution Information System (APIS) website[13] gives critical load values for specific SSSIs. For sites such as LWSs, critical load values can be found by location.

Table 9.1 shows the habitat types, critical loads and total nitrogen deposition values at the two SSSIs and six LWSs identified in Section 4.1. A habitat type of 'calcareous grassland' has been assumed for Holland Hall SSSI and the six LWSs, and two habitat types, 'broadleaved, mixed and yew woodland' and 'calcareous grassland', have been assumed for Therfield Heath SSSI. The total nitrogen deposition values presented are specific to habitat types at each designated conservation area. The total nitrogen deposition values presented represent the average deposition over the years 2019 to 2021, due to existing local sources and background contributions.

In some cases, the existing total nitrogen deposition rate exceeds the relevant critical load range.

Table 9.1: Total nitrogen deposition (kg N ha^{-1} yr^{-1})

<table>
<tr><th>Site name</th><th>Habitat type</th><th>Relevant Nitrogen critical load class</th><th>Critical load</th><th>Total nitrogen deposition</th></tr>
<tr><td rowspan="2">Therfield Heath SSSI</td><td>Broadleaved, mixed and yew woodland</td><td>Fagus woodland</td><td>10 – 20</td><td>27.6 (max)
26.8 (min)
27.2 (avg)</td></tr>
<tr><td>Calcareous grassland</td><td>Sub-Atlantic semi-dry calcareous grassland</td><td>15 - 25</td><td>15.7 (max)
15.2 (min)
15.5 (avg)</td></tr>
<tr><td>Holland Hall SSSI</td><td>Calcareous grassland</td><td>Sub-Atlantic semi-dry calcareous grassland</td><td>15 - 25</td><td>14.7 (max)
14.6 (min)
14.7 (avg)</td></tr>
<tr><td>Therfield, south of Tumulus LWS</td><td rowspan="6">Calcareous grassland</td><td rowspan="6">Sub-Atlantic semi-dry calcareous grassland</td><td rowspan="6">15 - 25</td><td>15.3</td></tr>
<tr><td>Royston Chalk Pit LWS</td><td>15.1</td></tr>
<tr><td>Shaftsbury Green LWS</td><td>15.1</td></tr>
<tr><td>Icknield Way, A505 north of Gallows Hill LWS</td><td>16.2 (max)
15.3 (min)
15.7 (avg)</td></tr>
<tr><td>Green Lane South of Royston LWS</td><td>15.5</td></tr>
<tr><td>Therfield Green Lane LWS</td><td>16.1 (max)
15.5 (min)
15.8 (avg)</td></tr>
</table>

9.1.2 Process contribution to nitrogen deposition, Apollo Phase 1

The deposition of nitrogen from concentrations of NO_2, NH_3 and NH_4Cl was considered.

The Environment Agency Air Quality Modelling and Assessment Unit (AQMAU)[23] recommend dry deposition velocities for grassland and forest. Dry deposition velocities of 0.0015 m/s for NO_x and 0.02 m/s for NH_3 were used for grassland; values of 0.003 m/s for NO_x and 0.03 m/s for NH_3 were used for forest. Wet deposition for these pollutants was not included, as advised by AQMAU.

Deposition of NH_4Cl was modelled assuming a particulate with density 1530 kg/m^3 and diameter 10 µm, which is likely to be a worst case (overestimating) assumption. Wet deposition of NH_4Cl was included based on the default ADMS parameters[24].

The maximum predicted annual PC to deposition rates of nitrogen at each designated conservation area, for Apollo Phase 1, is presented in Table 9.2, together with the PC as a percentage of the most stringent critical load applicable to each designated conservation area.

The maximum PCs to nitrogen deposition are screened out for grassland habitats at all designated conservation areas.

For the woodland habitat, the maximum PC to nitrogen deposition at Therfield Heath SSSI is greater than 1% of the lower value of the critical load range for two of the five years of meteorological data, so this impact was investigated further.

Figure 9.1 shows a contour plot of the PC to the nitrogen deposition rate at Therfield Heath SSSI, using meteorological data for the year 2018, using deposition velocities for the woodland habitat. The maximum value of 0.159 kgN ha^{-1} yr^{-1} occurs at the northern edge of the SSSI, coinciding with an area of grassland rather than woodland. The maximum value occurring at an area of woodland (indicated by solid green shading on the map) is less than 0.1 kgN ha^{-1} yr^{-1}, i.e. less than 1% of the lower value of the critical load range. Therefore, the PC to nitrogen deposition at Therfield Heath SSSI is screened out as insignificant, as it is less than 1% of the critical load range relevant to specific locations.

[23] AQTAG 06, *Technical Guidance on detailed modelling approach for an appropriate assessment for emissions to air*, Environment Agency, March 2014
[24] Washout coefficient A = 0.0001, washout coefficient B = 0.64.

Table 9.2: Maximum nitrogen deposition (kg N ha^{-1} yr^{-1}) at designated conservation areas, Apollo Phase 1

Site name	Critical load class	Critical load	Year	PC (from NO_2)	PC (from NH_3)	PC (from NH_4Cl)	PC (total)	PC as % of critical load	Significant release?
Therfield Heath SSSI	Fagus woodland	10 – 20	2016	0.058	0.065	0.0015	0.125	0.6 - 1.3	Yes
			2017	0.045	0.050	0.0015	0.096	0.5 - 1.0	No
			2018	0.072	0.086	0.0021	0.159	0.8 - 1.6	Yes
			2019	0.048	0.052	0.0013	0.101	0.5 - 1.0	No
			2020	0.044	0.052	0.0017	0.098	0.5 - 1.0	
	Calcareous grassland	15 – 25	2016	0.031	0.047	0.0015	0.079	0.4 – 0.7	No
			2017	0.024	0.035	0.0015	0.061		
			2018	0.038	0.061	0.0021	0.101		
			2019	0.025	0.037	0.0013	0.064		
			2020	0.024	0.037	0.0017	0.063		
Holland Hall SSSI	Calcareous grassland	15 – 25	2016	0.030	0.056	0.0022	0.088	0.5 – 0.6	No
			2017	0.033	0.062	0.0023	0.097		
			2018	0.026	0.047	0.0016	0.075		
			2019	0.033	0.060	0.0023	0.095		
			2020	0.029	0.055	0.0025	0.086		
Therfield, south of Tumulus LWS	Calcareous grassland	15 – 25	2016	0.012	0.018	0.0005	0.030	0.1 – 0.3	No
			2017	0.005	0.008	0.0003	0.014		
			2018	0.015	0.024	0.0007	0.040		
			2019	0.009	0.013	0.0004	0.023		
			2020	0.009	0.015	0.0006	0.025		

Table 9.2: continued

Site name	Critical load class	Critical load	Year	PC (from NO_2)	PC (from NH_3)	PC (from NH_4Cl)	PC (total)	PC as % of critical load	Significant release?
Royston Chalk Pit LWS	Calcareous grassland	15 – 25	2016	0.014	0.021	0.0007	0.036	0.2 – 0.3	No
			2017	0.018	0.026	0.0008	0.045		
			2018	0.011	0.017	0.0006	0.029		
			2019	0.015	0.022	0.0007	0.037		
			2020	0.012	0.018	0.0006	0.031		
Shaftsbury Green LWS	Calcareous grassland	15 – 25	2016	0.014	0.021	0.0007	0.036	0.2 – 0.3	No
			2017	0.018	0.026	0.0008	0.045		
			2018	0.011	0.017	0.0006	0.029		
			2019	0.015	0.022	0.0007	0.037		
			2020	0.012	0.018	0.0006	0.031		
Icknield Way, A505 north of Gallows Hill LWS	Calcareous grassland	15 – 25	2016	0.012	0.018	0.0005	0.030	0.1 – 0.2	No
			2017	0.006	0.009	0.0003	0.016		
			2018	0.011	0.016	0.0006	0.028		
			2019	0.011	0.015	0.0004	0.026		
			2020	0.011	0.016	0.0006	0.027		
Green Lane South of Royston LWS	Calcareous grassland	15 – 25	2016	0.013	0.019	0.0006	0.032	0.2 – 0.2	No
			2017	0.014	0.020	0.0007	0.035		
			2018	0.011	0.016	0.0005	0.028		
			2019	0.012	0.019	0.0006	0.032		
			2020	0.010	0.014	0.0005	0.024		

Table 9.2: continued

Site name	Critical load class	Critical load	Year	PC (from NO_2)	PC (from NH_3)	PC (from NH_4Cl)	PC (total)	PC as % of critical load	Significant release?
Therfield Green Lane LWS	Calcareous grassland	15 – 25	2016	0.010	0.015	0.0004	0.026	0.1 – 0.2	No
			2017	0.006	0.008	0.0003	0.014		
			2018	0.010	0.016	0.0005	0.027		
			2019	0.008	0.011	0.0003	0.019		
			2020	0.007	0.010	0.0003	0.018		

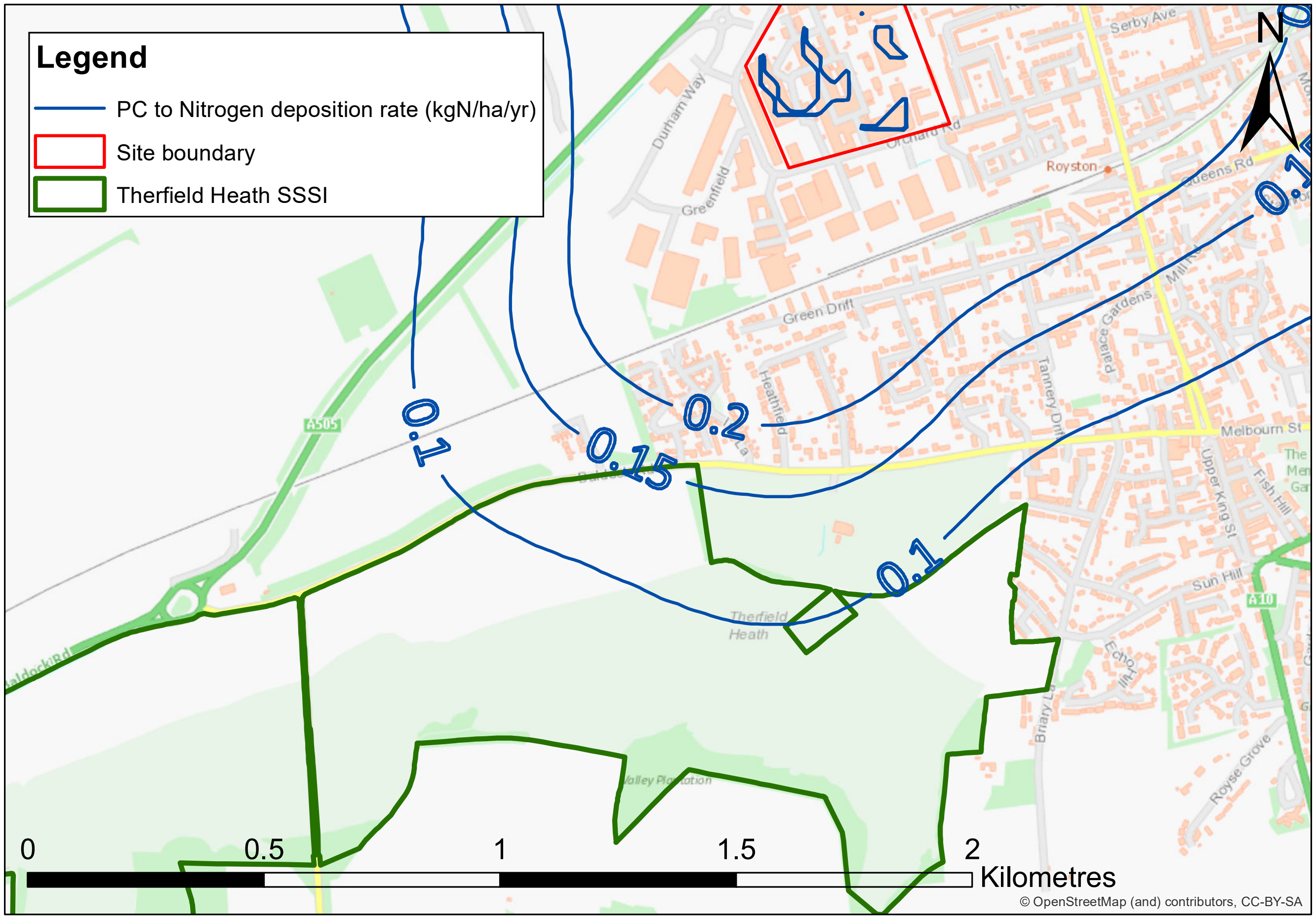

Figure 9.1: Contour plot of the PC to nitrogen deposition for woodland habitat at Therfield Heath SSSI, Apollo Phase 1, based on meteorological data for the year 2018

9.1.3 Process contribution to nitrogen deposition, Apollo Phase 2

The maximum predicted annual PC to deposition rates of nitrogen at each designated conservation area for Apollo Phase 2 is presented in Table 9.3, together with the PC as a percentage of the most stringent critical load applicable to each designated conservation area.

The results are very similar to those for Phase 1.

Table 9.3: Maximum nitrogen deposition (kg N ha^{-1} yr^{-1}) at designated conservation areas, Apollo Phase 2

Site name	Critical load class	Critical load	Year	PC (from NO_2)	PC (from NH_3)	PC (from NH_4Cl)	PC (total)	PC as % of critical load	Significant release?
Therfield Heath SSSI	Fagus woodland	10 – 20	2016	0.059	0.065	0.0015	0.125	1.3	Yes
			2017	0.046	0.050	0.0015	0.097	1.0	No
			2018	0.073	0.086	0.0021	0.160	1.6	Yes
			2019	0.048	0.052	0.0013	0.101	1.0	No
			2020	0.045	0.052	0.0017	0.099	1.0	
	Calcareous grassland	15 – 25	2016	0.031	0.047	0.0015	0.079	0.4 – 0.7	No
			2017	0.024	0.035	0.0015	0.061		
			2018	0.038	0.061	0.0021	0.102		
			2019	0.026	0.037	0.0013	0.064		
			2020	0.024	0.037	0.0017	0.063		
Holland Hall SSSI	Calcareous grassland	15 – 25	2016	0.030	0.056	0.0022	0.088	0.5 – 0.7	No
			2017	0.034	0.062	0.0023	0.098		
			2018	0.027	0.047	0.0016	0.075		
			2019	0.034	0.060	0.0023	0.096		
			2020	0.029	0.055	0.0025	0.087		
Therfield, south of Tumulus LWS	Calcareous grassland	15 – 25	2016	0.012	0.018	0.0005	0.030	0.1 – 0.3	No
			2017	0.005	0.008	0.0003	0.014		
			2018	0.015	0.024	0.0007	0.040		
			2019	0.010	0.013	0.0004	0.023		
			2020	0.010	0.015	0.0006	0.025		

Table 9.3: continued

Site name	Critical load class	Critical load	Year	PC (from NO_2)	PC (from NH_3)	PC (from NH_4Cl)	PC (total)	PC as % of critical load	Significant release?
Royston Chalk Pit LWS	Calcareous grassland	15 – 25	2016	0.015	0.021	0.0007	0.036	0.2 – 0.3	No
			2017	0.018	0.026	0.0008	0.045		
			2018	0.012	0.017	0.0006	0.029		
			2019	0.015	0.022	0.0007	0.037		
			2020	0.013	0.018	0.0006	0.031		
Shaftsbury Green LWS	Calcareous grassland	15 – 25	2016	0.015	0.021	0.0007	0.036	0.2 – 0.3	No
			2017	0.018	0.026	0.0008	0.045		
			2018	0.012	0.017	0.0006	0.029		
			2019	0.015	0.022	0.0007	0.037		
			2020	0.013	0.018	0.0006	0.031		
Icknield Way, A505 north of Gallows Hill LWS	Calcareous grassland	15 – 25	2016	0.012	0.018	0.0005	0.031	0.1 – 0.2	No
			2017	0.006	0.009	0.0003	0.016		
			2018	0.011	0.016	0.0006	0.028		
			2019	0.011	0.015	0.0004	0.026		
			2020	0.011	0.016	0.0006	0.028		
Green Lane South of Royston LWS	Calcareous grassland	15 – 25	2016	0.013	0.019	0.0006	0.032	0.1 – 0.2	No
			2017	0.014	0.020	0.0007	0.035		
			2018	0.011	0.016	0.0005	0.028		
			2019	0.013	0.019	0.0006	0.032		
			2020	0.010	0.014	0.0005	0.024		

Table 9.3: continued

Site name	Critical load class	Critical load	Year	PC (from NO_2)	PC (from NH_3)	PC (from NH_4Cl)	PC (total)	PC as % of critical load	Significant release?
Therfield Green Lane LWS	Calcareous grassland	15 – 25	2016	0.011	0.015	0.0004	0.026	0.1 – 0.2	No
			2017	0.006	0.008	0.0003	0.014		
			2018	0.011	0.016	0.0005	0.027		
			2019	0.008	0.011	0.0003	0.019		
			2020	0.007	0.010	0.0003	0.018		

9.2 Acid deposition

9.2.1 Critical loads and existing levels of acid deposition

The APIS website gives critical load values for specific SSSIs. For sites such as LWSs, critical load values can be found by location.

Table 9.4 shows the habitat types, critical loads and total acid deposition values at the two SSSIs and six LWSs identified in Section 4.1. The critical loads presented are specific to each designated conservation area.

The Critical Load Function is defined by three quantities to account for the contribution of different species to total acid deposition[13]. CLmaxS is the maximum critical load for acidity expressed in terms of sulphur, i.e. when nitrogen deposition is zero; this value also considers non marine chloride deposition[23]. Similarly, CLmaxN is the maximum critical load of acidity expressed in terms of nitrogen only, i.e. when sulphur and non-marine chloride deposition is zero. Finally, CLminN defines a nitrogen deposition level below which additional nitrogen will not acidify the system, due to long-term nitrogen losses in the soil, e.g. nitrogen uptake by vegetation.

The total acid deposition values presented represent the average deposition over the years 2019 to 2021, due to existing local sources and background contributions. The nitrogen (N) and sulphur (S) contributions are presented.

Table 9.4: Total acid deposition (keq ha^{-1} yr^{-1})

Site name	Habitat type	Relevant Acidity critical load class	Critical load (keq)	Total acid deposition N|S
Therfield Heath SSSI	Broadleaved, mixed and yew woodland	Unmanaged broadleafed/ coniferous woodland	MaxCLminN: 0.142 MaxCLmaxN: 10.918 MaxCLmaxS: 10.776 MinCLminN: 0.142 MinCLmaxN: 10.828 MinCLmaxS: 10.686	1.92|0.15
	Calcareous grassland	Calcareous grassland (using base cation)	MaxCLminN: 0.856 MaxCLmaxN: 4.856 MaxCLmaxS: 4 MinCLminN: 0.856 MinCLmaxN: 4.856 MinCLmaxS: 4	1.09|0.12
Holland Hall SSSI	Calcareous grassland	Calcareous grassland (using base cation)	MaxCLminN: 0.856 MaxCLmaxN: 4.856 MaxCLmaxS: 4 MinCLminN: 0.856 MinCLmaxN: 4.856 MinCLmaxS: 4	1.05|0.11

Table 9.4: Total acid deposition (keq ha^{-1} yr^{-1}): continued

Site name	Habitat type	Relevant Acidity critical load class	Critical load (keq)	Total acid deposition N|S
Royston Chalk Pit LWS	Calcareous grassland	Calcareous grassland (using base cation)	CLminN: 0.856 CLmaxN: 4.856 CLmaxS: 4	1.08|0.11
Shaftsbury Green LWS				1.08|0.11
Icknield Way, A505 North of Gallows Hill LWS				1.12|0.12
Green Lane South of Royston LWS				1.10|0.12
Therfield, South of Tumulus LWS				1.09|0.12
Therfield Green Lane LWS				1.12|0.12

9.2.2 Process contribution to acid deposition, Apollo Phase 1

The rate of acid deposition calculated in this assessment is based on the PC to acid deposition from nitrogen, presented in Section 9.1, plus the additional contribution from HCl.

Dry deposition velocities recommended by AQMAU were used for all pollutants. The dry deposition velocities used for NO_2 and NH_3, and the parameters assumed for NH_4Cl, are provided in Section 9.1.

For HCl, a dry deposition velocity of 0.025 m/s, for grassland, and a dry deposition velocity of 0.06 m/s, for forest, was assumed. Wet deposition was also included for HCl, calculated from rainfall in the meteorological data and assuming washout coefficients A=0.0003 and B=0.66, as suggested in the Power Technology report PT/04/BE965/R[25].

The APIS Critical Load Function Tool[26] was used to assess the combined impact of the nitrogen and HCl contributions to acid deposition at each of the designated conservation areas.

For each identified habitat, minCLmaxS, minCLmaxN and minCLminN were input to the tool, along with the maximum background deposition, presented in Table 9.4.

[25] Power Technology report *Comparison of ADMS wet deposition against monitored data and assessment of the relevance of HCl deposition from power stations*, SJ Griffiths, September 2004

[26] http://www.apis.ac.uk/critical-load-function-tool

The maximum PCs to the nitrogen contribution were also input to the tool. The maximum PCs to the HCl contribution were included as the sulphur contribution, as specified in the AQTAG 06 habitats assessment guidance[27].

Table 9.5 presents the maximum predicted contributions from nitrogen and HCl to the acid deposition rates at each designated conservation area, for Apollo Phase 1.

Table 9.5: Contributions to acid deposition (keq ha^{-1} yr^{-1}) at designated conservation areas, Apollo Phase 1

Site name	Habitat type	Year	PC (N)	PC (HCl as H)
Therfield Heath SSSI	Broadleaved, mixed and yellow woodland	2016	0.009	0.011
		2017	0.007	0.011
		2018	0.011	0.016
		2019	0.007	0.010
		2020	0.007	0.010
	Calcareous grassland	2016	0.006	0.005
		2017	0.004	0.006
		2018	0.007	0.008
		2019	0.005	0.005
		2020	0.004	0.005
Holland Hall SSSI	Calcareous grassland	2016	0.006	0.006
		2017	0.007	0.006
		2018	0.005	0.005
		2019	0.007	0.006
		2020	0.006	0.006
Royston Chalk Pit LWS	Calcareous grassland	2016	0.003	0.003
		2017	0.003	0.003
		2018	0.002	0.002
		2019	0.003	0.003
		2020	0.002	0.002
Shaftsbury Green LWS	Calcareous grassland	2016	0.003	0.003
		2017	0.003	0.003
		2018	0.002	0.002
		2019	0.003	0.003
		2020	0.002	0.002

[27] AQTAG 06, *Technical Guidance on detailed modelling approach for an appropriate assessment for emissions to air*, Environment Agency, March 2014

Table 9.5: continued

Site name	Habitat type	Year	PC (N)	PC (HCl as H)
Icknield Way, A505 North of Gallows Hill LWS	Calcareous grassland	2016	0.002	0.002
		2017	0.001	0.001
		2018	0.002	0.002
		2019	0.002	0.002
		2020	0.002	0.002
Green Lane South of Royston LWS	Calcareous grassland	2016	0.002	0.002
		2017	0.002	0.003
		2018	0.002	0.002
		2019	0.002	0.002
		2020	0.002	0.002
Therfield, South of Tumulus LWS	Calcareous grassland	2016	0.002	0.002
		2017	0.001	0.001
		2018	0.003	0.003
		2019	0.002	0.002
		2020	0.002	0.002
Therfield Green Lane LWS	Calcareous grassland	2016	0.002	0.002
		2017	0.001	0.001
		2018	0.002	0.002
		2019	0.001	0.001
		2020	0.001	0.001

Table 9.6 presents the PC as a percentage of the Critical Load Function, as output from the APIS Critical Load Function Tool, for each identified habitat at each designated conservation area, for Apollo Phase 1.

According to the Critical Load Function Tool, the maximum PCs to acid deposition are screened out at all designated conservation areas.

Table 9.6: Results from APIS Critical Load Function Tool, Apollo Phase 1

Site name	Habitat type	Acidity critical load class	PC as % of CL function	Significant?
Therfield Heath SSSI	Broadleaved, mixed and yew woodland	Unmanaged broadleafed/ coniferous woodland	0.3	No
	Calcareous grassland	Calcareous grassland (using base cation)	0.4	No
Holland Hall SSSI	Calcareous grassland	Calcareous grassland (using base cation)	0.2	No
Royston Chalk Pit LWS	Calcareous grassland	Calcareous grassland (using base cation)	0.2	No
Shaftsbury Green LWS	Calcareous grassland	Calcareous grassland (using base cation)	0.2	No
Icknield Way, A505 North of Gallows Hill LWS	Calcareous grassland	Calcareous grassland (using base cation)	0	No
Green Lane South of Royston LWS	Calcareous grassland	Calcareous grassland (using base cation)	0.2	No
Therfield, South of Tumulus LWS	Calcareous grassland	Calcareous grassland (using base cation)	0.2	No
Therfield Green Lane LWS	Calcareous grassland	Calcareous grassland (using base cation)	0	No

9.2.3 Process contribution to acid deposition, Apollo Phase 2

The acid deposition results for Phase 2 were identical to those for Phase 1.

10. Discussion

In order to investigate the impact on air quality of all relevant processes at the Royston site, to support the permit variation for the Apollo and replacement boiler projects, dispersion modelling of emissions to air was carried out.

10.1 Objectives and EALs for the protection of human health

The maximum offsite concentrations of carbon monoxide, acetic acid, ammonia, hydrogen chloride, ammonium chloride, nitrous oxide and ethanal are screened out as insignificant for all years.

PCs to NO_2 and particulate concentrations are not screened out, but the PECs for both pollutants are below the air quality objectives.

Predicted concentrations of NMVOCs are compared against EALs for DMF, which has the most stringent standard. Annual average NMVOC concentrations are not screened out, but they are well below the long-term EAL for DMF. Hourly average offsite concentrations are screened out as insignificant for all years.

Chlorine concentrations are not screened out, but they are below the short-term EAL. There is no long-term EAL for chlorine.

10.2 Critical levels for the Protection of Vegetation and Ecosystems

The daily average NO_x PCs are not screened out for any of the designated conservation areas, but the annual average PCs are screened out for the six LWSs. The annual and daily average PECs are below the respective critical levels.

At all designated conservation areas except Therfield Heath, the annual average NH_3 concentrations are screened out as insignificant. At Therfield Heath, the more stringent critical level was used and the PCs are not screened out for two out of the five years of meteorological data considered. The background concentration, 1.6 $\mu g/m^3$, exceeds the critical level of 1 $\mu g/m^3$.

10.3 Critical loads for the Protection of Vegetation and Ecosystems

The maximum PCs to nitrogen and acid deposition are screened out at relevant habitats at all designated conservation areas.

APPENDIX A: Summary of ADMS 6

ADMS, the **A**tmospheric **D**ispersion **M**odelling **S**ystem[28], has been developed to make use of the most up-to-date understanding of the airflow and turbulence behaviour in the lower levels of the atmosphere in an easy-to-use computer modelling system for the dispersion of atmospheric emissions. This allows the impact of emissions from industrial and other facilities to be thoroughly investigated as part of an environmental assessment or for other regulatory purposes. The model is supported on Windows 11 and Windows 10 environments.

ADMS's original sponsors included the Environment Agency, the Health and Safety Executive (HSE) and successor power companies of the CEGB (Central Electricity Generating Board), whilst the Met Office and University of Surrey contributed to its development. The model is now used for regulatory and other purposes in many countries across the world.

The following is a summary of the capabilities and validation of ADMS 6. More details can be found on the CERC web site at www.cerc.co.uk.

The core model calculates the average concentration arising from an emission for a given meteorological condition (for example, wind speed and direction), taking account of plume rise and stack downwash where required. The emission may be released from a single source or from a number of sources. In addition, ADMS is able to:

- calculate long-term concentration statistics, typically for a period of one year, for direct comparison with air quality standards and objectives;
- take into account the often very significant effects that a nearby building can have on the dispersion of emissions;
- model the chemical conversions that occur in the atmosphere between nitric oxide (NO), nitrogen dioxide (NO_2) and ozone (O_3);
- include background concentrations in concentration statistics;
- allow for the effects of complex terrain and changes in surface roughness on wind speed and direction, and on the levels of turbulence in the atmosphere;
- determine the quantities of an emission deposited to the ground by both dry and wet deposition processes;
- include the decay of radioactive emissions and determine the gamma dose at a location received from passing material;
- report the extent to which a moist plume will be visible;
- model sources over the sea, such as oil platforms, using special calculations of surface roughness and heat fluxes;
- output temperature, relative and/or specific humidity, as well as exceedences of temperature and/or humidity thresholds and simultaneous exceedences of temperature and humidity threshold values;
- output concentrations in units of ou_e for odour studies;
- model the effect of a coastline by accounting for the development of an internal convective layer during sea breeze events;

[28] Carruthers DJ, Holroyd RJ, Hunt JCR, Weng W-S, Robins AG, Apsley DD, Thompson DJ and Smith FB, **1994**: UK-ADMS: A new approach to modelling dispersion in the earth's atmospheric boundary layer. J. of Wind Engineering and Industrial Aerodynamics, vol. 52, pp. 139-153, DOI: 10.1016/0167-6105(94)90044-2.

- calculate concentrations and deposition fluxes due to an instantaneous or finite duration release (puffs);
- model short-term fluctuations in concentration due to atmospheric turbulence, particularly important for modelling odours and concentrations for averaging times less than one hour;
- model the effect of building density on near-surface wind and turbulence profiles (urban canopy); and
- model the effect of wind turbines on plume dispersion.

More details of some of these processes are given below, along with a summary of data comparisons that have been used to validate the model.

Dispersion Modelling

ADMS uses boundary layer similarity profiles in which the boundary layer structure is characterised by the height of the boundary layer and the Monin-Obukhov length, a length scale dependent on the friction velocity and the heat flux at the ground. This has significant advantages over earlier methods in which the dispersion parameters did not vary with height within the boundary layer.

In stable and neutral conditions, dispersion is represented by a Gaussian distribution. In convective conditions, the vertical distribution takes account of the skewed structure of the vertical component of turbulence. This is necessary to reflect the fact that, under convective conditions, rising air is typically of limited spatial extent but is balanced by descending air extending over a much larger area. This leads to higher ground-level concentrations than would be given by a simple Gaussian representation.

The formulation of ADMS means that, for a given meteorological condition, as well as determining average concentrations, the model is also able to provide statistical information on concentration fluctuations. This can be particularly important in applications, for example, determining whether or not a dispersing material exceeds flammability or odour detection thresholds.

Emissions

Buoyant emissions, and those with vertical momentum, rise in the atmosphere after emission. This movement, which is referred to as *plume rise*, also results in additional dilution and can result in the emission penetrating the top of the atmospheric boundary layer and being lost from the local area. These effects are included in the modelling using an integral solution of the conservation equations for the plume's mass, momentum and heat. The possibility of entrainment behind the stack, known as *downwash*, which can lower the effective height of the emission, is also included in the calculation.

ADMS can also model emissions represented as:
- lines – for linear sources;
- areas – to represent situations where a source can best be represented as uniformly spread over an area, such as evaporation from an open tank;
- volumes – to represent situations where a source can best be represented as uniformly spread throughout a volume, such as fugitive emissions from a factory complex; and
- jets – to represent situations where emissions are not emitted vertically upwards.

Presentation of Results

For most situations ADMS is used to model the fate of emissions for a large number of different meteorological conditions. Typically, meteorological data are input for every hour during a year or for a set of conditions representing all those occurring at a given location. ADMS uses these individual results to calculate statistics for the whole data set. These are usually average values, including rolling averages, percentiles and the number of hours for which specified concentration thresholds are exceeded. This allows concentrations to be calculated for direct comparison with air quality limits, guidelines and objectives, in whatever form they are specified.

Results can be presented as numerical values at specified locations. In addition, by calculating concentrations over a grid of locations, results can be presented graphically as concentration contours or isopleths. This can be done using an integrated Mapper, which can also be used to visualise, add and edit sources, buildings and output points. The model also links to other software packages, such as Surfer, ArcGIS and MapInfo GIS.

Complex Effects - Buildings

A building or similar large obstruction can affect dispersion in three ways:

1. It deflects the wind flow and therefore the route followed by dispersing material;
2. This deflection increases levels of turbulence, possibly enhancing dispersion; and
3. Material can become entrained in a highly turbulent, recirculating flow region or cavity on the downwind side of the building.

The third effect is of particular importance because it can bring relatively concentrated material down to ground-level near to a source. From experience, this occurs to a significant extent in more than 95% of studies for industrial facilities.

The buildings effects module in ADMS has been developed using extensive published data from scale-model studies in wind-tunnels, CFD modelling and field experiments on the dispersion of pollution from sources near large structures. It has the following stages:

(i) A complex of buildings is reduced to a single wind-aligned rectangular block with the height of the dominant building and representative streamwise and crosswind lengths.

(ii) The disturbed flow field consists of a recirculating flow region in the lee of the building with a diminishing turbulent wake downwind, as shown in Figure A1.

(iii) Concentrations of the entrained part of the plume are uniform within the well-mixed recirculating flow region and based upon the fraction of the release that is entrained.

(iv) Concentrations further downwind in the main wake are the sum of those from two plumes: a ground level plume from the recirculating flow region and an elevated plume from the non-entrained remainder. The turbulent wake reduces plume height and increases turbulent spread.

(v) If the source is directly upwind of the building, the plume will be split into up to three plumes going around and over the building. These plumes are then used in the calculation of the fraction entrained into the cavity and represent the elevated plume for the non-entrained contribution in the main wake

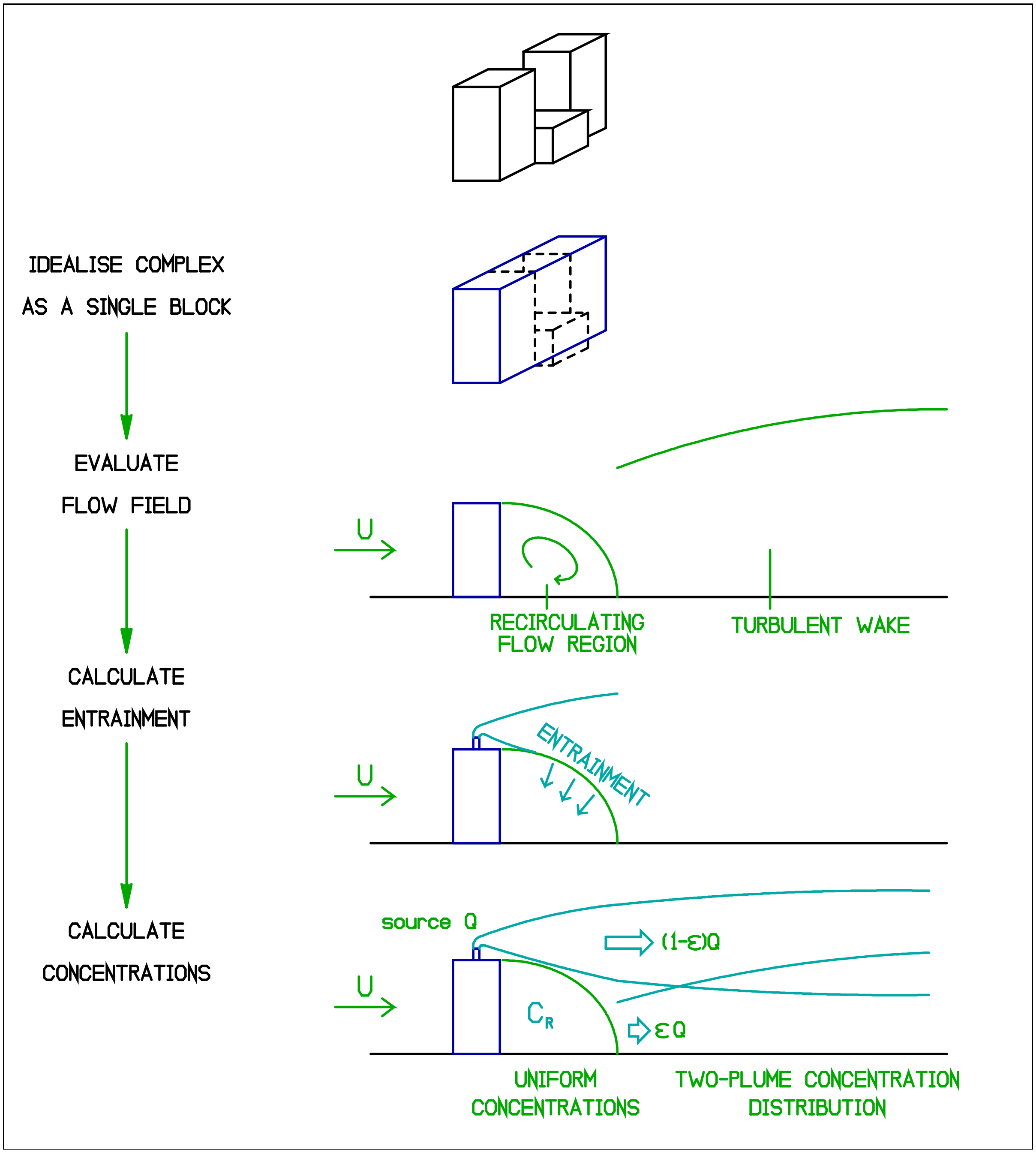

Figure A1: Stages in the modelling of building effects

Complex Effects – NO_x Chemistry

Nitrogen oxides (NO_x) emitted from combustion processes are typically only 5% to 10% nitrogen dioxide (NO_2), with the remainder as nitric oxide (NO). After emission, the NO combines with the ozone (O_3) present in the atmosphere to increase the proportion of NO_2. The key features of the two processes involved can be represented by:

(1)	$NO + O_3$	→	NO_2; and
(2)	$NO_2 + h\nu$	→	$NO + O_3$,

where the role played by oxygen (O and O_2) has been omitted for clarity and $h\nu$ represents ultra violet radiation. Both of these reactions, which can proceed relatively rapidly, are modelled by ADMS, which only allows the second reaction to occur in daylight. A third reaction $2NO + O_2 \rightarrow 2NO_2$ is also included, though this will not have significant impact on NO and NO_2 concentrations unless the initial NO concentration is sufficiently high and the reaction takes place over a long period of time. Other reactions that involve O_3 and NO_2, such as those with Volatile Organic Compounds (VOCs), have not been included because their reaction times are significantly longer. They would not have any significant effect on concentrations arising from specific industrial emissions.

Complex Effects – Terrain and Roughness

Complex terrain can have a significant impact on wind-flow and consequently on the fate of dispersing material. Primarily, terrain can deflect the wind and therefore change the route taken by dispersing material. Terrain can also increase the levels of turbulence in the atmosphere, resulting in increased dilution of material. This is of particular significance during stable conditions, under which a sharp change with height can exist between flows deflected over hills and those deflected around hills or through valleys. The height of dispersing material is therefore important in determining the route it takes. In addition, areas of reverse flow, similar in form and effect to those occurring adjacent to buildings, can occur on the downwind side of a hill.

Changes in the surface roughness can also change the vertical structure of the boundary layer, affecting both the mean wind and levels of turbulence.

The ADMS Complex Terrain Module models these effects using the wind-flow model FLOWSTAR. This model uses linearised analytical solutions of the momentum and continuity equations, and includes the effects of stratification on the flow. The model is most accurate for hills of moderate slope and can typically be used for gradients up to about 1:2 but may not be reliable close to isolated slopes or escarpments with higher gradients or more generally if large parts of the modelling domain have slopes greater than 1:2. The terrain height is specified at up to 770,000 points that are interpolated by the model onto a regular grid of up to 512 by 512 points. The best results are achieved if the specified data points are regularly spaced. FLOWSTAR has been extensively tested with laboratory and field data.

Regions of reverse flow are treated by assuming that any emissions into the region are uniformly mixed within it. Material then disperses away from the region as if it were a virtual point source. Material emitted elsewhere is not able to enter reverse flow regions.

Deposition

Material in a plume that is close to the ground can be lost to the ground by dry deposition. This process is included in ADMS by using a gravitational settling velocity (which affects particles) and a deposition velocity based on aerodynamic, sub-layer and surface-layer resistance values (which affects gases and particles). The concentration profile within a dispersing plume is then adjusted to take account of the losses at the surface. Dry and wet deposition parameters can be varied spatially, to take into account changes in land use across the modelled area.

Wet deposition is included via a washout coefficient to control the quantity of material incorporated into rain. In addition, for SO_2 and HCl emitted from point sources, the 'Falling Drop' model is available, which includes the kinetics of the uptake of gases, as well as the thermodynamics and chemistry of the dissolution of gases in raindrops.

Radioactivity

For radioactive releases ADMS calculates the transformations within the plume of one isotope into another by radioactive decay. ADMS can also determine the gamma dose received at a location from a dispersing plume.

Visible Plumes

For moist emissions ADMS determines the section of the plume where the liquid water content is sufficient for the plume to be visible. This allows statistics of the frequency and lengths of visible plumes to be calculated.

Data Comparisons – Model Validation

The individual components of ADMS, for example the Buildings Module, have been developed using published scientific data and each component extensively tested to ensure that it provides reliable results. In addition, a very large number of studies have been performed on the accuracy of ADMS for point source emissions.

Among other validation studies, ADMS output has been compared with three flat terrain data sets known as Kincaid, Indianapolis and Prairie Grass, which are available from the US Modellers Data Archive. Each of these datasets has been generally accepted as containing enough measurements of sufficient quality for meaningful validation.

Further details of ADMS and model validation, including a full list of references, are available from the CERC web site at www.cerc.co.uk.

APPENDIX 03

Noise Impact Assessment

(model files submitted separately)

ROYSTON ENVIRONMENTAL PERMIT APPLICATION

Noise Impact Assessment

Prepared for: Johnson Matthey

SLR Ref: 416.063922.00001
Version No: 4
January 2024

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CONTENTS

DOCUMENT REFERENCES

TABLES

Table 3-1 NVM Assessment ... 5
Table 4-1 Summary of 2020 Survey Results dB(A) ... 8
Table 5-1 Equipment ... 10
Table 5-2 Location 4: Blake Road Summary of 2023 Survey Results dB(A) ... 12
Table 5-3 Location 5: Rock Road Summary of 2023 Survey Results dB(A) ... 16
Table 5-4 Location 6: Orchard Way Summary of 2023 Survey Results dB(A) ... 20
Table 5-5 Location 4: Blake Road Summary of 2023 Survey Results dB(A) ... 24
Table 5-6 Location 5: Rock Road Summary of 2023 Survey Results dB(A) ... 28
Table 5-7 Location 6: Orchard Way Summary of 2023 Survey Results dB(A) ... 32
Table 6-1 Summary of 2020 Survey Results dB(A) ... 39
Table 6-2 Existing Site BS4142 Assessment, dB ... 43
Table 7-1 Project Apollo Plant Noise Data – dB ... 44
Table 7-2 Distance Between Apollo Plant and NSR Locations ... 45
Table 7-3 Plant Characteristics in CadnaA ... 47

FIGURES

Figure 2-1 Site Location 2
Figure 4-1 Monitoring and Sensitive Receptor Locations 8
Figure 5-1 Monitoring and Sensitive Receptor Locations 11

APPENDICES

1.0 Introduction

Johnson Matthey has appointed SLR Consulting Ltd. (SLR) to undertake an assessment of the noise impact of new plant to be installed at the Johnson Mathey Site.

Due to the potential for the new plant to increase noise levels in the area the Environment Agency (EA) has requested that an application to vary the site's Permit is made, and that the application includes a Noise Impact Assessment.

This Report has been completed by Michelle Dawson a Corporate Member of the Institute of Acoustics (MIOA).

1.1 Report Structure

This Report presents:

- A description of the Site.
- A description of applicable guidance.
- The results of a baseline background sound survey at locations representative of the nearest noise-sensitive receptors to the proposed new plant.
- An assessment of existing and cumulative sound from the Site undertaken in accordance with British Standard 4142:2014+A1:2019 *Methods for rating and assessing industrial and commercial sound* as required by the Environment Agency (EA) Guidance *Noise and vibration management: environmental permits.*

Whilst reasonable effort has been made to ensure that this report is easy to understand, it is technical in nature; to assist the reader, a glossary of terminology is included in Appendix 01.

2.0 Site Description

2.1 Existing Site

Johnson Matthey, Royston is situated in an industrial area on the north-west edge of Royston, immediately adjacent to residential houses. The site is bounded by York Way to the north and Orchard Road to the south, with industrial units to the west and residential houses to the east.

The A505 dual carriageway passes close (about 100m) to the north-west boundary, the Baldock to Royston main railway line is about 225m to the south of the site, and the A1198 main road is about 325m to the east of the site. The nearest residential houses are immediately adjacent to the east boundary. There are further residential houses to the east of the A1198 main road and to the south of the Baldock to Royston main railway line.

The position of the Site in the context of the surrounding area can be seen in Figure 2-1.

Figure 2-1
Site Location

2.2 Proposals

The proposals include the following:

1. PU12 2A Fuel Cells: a new process to manufacture 20mT/year of catalyst and catalyst precursors including process vessels, centrifuges, ovens, cone mill, extraction booths, utilities and abatement systems consisting of caustic and ammonia wet scrubbers. The emissions will be vented by a new stack. It is considered that this would also be a Section 4.2 Part A(1) (a) activity.

2. Apollo project: a new production line for manufacture of components for fuel cells, which will require decommissioning of existing equipment and installation of the new equipment including cleanroom provision, within building CSF2. The process includes annealing and coating of membrane film by a slot die process. An existing emission point will be used. It is considered that this process would be a Section 4.2 Part A (1) (c) activity.

3. Boiler Replacement: a new gas-fired boiler with thermal output of 2.94MW will be installed. This will be a Directly Associated Activity to the installation activities.

3.0 Scope and Guidance

A summary of the requirements outlined in the EA Guidance document, and the assessment methodology outlined in BS4142:2014+A1:2019 are provided below.

3.1 Noise and vibration management: environmental permits

The Environment Agency (EA) released the guidance document *Noise and vibration management: environmental permits* (NVM) in July 2021, replacing the previous guidance presented in *Horizontal Guidance for Noise (H3) parts 1 and 2*. The NVM details when a noise assessment is required, the competency required to undertake an assessment and how to carry out a noise impact assessment.

The NVM references BS4142:2014+A1:2019 as the appropriate assessment methodology.

The NVM outlines how context should be taken into account in the assessment and notes that *"Whilst context allows you to interpret impact thresholds (to a degree), there are practical limits to the extent of the interpretation. It is unlikely you could adjust the assessment outcome beyond the next band (for example, modifying a BS 4142 outcome of more than 10dB to be less than an 'adverse impact')."*

Determining the outcome of the assessment the following should be considered:

- weekdays rather than weekends.
- what the sound 'means' – meaningful sound is one that conveys an unpleasant meaning beyond its mere acoustic content, for example noise from an abattoir.
- time of day.
- the absolute sound level.
- where the sound occurs.
- new industry or new residences.
- intrinsic links between the source and receptor, for example the source is the resident's place of work.
- local attitudes.
- the residual acoustic environment.
- the land use at the receptor (for example, gardens rather than yards).
- the exceedance (traditional BS 4142).
- whatever else might be particular to that individual situation.

Based on the results of the BS4142:2014+A1:2019 assessment the NVM has three distinct requirements as detailed in Table 3-1.

Table 3-1
NVM Assessment

NVM Result	BS4142 Descriptor	Next Stage
Unacceptable level of audible or detectable noise	The closest corresponding BS 4142 descriptor is 'significant adverse impact'	You must take further action or you may have to reduce or stop operations. The environment agencies will not issue a permit if you are likely to be operating at this level.
Audible or detectable noise	The closest corresponding BS 4142 descriptor is 'adverse impact'	Your duty is to use appropriate measures to prevent or, where that is not practicable, minimise noise. You are not in breach if you are using appropriate measures. But you will need to rigorously demonstrate that you are using appropriate measures.
No noise, or barely audible or detectable noise	The closest corresponding BS 4142 descriptor is 'low impact or no impact'	Low impact does not mean there is no pollution. However, if you have correctly assessed it as low impact under BS 4142, the environment agencies may decide that taking action to minimise noise is a low priority.

3.2 British Standard 4142:2014+A1:2019

British Standard 4142:2014+A1:2019 *Methods for rating and assessing industrial and commercial sound* is intended to be used to assess the potential adverse impact of sound, of an industrial and/or commercial nature, at nearby noise-sensitive receptor locations within the context of the existing sound environment.

Where the specific sound contains tonality, impulsivity and/or other sound characteristics, penalties should be applied depending on the perceptibility. For tonality, a correction of either 0, 2, 4 or 6dB should be added and for impulsivity, a correction of either 0, 3, 6 or 9dB should be added. If the sound contains specific sound features which are neither tonal nor impulsive, a penalty of 3dB should be added.

In addition, if the sound contains identifiable operational and non-operational periods, that are readily distinguishable against the existing sound environment, a further penalty of 3dB may be applied.

The assessment of impact contained in BS4142:2014+A1:2019 is undertaken by comparing the sound rating level, i.e. the specific sound level of the source plus any penalties, to the measured representative background sound level immediately outside the noise-sensitive receptor location. Consideration is then given to the context of the existing sound environment at the noise-sensitive receptor location to assess the potential impact.

Once an initial estimate of the impact is determined, by subtracting the measured background sound level from the rating sound level, BS4142:2014+A1:2019 states that the following should be considered:

- typically, the greater the difference, the greater the magnitude of the impact;
- a difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context;
- a difference of around +5dB is likely to be an indication of an adverse impact, depending on the context; and

- the lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. It is an indication that the specific sound source has a low impact, depending on the context.

BS4142:2014+A1:2019 notes that:

"Adverse impacts include, but are not limited to, annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact."

BS4142:2014+A1:2019 outlines guidance for the consideration of the context of the potential impact including consideration of the existing residual sound levels, location and/or absolute sound levels.

To account for the acoustic character of proposed sound sources, BS4142:2014+A1:2019 provides the following with respect to the application of penalties to account for *"the subjective prominence of the character of the specific sound at the noise-sensitive locations and the extent to which such acoustically distinguishing characteristics will attract attention".*

- **Tonality** – *"For sound ranging from not tonal to predominantly tonal the Joint Nordic Method gives a correction of between 0dB and +6dB for tonality. Subjectively, this can be converted to a penalty of 2dB for a tone which is just perceptible at the noise receptor, 4dB where it is clearly perceptible and 6dB where it is highly perceptible;*
- **Impulsivity** – *A correction of up to +9dB can be applied for sound that is highly impulsive, considering both the rapidity of the change in sound level and the overall change in sound level. Subjectively, this can be converted to a penalty of 3dB for impulsivity which is just perceptible at the noise receptor, 6dB where it is clearly perceptible, and 9dB where it is highly perceptible;*
- **Intermittency** – *When the specific sound has identifiable on/off conditions, the specific sound level ought to be representative of the time period of length equal to the reference time interval which contains the greatest total amount of on time. If the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3dB can be applied; and*
- **Other Sound Characteristics** – *Where the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3dB can be applied."*

Finally, BS4142:2014+A1:2019 outlines guidance for the consideration of the context of the potential impact, including consideration of the existing residual sound levels, location and/or absolute sound levels.

3.3 ISO 9613-2:1996

The levels of sound generated by the operation of the proposed Plant has been predicted in accordance with the prediction framework within ISO 9613-2:1996 *Acoustics – Attenuation of Sound during Propagation Outdoors– Part 2: General Method of Calculation*. This method of calculation takes into account the distance between the sound sources and the closest receptors, and the amount of attenuation due to atmospheric absorption. The methodology also assumes downwind propagation, i.e. a wind direction that assists the propagation of sound from the source to the receiver.

4.0 Baseline Background Noise Levels - 2020

4.1 Survey Date

To determine sound levels in the vicinity of the Site noise surveys have been undertaken by INVC during 2002, 2004, 2006, 2008, 2010, 2012, 2014, 2016, 2018, and 2020.

The 2020 survey was undertaken between Monday the 14th and Thursday the 17th of September 2020. During the survey the Site was operational, and as such noise from the existing Site may have contributed to the measured baseline background sound level, most notably at No.2 Orchard Close.

4.2 Weather Conditions

During the survey, weather conditions were reported as generally dry and warm with a very light wind. Full details of the weather conditions during the survey are given in Appendix A of the INVC Report[1].

4.3 Equipment

Full details of the monitoring equipment are given in Appendix B of the INVC Report[2].

4.4 Survey Locations

Sound levels were measured at three locations, representative of the nearest residential receptors to the site, as follows:

- Location 1: Orchard Way.
- Location 2: Rock Road.
- Location 3: Eliot Road.

The survey locations are shown in Figure 4-1.

[1] INVC Report 9706 Dated 9th October 2020.
[2] INVC Report 9706 Dated 9th October 2020.

Figure 4-1
Monitoring and Sensitive Receptor Locations

4.5 Baseline Background Sound Level Results

A summary of the survey results at Location One is shown in Table 4-1. The full survey results are available in Appendix 02.

Table 4-1
Summary of 2020 Survey Results dB(A)

Location	Period	$L_{A90,5min}$	$L_{Aeq,5min}$
No. 2 Orchard Way	Daytime	40	56
	Night-Time	37	39
No. 25 Rock Road	Daytime	47	50
	Night-Time	37	51
Eliot Road	Daytime	40	60
	Night-Time	30	34

4.6 Soundscape

It was noted in the INVC Report that some noise from Johnson Matthey is audible along most of the east boundary, but it is well controlled and not particularly intrusive. However, the noise level at the north end of the east boundary increases significantly when the Fast Cat roller shutter door (FC3) is open.

It is further stated that the average ambient noise level along the east boundary (adjacent to the residential houses) is about the same as it was in recent years since 2010 and has gradually decreased (by up to 9 dB) over the earlier years 2002 to 2008.

5.0 Baseline Background Noise Levels - 2023

5.1 Survey Date

To further inform this assessment SLR completed a noise survey in December 2023. The 2023 survey was undertaken between Friday the 1st and Monday the 4th of December. During the survey the Site was operational, and as such noise from the existing Site may have contributed to the measured baseline background sound level. However, to reduce any noise from the Site elevating the measured sound levels, care was taken to position noise meters at locations where the microphone was shielded by noise from the Site by intervening buildings. For Orchard Way (where Site noise at the boundary with Orchard Way would influence measured noise levels) the meter was positioned at approximately 80m further from the Site boundary with intervening residential buildings shielding the meter from Site noise.

5.2 Weather Conditions

During the survey, weather conditions were reported as generally dry, but cold with temperatures ranging from 7°C to -3°C with a very light wind. Full details of the weather conditions during the survey are given in Appendix 03.

5.3 Equipment

The noise survey equipment used during the survey is detailed in Table 4-1. All measurement instrumentation was calibrated before and after the measurements. No significant drift was observed. The calibration chain is traceable via the United Kingdom Accreditation Service to National Standards held at the National Physical Laboratory.

Table 5-1
Equipment

Meter	Serial no.	Start time	End time	Calibration Drift (dB)	Calibrator serial no.
Location 4 – N1	1403010	1246	1156	0	31875
Location 5 – C2	G061094	1315	1208	0.06	72210
Location 6 – C4	G068726	1346	1221	0.5	72210

5.4 Survey Locations

Sound levels were measured at three locations, representative of the nearest residential receptors to the site, as follows:

- Location 4: 22 Blake Close (used as a proxy for Elliot Road)
- Location 5: 25 Rock Road
- Location 6: 21 Orchard Way

The survey locations are shown in Figure 5-1.

Figure 5-1
Monitoring and Sensitive Receptor Locations

Photographs of the meter set up can be seen in Appendix 04.

5.5 Soundscape

At Location 3 Orchard Way, on collection a reversing siren of a forklift was heard, which was considered to be operating at the Site. Other Site noise was not distinguished. Additionally, there was also birdsong, high altitude planes and the occasional car passing on Orchard Way.

Location 4 Blake Close had distant road noise, birdsong, and the occasional train as well as the dog barking from within the house. The soundscape on collection was the same with the addition of rain falling on the adjacent trees and a high-altitude plane audible also.

Location 5 Rock Road had road noise most dominant and birdsong as well. This was observed on both setup and collection.

5.6 Baseline Background Sound Level Results - Weekday

5.6.1 Location 4 Blake Road

A summary of the survey results at Location Four Blake Road is shown in Table 5-2. The full survey results are available in Appendix 5.

Table 5-2
Location 4: Week Blake Road Summary of 2023 Survey Results dB(A)

Date	Period	L_{Aeq}	L_{A90}	L_{A10}	L_{Amax}
1st December	Daytime	47	43	48	85
	Night-Time	39	29	38	81
4th December	Daytime	50	48	51	68
	Night-Time	-	-	-	-

A graph of the sound levels measured (over the whole period) at Blake Road can be seen in Figure 5-2. Histograms of the $L_{Aeq,T}$ and the L_{A90} during the week can be seen in Figures 5-3 and 5-4.

Figure 5-2
Measured Noise Levels at Blake Road

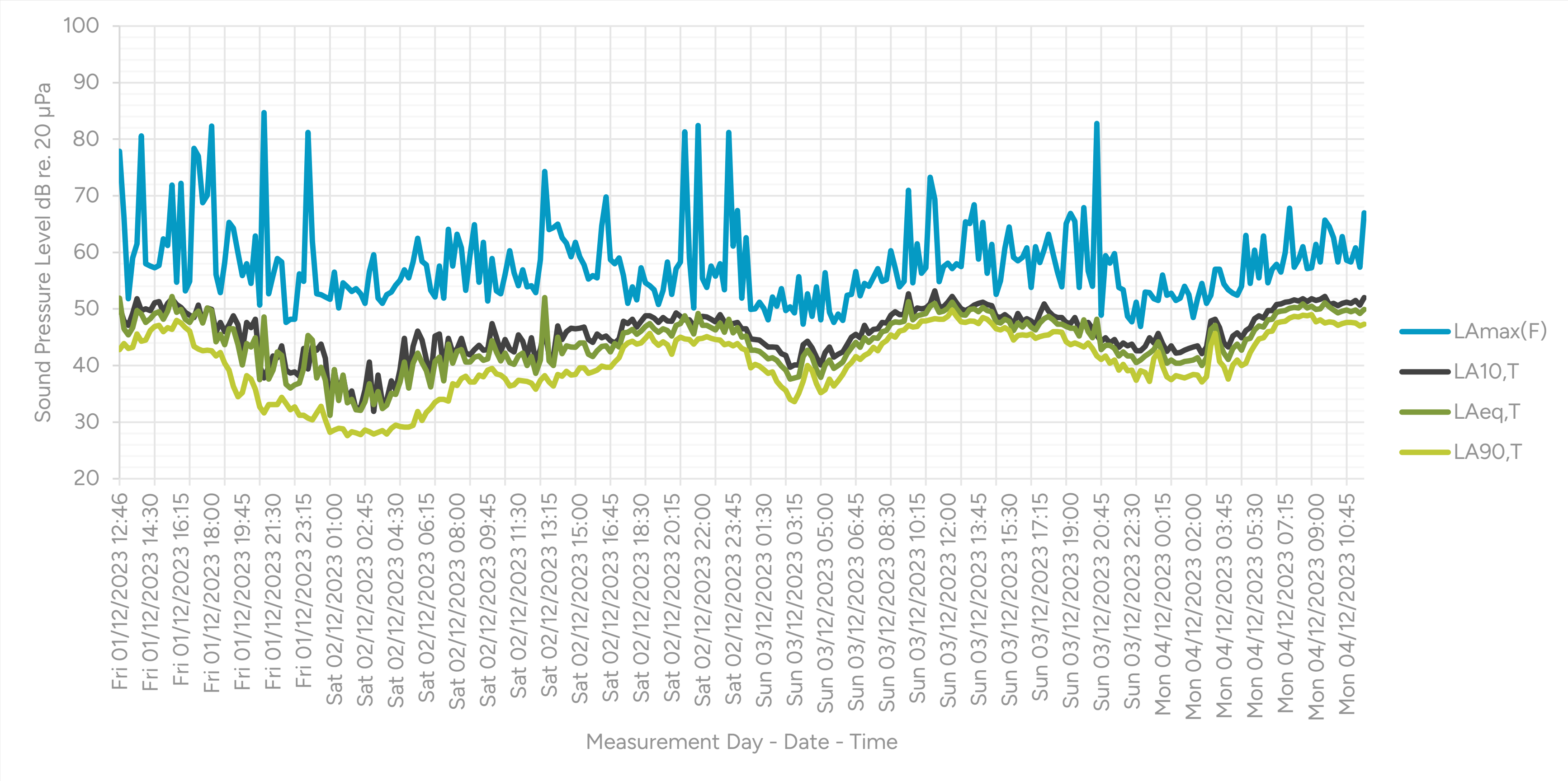


Figure 5-3
Histogram of Week $L_{Aeq,T}$ at Blake Road

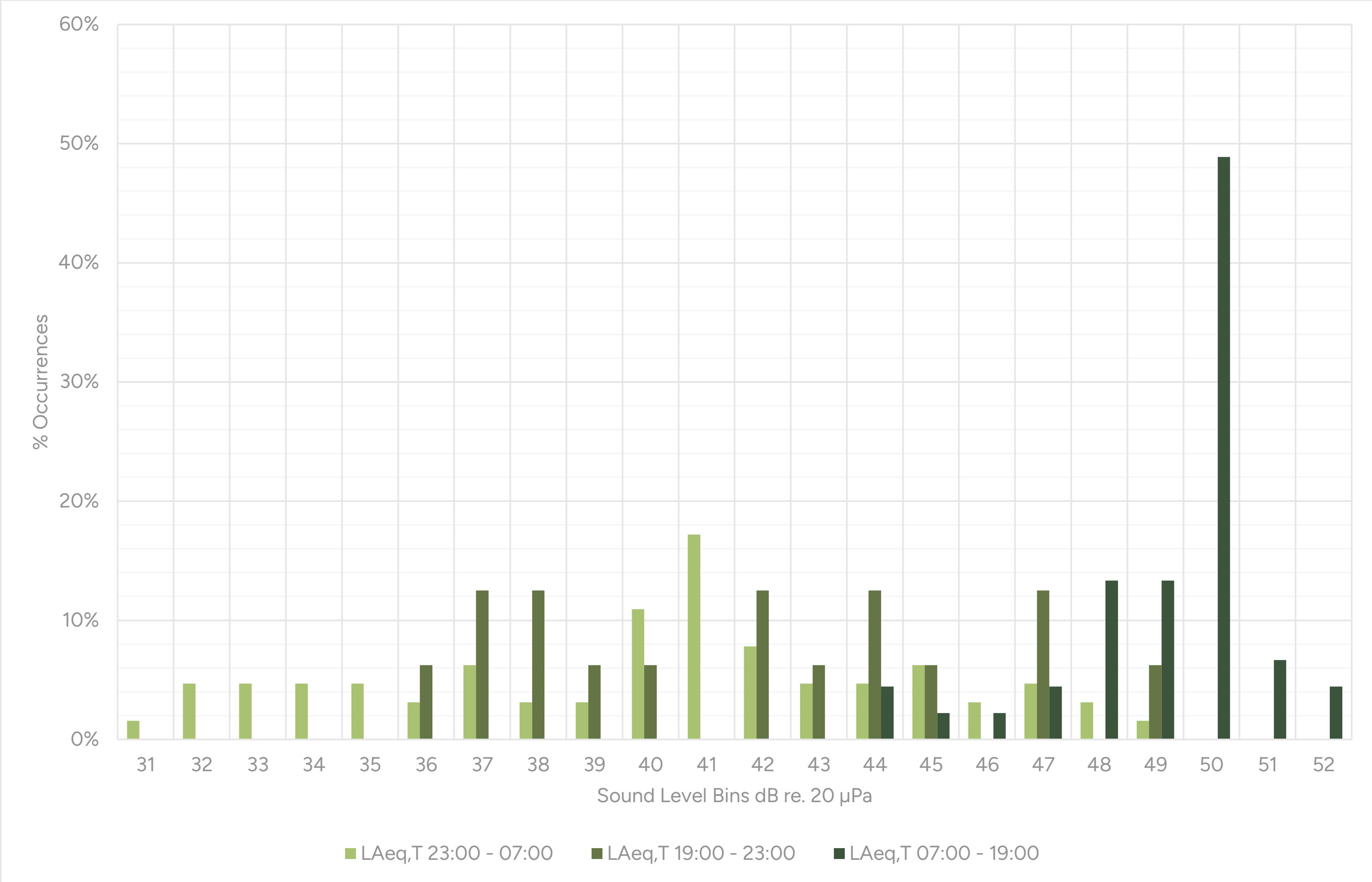
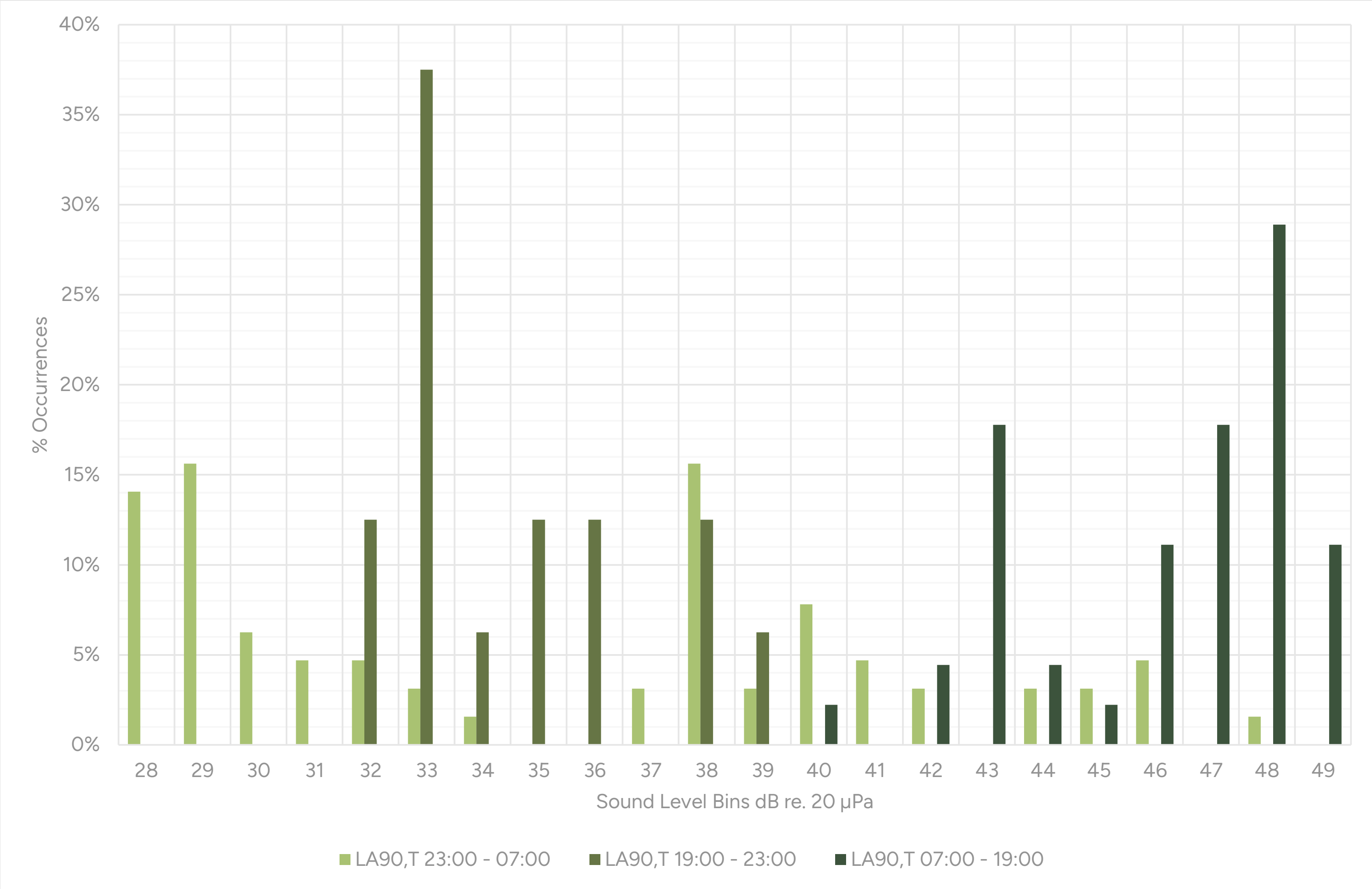


Figure 5-4
Histogram of Measured Week L_{A90} at Blake Road



5.6.2 Location 5 Rock Road

A summary of the survey results at Location Five Rock Road is shown in Table 5-3. The full survey results are available in Appendix 5.

Table 5-3
Location 5: Rock Road Summary of Week 2023 Survey Results dB(A)

Date	Period	L_{Aeq}	L_{A90}	L_{A10}	L_{Amax}
1st December	Daytime	49	45	49	73
	Night-Time	42	40	42	70
4th December	Daytime	45	42	46	75
	Night-Time	-	-	-	-

A graph of the sound levels (over whole survey period) measured at Rock Road can be seen in Figure 5-5. Histograms of the $L_{Aeq,T}$ and the L_{A90} measured over the week period can be seen in Figures 5-6 and 5-7.

Figure 5-5
Measured Noise Levels at Rock Road

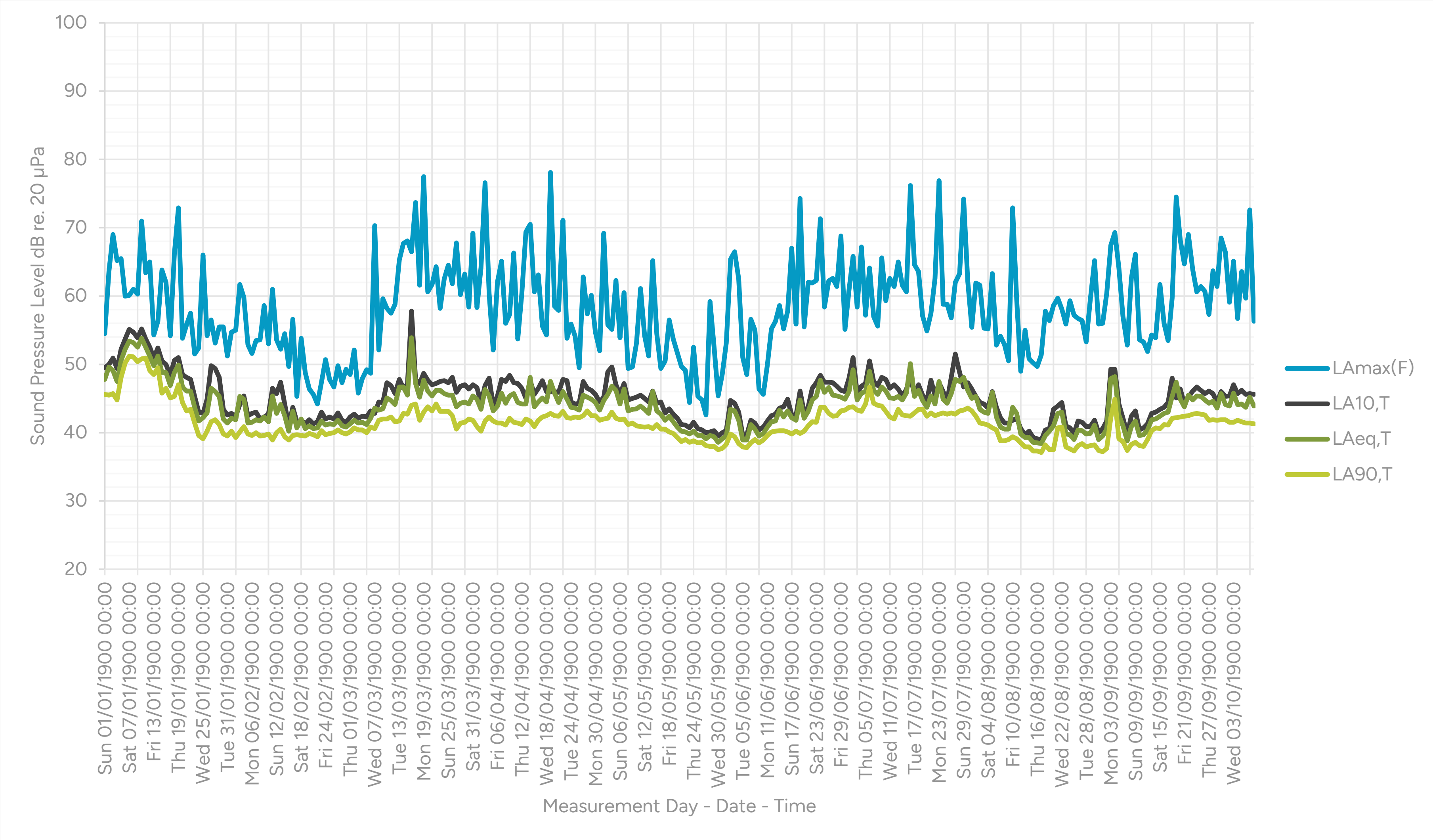


Figure 5-6
Histogram of Week $L_{Aeq,T}$ at Rock Road

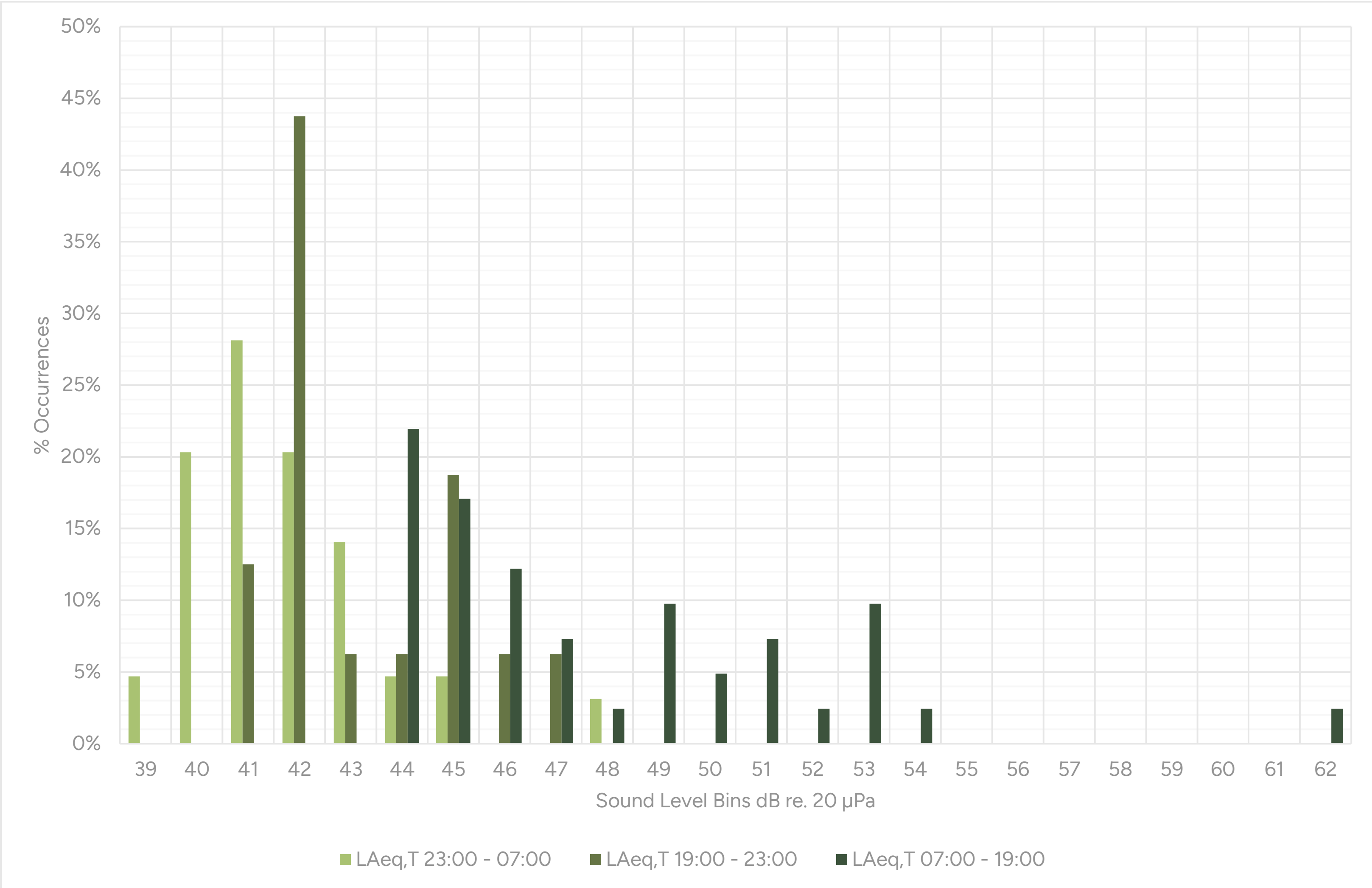
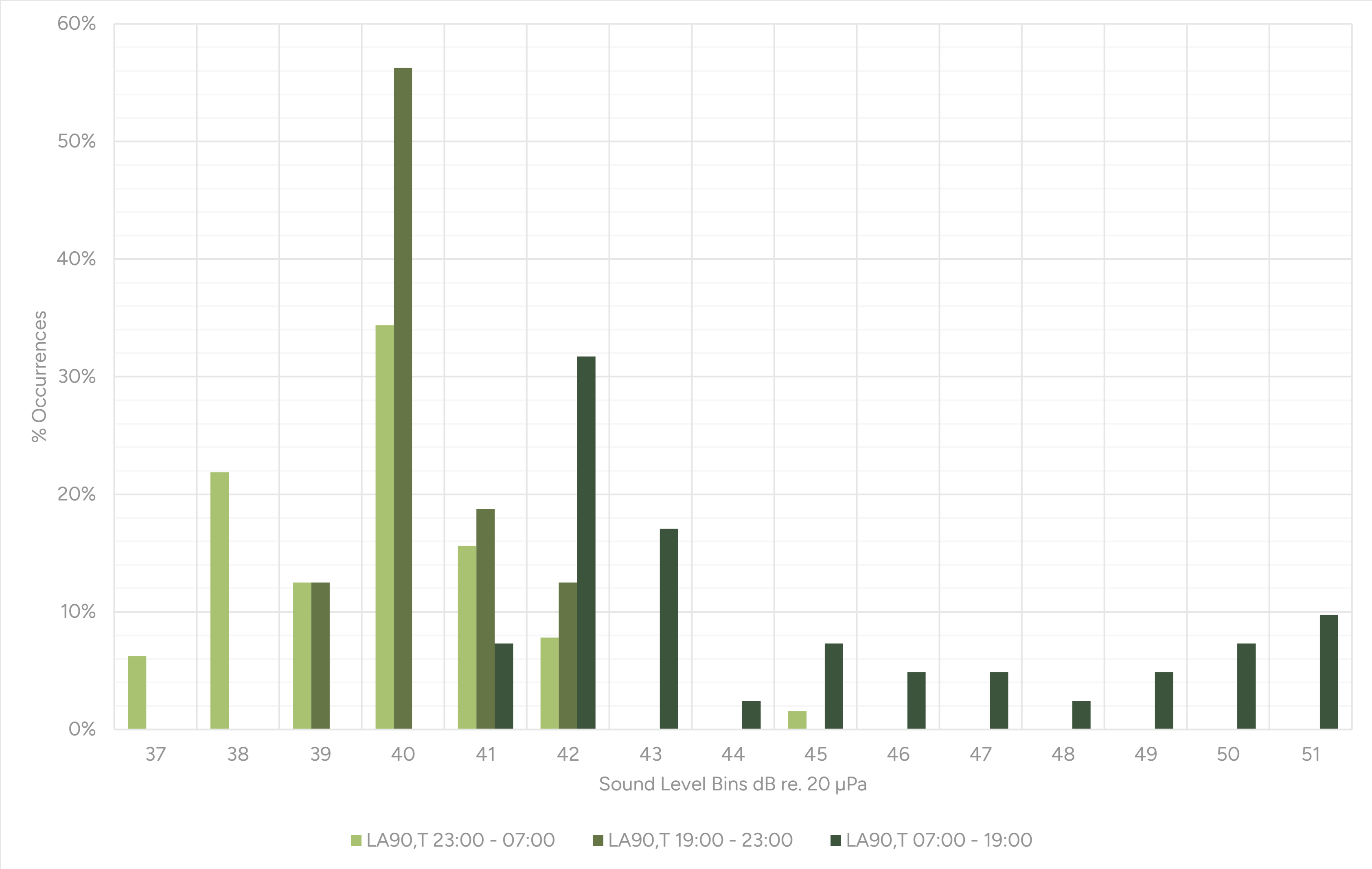


Figure 5-7
Histogram of L_{A90} at Week Rock Road



5.6.3 Location 6 Orchard Way

A summary of the survey results at Location Six Orchard Way is shown in Table 5-4. The full survey results are available in Appendix 5.

Table 5-4
Location 6: Orchard Way Summary of Week 2023 Survey Results dB(A)

Date	Period	L_{Aeq}	L_{A90}	L_{A10}	L_{Amax}
1st December	Daytime	48	42	47	78
	Night-Time	44	41	44	68
4th December	Daytime	49	43	48	80
	Night-Time	-	-	-	-

A graph of the sound levels measured (over whole period) at Orchard Way can be seen in Figure 5-8. Histograms of the $L_{Aeq,T}$ and the L_{A90} in the week can be seen in Figures 5-9 and 5-10.

Figure 5-8
Measured Noise Levels at Orchard Way

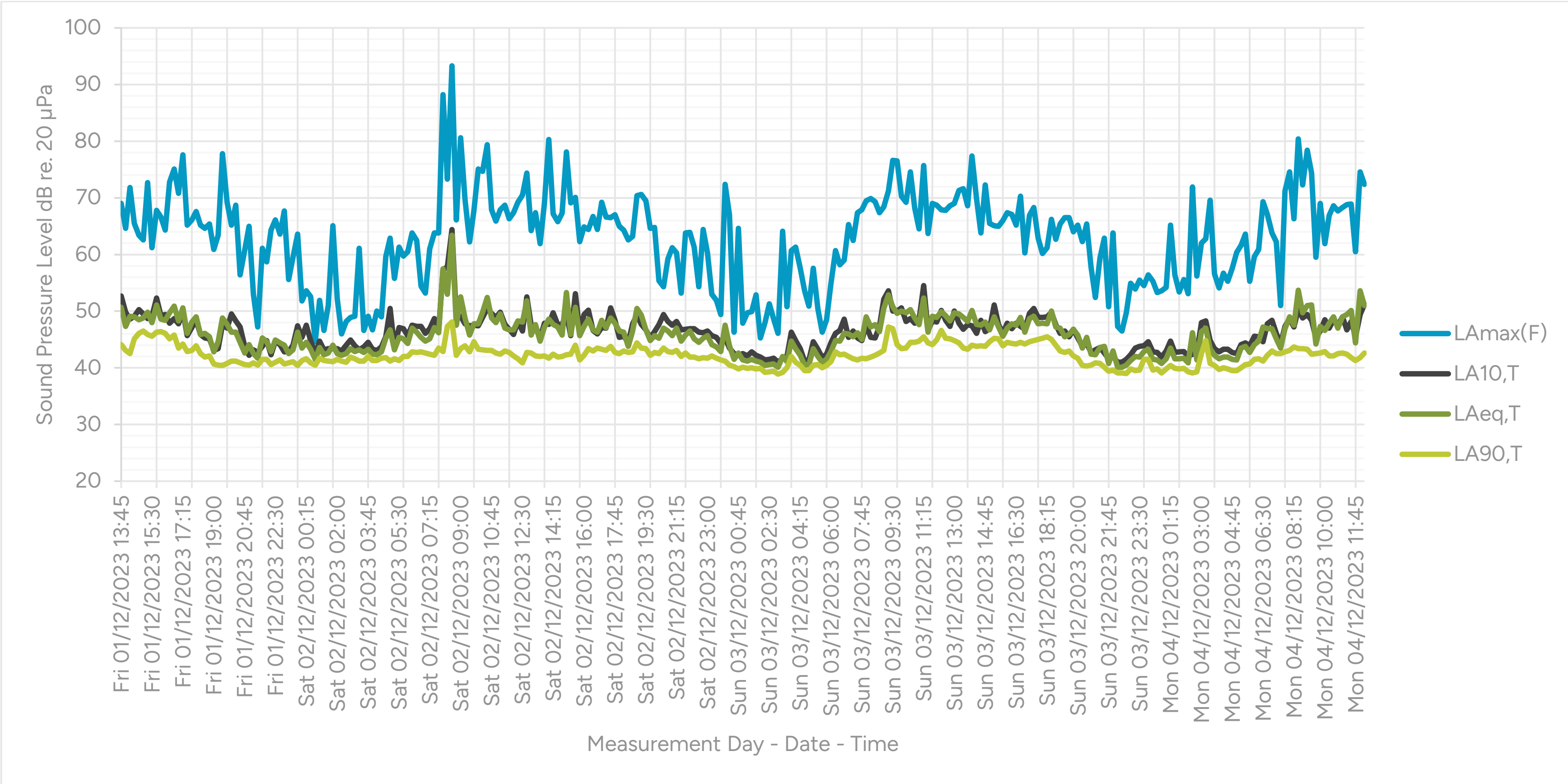


Figure 5-9
Histogram of Week $L_{Aeq,T}$ at Orchard Way

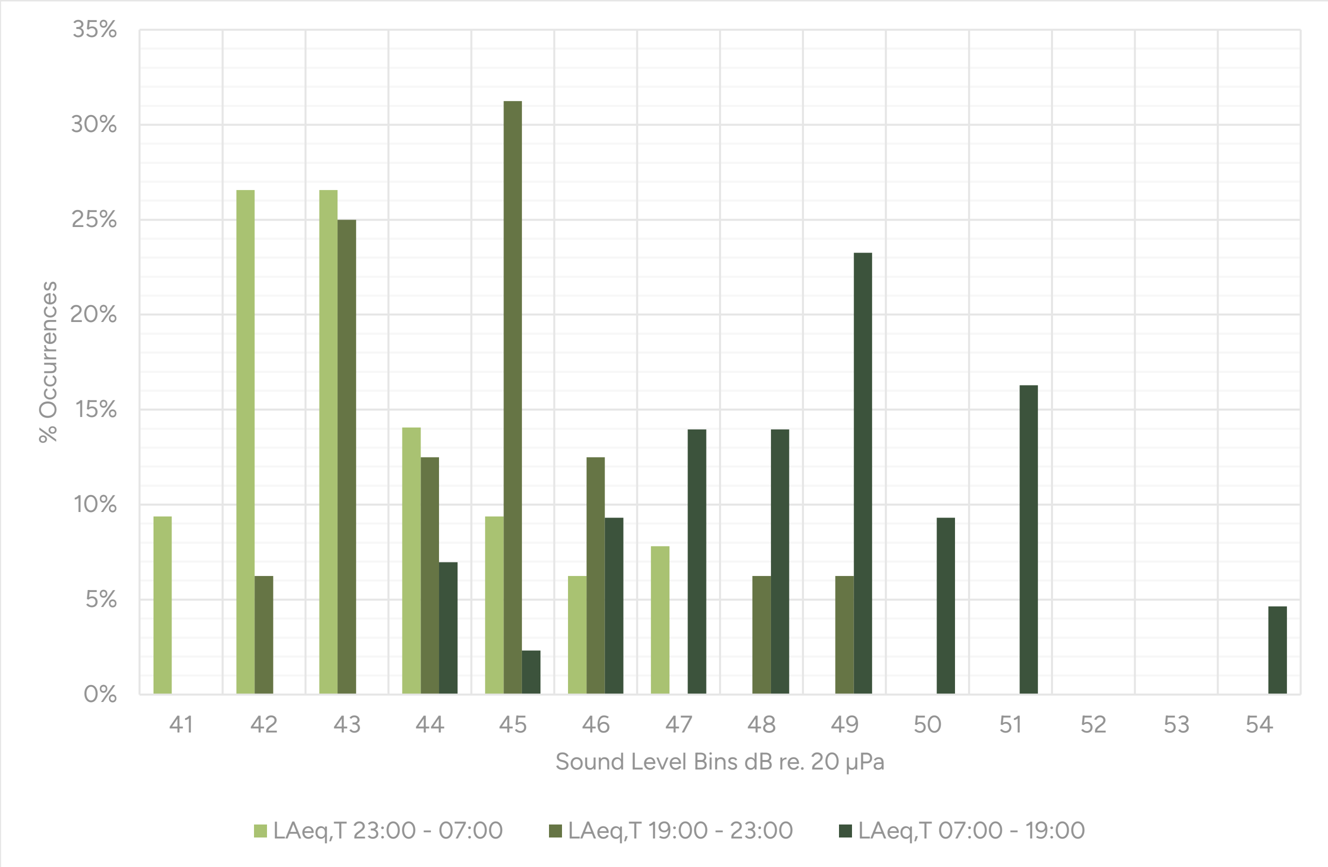
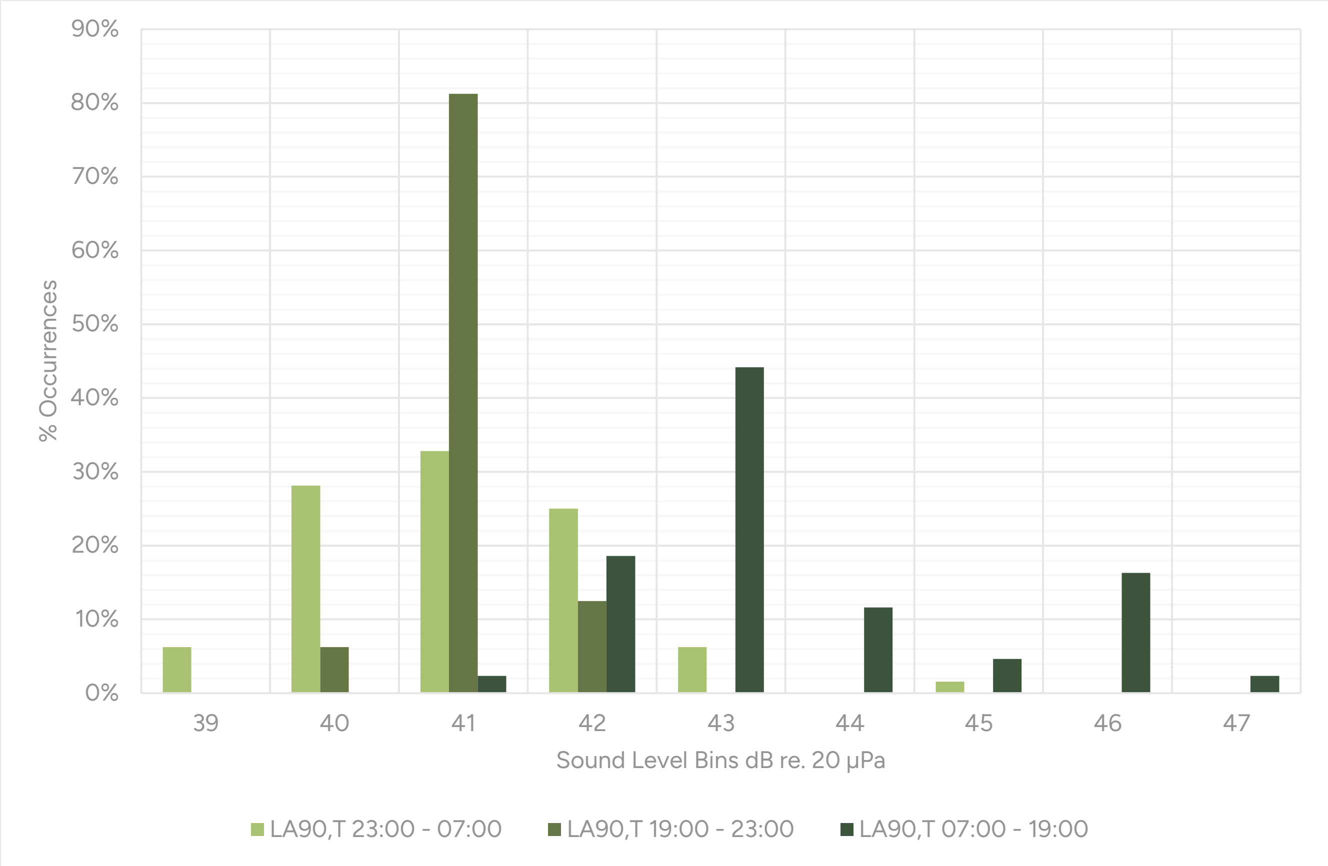


Figure 5-10
Histogram of Week L_{A90} at Orchard Way



5.7 Baseline Background Sound Level Results - Weekend

5.7.1 Location 4 Blake Road

A summary of the survey results at Location Four Blake Road is shown in Table 5-5. The full survey results are available in Appendix 5.

Table 5-5
Location 4: Blake Road Summary of Weekend 2023 Survey Results dB(A)

Date	Period	L_{Aeq}	L_{A90}	L_{A10}	L_{Amax}
2nd December	Daytime	45	39	46	82
	Night-Time	43	39	44	81
3rd December	Daytime	48	45	49	83
	Night-Time	44	40	44	63

A graph of the sound levels measured over the whole period at Blake Road can be seen in Figure 5-11. Histograms of the $L_{Aeq,T}$ and the L_{A90} at the weekend can be seen in Figures 5-12 and 5-13.

Figure 5-11
Measured Noise Levels at Blake Road

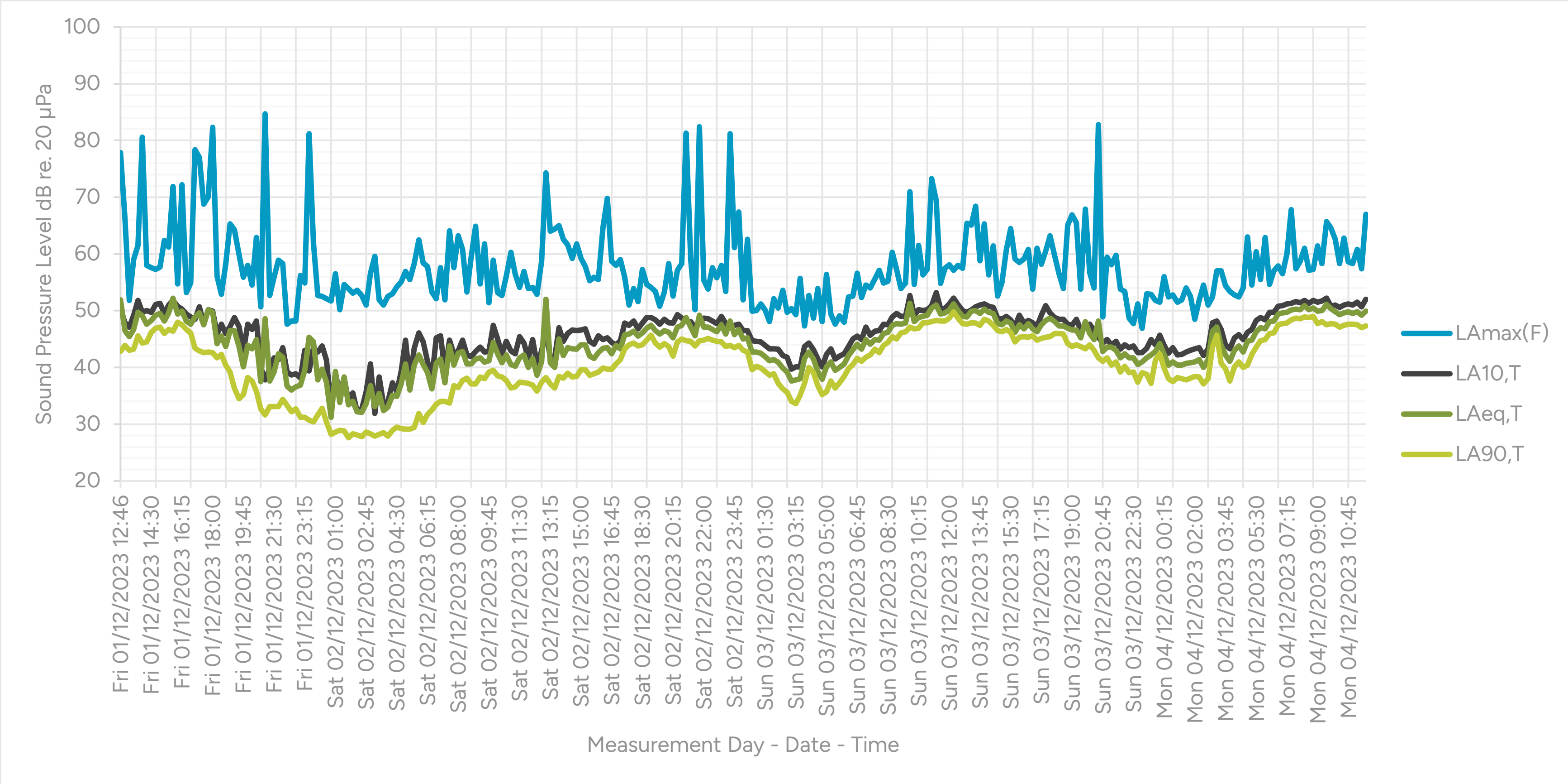


Figure 5-12
Histogram of Weekend $L_{Aeq,T}$ at Blake Road

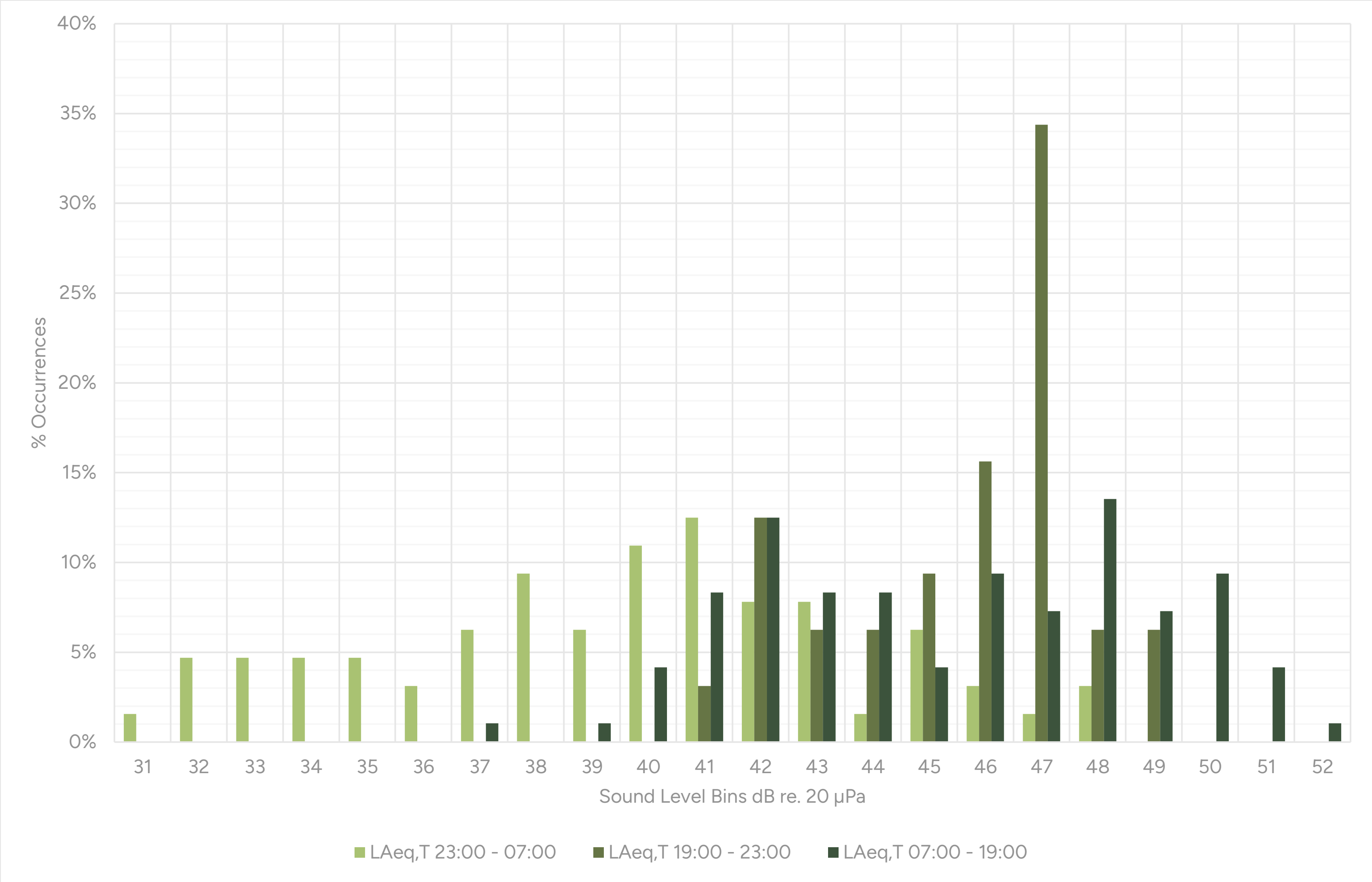
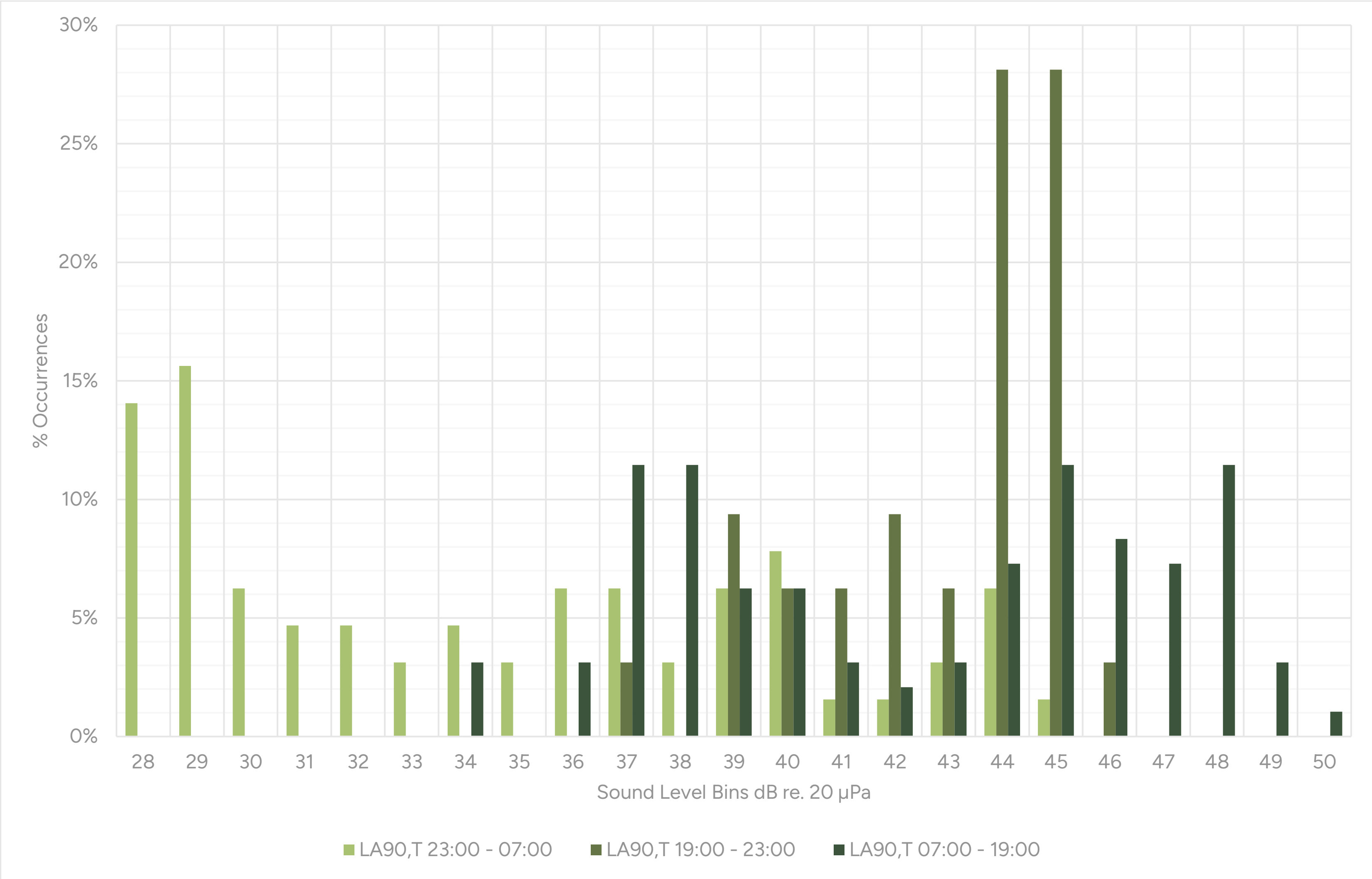


Figure 5-13
Histogram of Weekend Measured L_{A90} at Blake Road



5.7.2 Location 5 Rock Road

A summary of the survey results at Location Five Rock Road is shown in Table 5-6. The full survey results are available in Appendix 5.

Table 5-6
Location 5: Rock Road Weekend Summary of 2023 Survey Results dB(A)

Date	Period	L_{Aeq}	L_{A90}	L_{A10}	L_{Amax}
2nd December	Daytime	46	42	47	78
	Night-Time	41	39	41	67
3rd December	Daytime	45	43	46	77
	Night-Time	42	38	42	69

A graph of the sound levels measured over the whole period at Rock Road can be seen in Figure 5-14. Histograms of the $L_{Aeq,T}$ and the L_{A90} over the weekend can be seen in Figures 5-15 and 5-16.

Figure 5-14
Measured Noise Levels at Rock Road

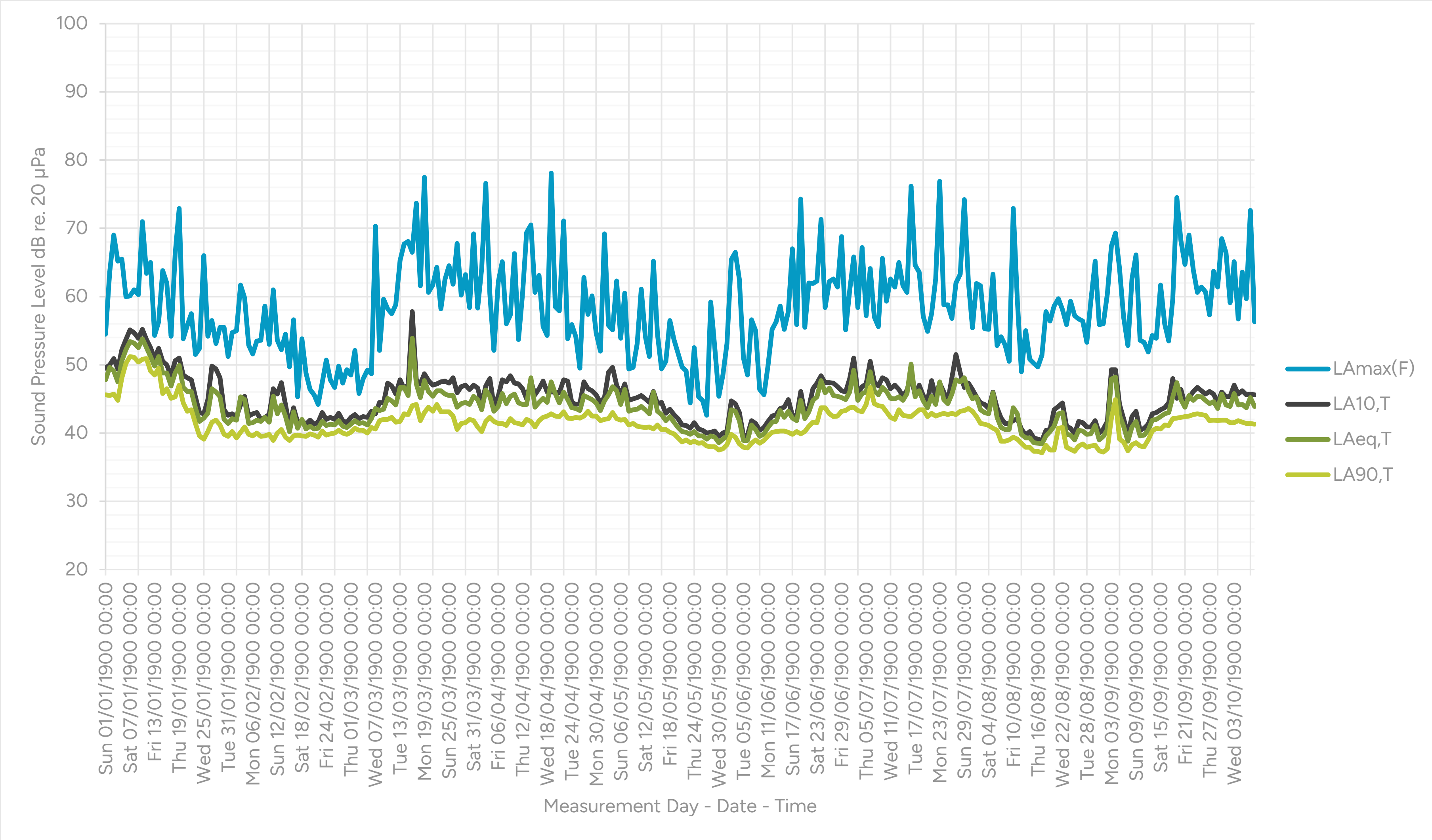


Figure 5-15
Histogram of Weekend $L_{Aeq,T}$ at Rock Road

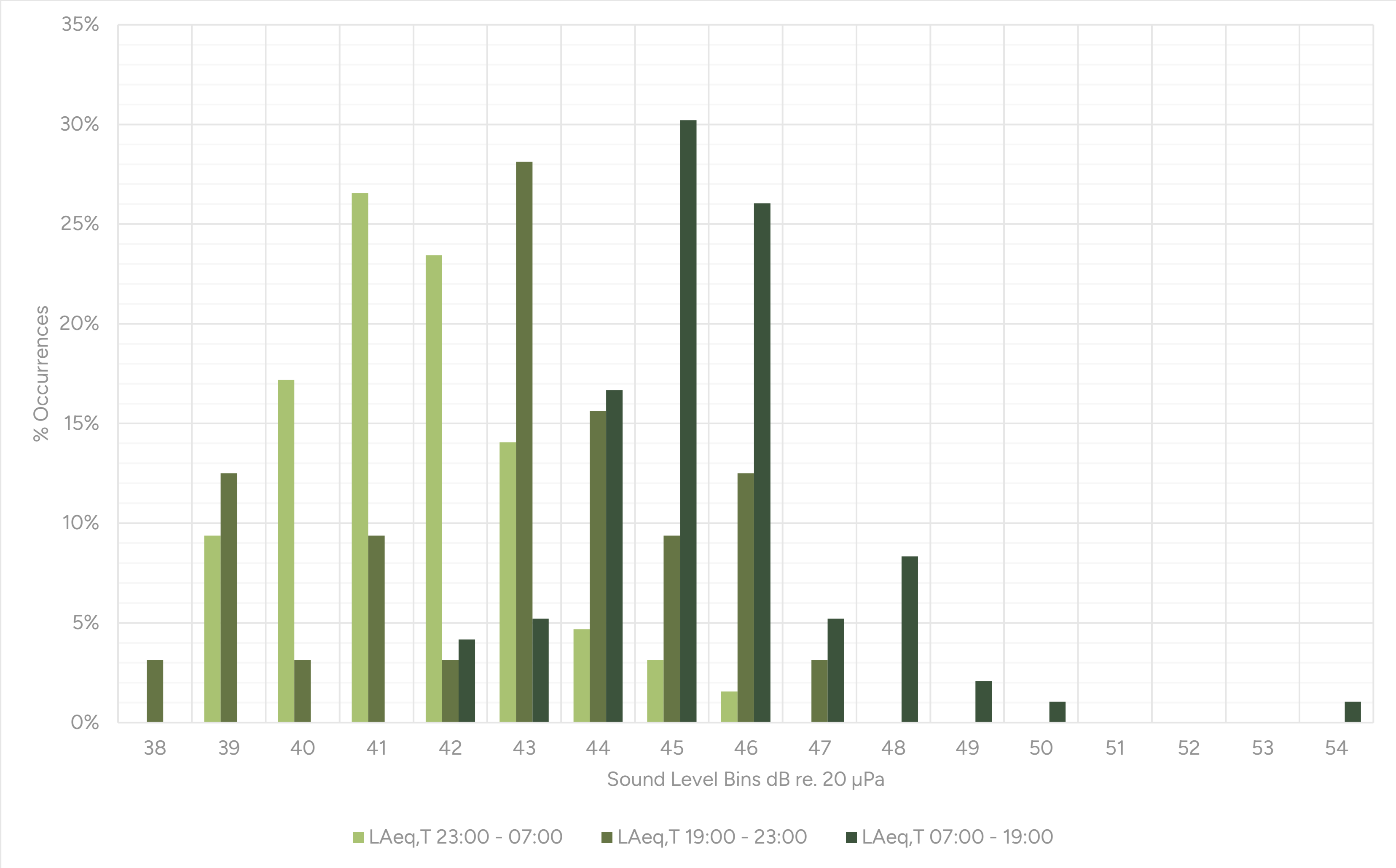
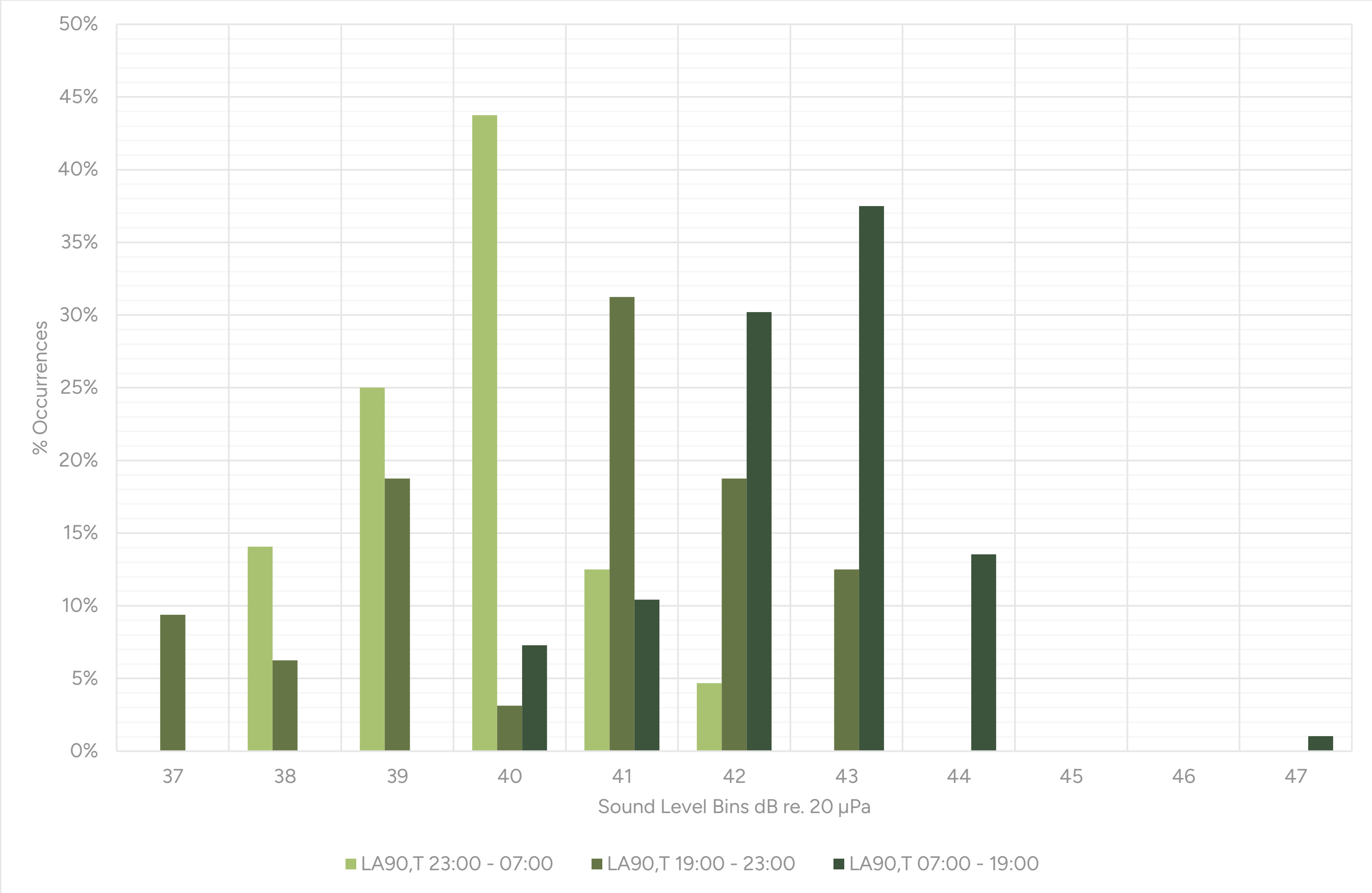


Figure 5-16
Histogram of Weekend L_{A90} at Rock Road



5.7.3 Location 6 Orchard Way

A summary of the survey results at Location Six Orchard Way is shown in Table 5-7. The full survey results are available in Appendix 5.

Table 5-7
Location 6: Orchard Way Weekend Summary of 2023 Survey Results dB(A)

Date	Period	L_{Aeq}	L_{A90}	L_{A10}	L_{Amax}
2nd December	Daytime	50	43	48	93
	Night-Time	43	40	43	72
3rd December	Daytime	48	44	47	77
	Night-Time	43	40	43	72

A graph of the sound levels measured over the whole survey at Orchard Way can be seen in Figure 5-17. Histograms of the $L_{Aeq,T}$ and the L_{A90} over the weekend can be seen in Figures 5-18 and 5-19.

Figure 5-17
Measured Noise Levels at Orchard Way

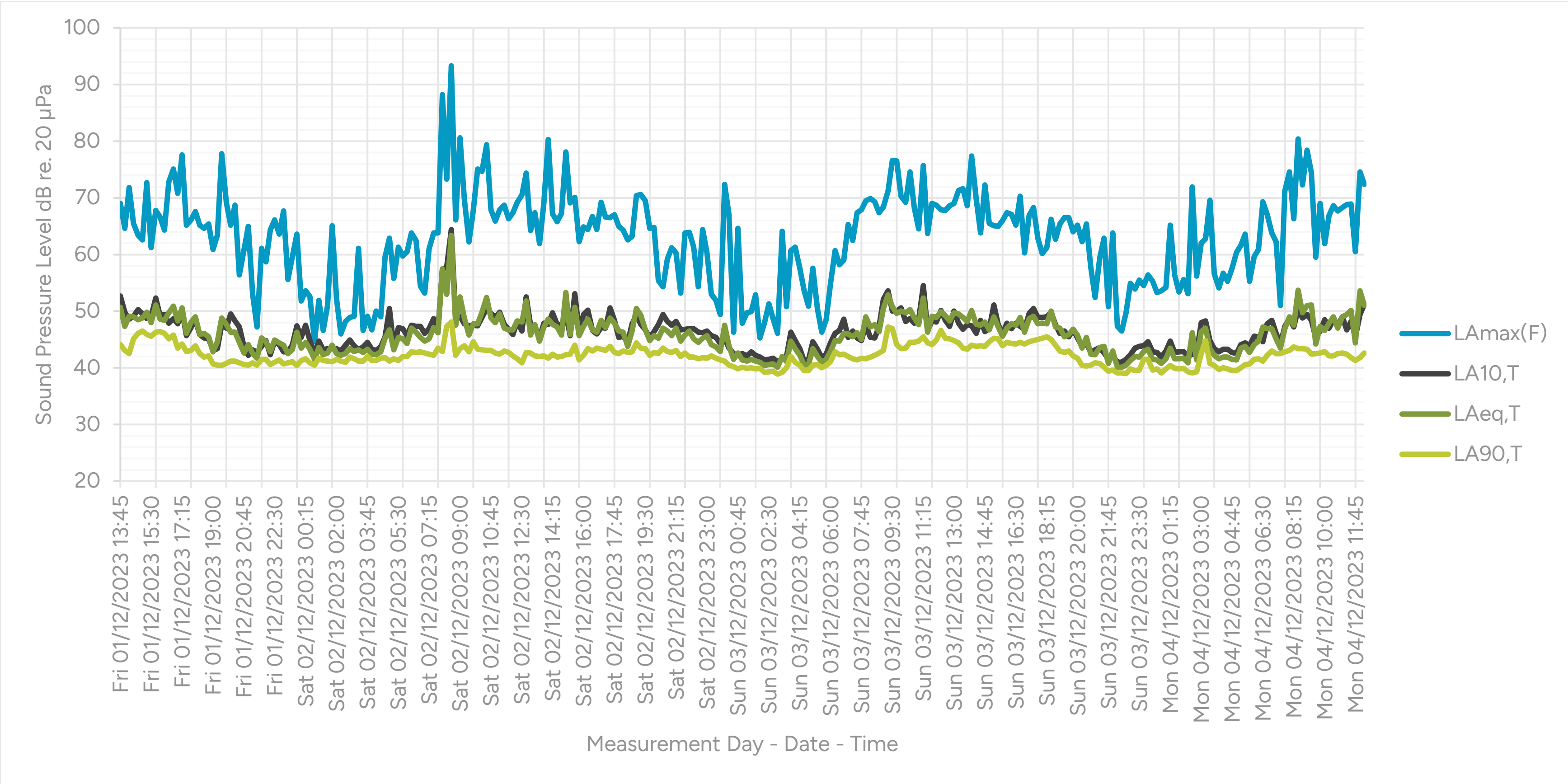


Figure 5-18
Histogram of Weekend $L_{Aeq,T}$ at Orchard Way

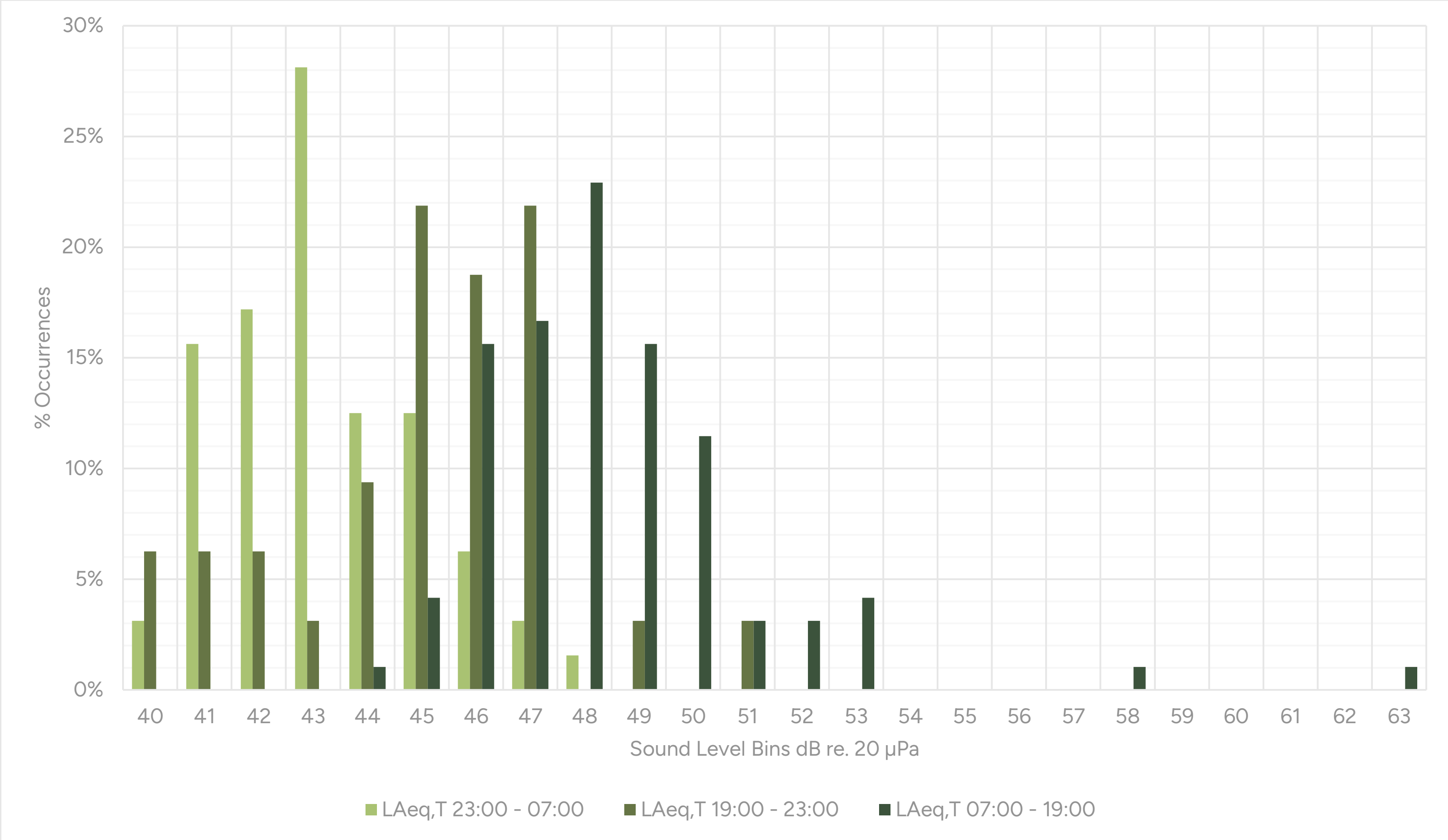
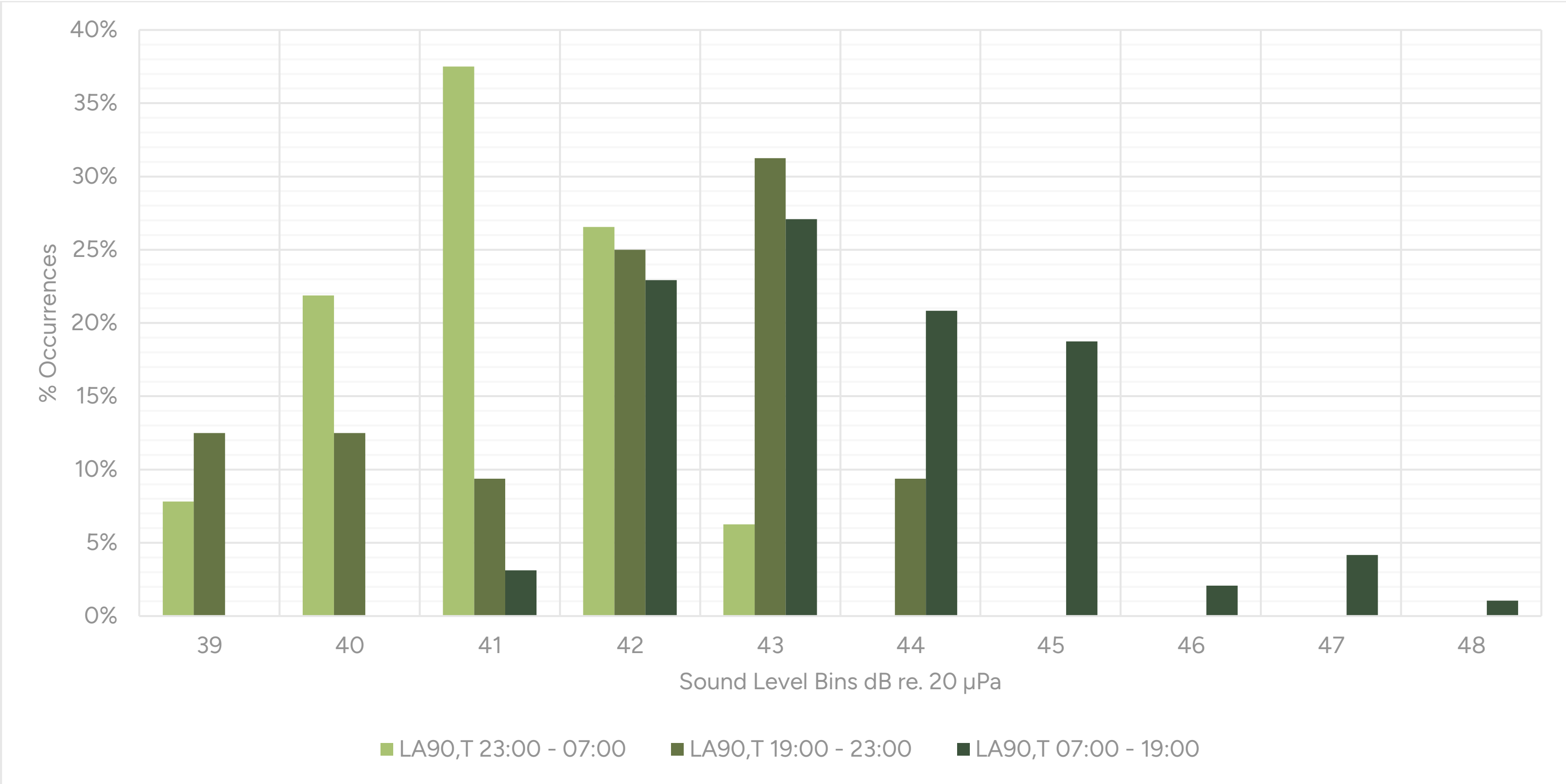


Figure 5-19
Histogram of Weekend L_{A90} at Orchard Way



5.8 Baseline Backgrounds for Assessment

Based on the data presented the following baseline background sound levels will be used in the BS4142 assessments for the NSR locations 1, 2, and 3 as follows. The 2023 data is considered to supersede the 2020 survey as the survey was completed over an extended period of time (compared to the short survey completed in 2020). The 2023 survey was completed during suitable weather conditions and at each survey location the Site was not audible, with the exception of a forklift audible during the collection of the meter at Orchard Way.

- **Location 1[3] Orchard Way**
- Week: A daytime baseline background of 41dB(A). A night-time baseline background of 40dB(A).
- Weekend: A daytime baseline background of 43dB(A). A night-time baseline background of 41dB(A).
- **Location 2[4] Rock Road**
- Week: A daytime baseline background of 40dB(A). A night-time baseline background of 38dB(A).
- Weekend: A daytime baseline background of 42dB(A). A night-time baseline background of 39dB(A).
- **Location 3[5] Elliot Road**
- Week: A daytime baseline background of 38dB(A). A night-time baseline background of 34dB(A).
- Weekend: A daytime baseline background of 39dB(A). A night-time baseline background of 34dB(A).

[3] Using measured baselines background sound levels at proxy location 6 (Orchard Way)
[4] Using measured baselines background sound levels at proxy location 5 (Rock Rd)
[5] Using measured baselines background sound levels at proxy location 4 (Blake Rd)

6.0 Existing Site BS4142 Assessment

It is stated in the INVC Report[6] that:

"Johnson Matthey operates 24 hours a day, 7 days a week. The noise from the site is therefore almost constant, although there will be some small fluctuation in level as individual noise sources are turned on and off. However, all of the boundary positions are affected by extraneous noise including intermittent road traffic on York Way and Orchard Road, constant road traffic on the A505, occasional aircraft and trains, other industrial units, intermittent construction noise from the new building on the Johnson Matthey site, and (during the day) birdsong. The background noise readings (L_{A90}) are therefore likely to be a better measure of the noise from the site than the equivalent continuous noise readings (L_{Aeq}), which are more affected by intermittent extraneous noise".

On that basis the specific sound level of the Johnson Matthey Site at the eastern boundary of the Site may be inferred from the baseline background sound levels measured by INCV in 2020 at boundary positions 1, 1a, 11, and 12. However, to present a robust assessment, the measured $L_{Aeq,T}$ data will be used. The date, weather, and equipment used during the survey is detailed in Section 4 of this Report.

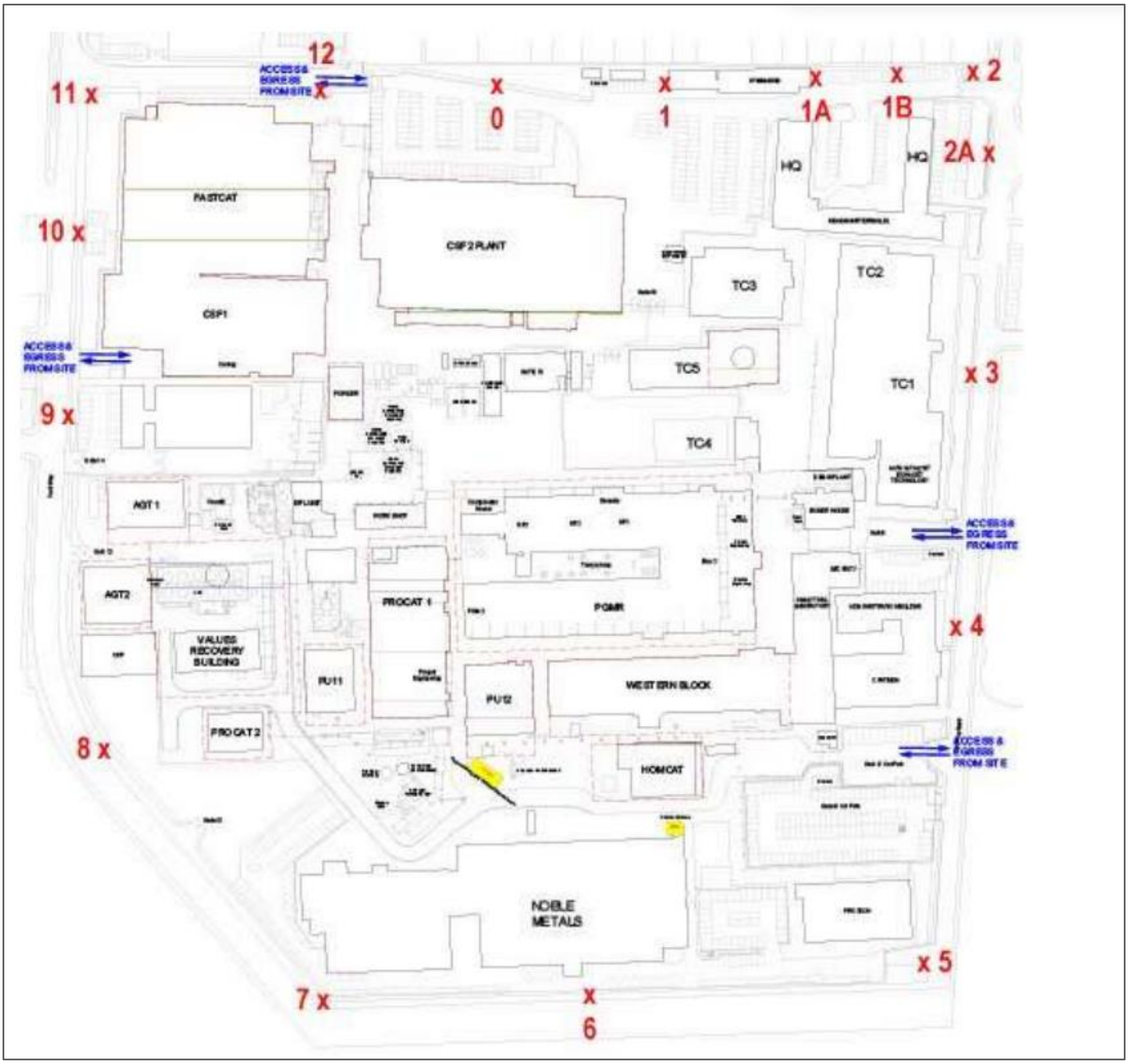
6.1 Survey Locations

Sound levels were measured at the following eastern boundary positions 1, 1A, 11 and 12.

The on-site survey locations are shown in Figure 6-1. The NSR locations are shown in Figure 4-1.

[6] At page 6 INVC Report 9706 Dated 9th October 2020

Figure 6-1
Eastern Boundary Measurement Positions[7]



[7] NOTE the figure taken from the INVC Report is not rotated north to south. The eastern boundary is the top boundary shown on the Figure.

6.2 Specific Sound Level Results

A summary of the background survey results at Locations 1, 1A, 11 and 12 are shown in Table 6-1. The full survey results are available in the INVR Report[8].

Table 6-1
Summary of 2020 Survey Results dB(A)

Location	Period	Measured L_{Aeq}[9]	Inferred Specific Sound Level
1	Daytime	55	55
	Night-Time	51	51
1A	Daytime	53	53
	Night-Time	41	41
11	Daytime	66	66
	Night-Time	49	49
12	Daytime	61	61
	Night-Time	58	58

6.3 Noise Model

To determine the specific sound level of the Existing Site at the NSR locations a noise model has been developed.

The sound predictions in this assessment have been undertaken using a proprietary software-based noise model, CadnaA, which implements the full range of UK noise-based calculation methods. The calculation algorithms set out in ISO 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors – Part 2 General method of calculation have been used and the model assumes:

- A ground absorption factor of 0.25.
- Contour Data to include OS terrain data.
- A reflection factor of 3.

To determine the specific sound level off-site two area sources have been modelled across the Johnson Mathey Site. The area sources have been calibrated to ensure that the specific sound level at each boundary location agrees with Table 6-1[10]. The area sources have been modelled at a height of 4m and with a sound power level per unit area of 100dB(A) to 115dB(A) (daytime) and 98dB(A) and 109dB(A) (night-time). The resultant specific sound level at the boundary locations and at the off-site Receptors locations can be seen in Figure 6-2 for the daytime and Figure 6-3 for the night-time.

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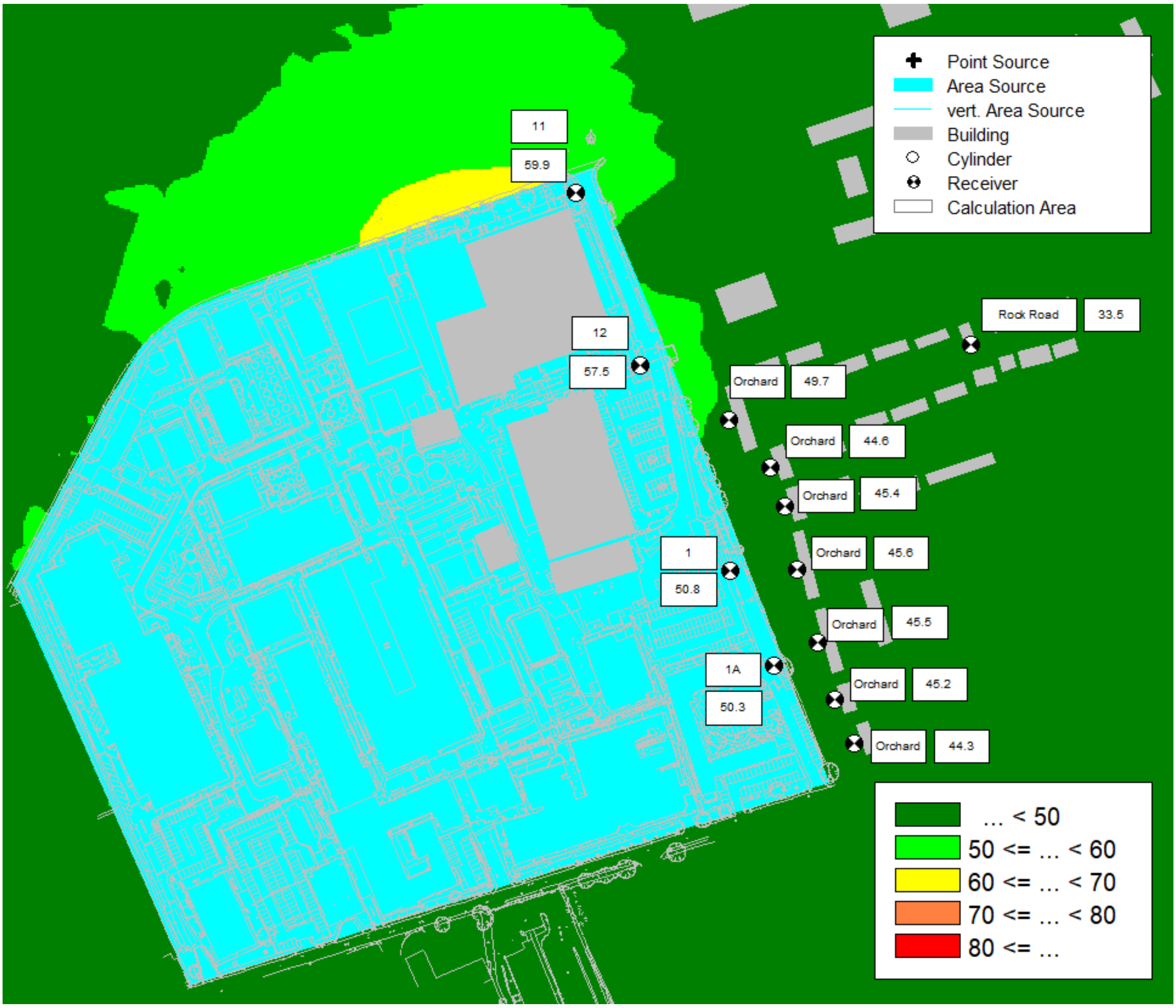
[8] INVC Report 9706 Dated 9th October 2020
[9] See Page 13 of INVC Report second table on page.
[10] Daytime: Within 1dB(A) or higher.

Figure 6-2
Existing Daytime Site-Specific Sound Level at 1.5m

Figure 6-3
Existing Night-Time Site-Specific Sound Level at 1.5m



6.4 Character Corrections

The character of the noise source and the sound penalty that will be applied in the BS4142:2014+A1:2019 assessment are detailed below:

- Tonality: SLR has not undertaken the BS4142:2014+A1:2019 *Objective method for assessing the audibility of tones in sound: one third octave method*. However, within the INVC Report it is stated that tones were identified in the datasets at the three off-site NSR that may be attributable to Site plant. Therefore, a 2dB(A) character correction will be applied.
- Impulsivity: Noise from the Site is not considered impulsive.
- Other sound characteristics: When operating, the proposals may be readily distinctive against the residual acoustic environment. A 3dB correction will therefore be required.

- Intermittency: Over the BS4142:2014+A1:2019 reference period of 1-hour in the daytime (07:00 – 23:00) and 15-minutes at night-time (23:00 – 07:00), it is anticipated that the noise sources would be constant; therefore, no intermittency correction is required.

Based on the above, a 5dB penalty is applicable to the predicted specific sound level at the nearest noise-sensitive receptors to derive the corresponding rating levels.

6.5 Existing Site BS4142 Assessment Results

The corrections described in Section 6-4 above have been added to the specific sound levels shown in Figures 6-2 and 6-3 to derive the rating levels at the nearest noise-sensitive receptors.

The rating level has then been compared to the derived background sound level.

The results of the BS4142:2014+A1:2019 assessment are shown in Table 6-2. It must be noted that the rating levels and the representative background sound levels have been rounded to the nearest decibel.

Table 6-2
Existing Site BS4142 Assessment, dB

Receptor	Period	Assessment	Predicted Specific Sound Level, $L_{Aeq,T}$	Predicted Rating Level, $L_{Ar,T}$	Derived Background Sound Level L_{A90}	Difference
Orchard Way[11]	Weekday	Daytime	54	59	41	+18
		Night-Time	50	55	40	+15
	Weekend	Daytime	54	59	43	+16
		Night-Time	50	55	41	+14
Rock Road	Weekday	Daytime	37	42	40	+2
		Night-Time	34	39	38	+1
	Weekend	Daytime	37	42	42	0
		Night-Time	34	39	39	0
Eliot Road	Weekday	Daytime	31[12]	36	38	-2
		Night-Time	25[13]	30	34	-4
	Weekend	Daytime	31	36	39	-3
		Night-Time	25	30	34	-4

It can be seen from Table 6-2 that the rating level of existing operations exceeds the background sound level at Orchard Way and at Rock Road during the weekday period.

[11] Highest level taken from Figures 6-2 and 6-3
[12] Not on Figure 6-1 due to distance but this is the value.
[13] Not on Figure 6-1 due to distance but this is the value.

7.0 BS4142:2014+A1:2019 Cumulative Site Assessment

7.1 Project Apollo

The main noise sources that are expected to be audible externally are detailed in Table 7-1.

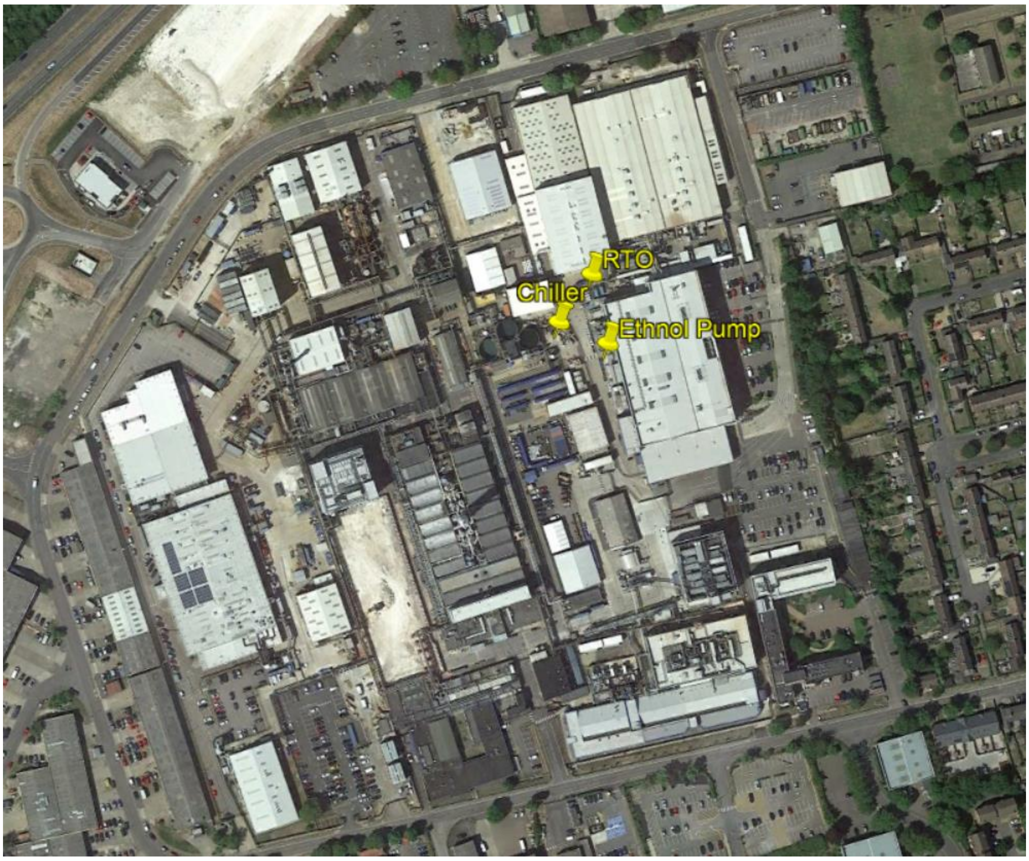
Table 7-1
Project Apollo Plant Noise Data – dB

Plant	Sound Power Level dB(A)
Regenerative Thermal Oxidiser[14] (RTO) TO Fan	83
RTO Stack	83
RTO Furnace	83
Chiller	90
Ethanol Pump	83

The location of the Plant can be seen in Figure 7-1. It is stated in the *Environment Permit Variation Application Best Available Techniques & Operating Techniques* that (dated October 2022) at Section 3.6.6 that Project Apollo Plant will be designed to ensure no increase of noise will be detectable at the installation boundary.

[14] It I stated in the *Environment Permit Variation Application Best Available Techniques & Operating Techniques* that (dated October 2022) *"The RTO will be fitted with acoustic insulation, silencers and noise hoods. The environmental noise level when measured at site boundary (Approx.90m) shall not exceed 55dBA"*

Figure 7-1
Location of Proposed Apollo Plant



The approximate distances between the proposed Apollo Plant and the NSR locations are detailed in Table 7-2.

Table 7-2
Distance Between Apollo Plant and NSR Locations

Apollo Plant	Distance to NSR (m)		
	No. 2 Orchard Rd	No. 25 Rock Road	Eliot Road
RTO Fan	274	285	715
RTO Stack	274	285	715
RTO Furnace	274	285	715
Chiller	302	302	727
Ethanol Pump	238	281	724

7.2 Boiler Replacement

JM will replace the three existing boilers in the main boiler house with up-to-date state of the art boilers and burners. This will improve efficiency and remove the requirement to manage wet steam.

At Section 6.5.5 of the *Environment Permit Variation Application Best Available Techniques & Operating Techniques* that (dated October 2022) it is stated:

"The boilers will be designed in accordance with European noise standards; the equipment will be subject to regular preventative maintenance in accordance with the manufacturer's requirements. It is considered unlikely that the proposed changes will give rise to noise or vibration nuisance at the site boundary. The new boilers are considered to be less noisy than their predecessors as the equipment is brand new.

A noise survey was undertaken by Industrial Noise and Vibration Centre in October 2020 (reference R9706). The report concluded that JM operates 24 hours a day, 7 days a week and therefore the noise from the site is therefore almost constant, although there will be some small fluctuation in level as individual noise sources are turned on and off. Many of the main noise sources on site are shielded from the surrounding area by acoustic screens and/or other buildings, so the noisiest sources may not necessarily be audible at the boundary.

Potential sources of noise that may impact the site boundary from the boilers are listed below:

- *Fans and blowers from the boilers.*

These elements will be designed to ensure no increase of noise will be detectable at the installation boundary. All fans will be fitted with anti-vibration mounts. The site carries out noise monitoring every two years and reports this to the EA as part of the current EP requirement; the survey will be reviewed and extended to ensure no noise from the boiler house is present at the boundary".

7.3 Noise Model

The sound predictions in this assessment have been undertaken using a proprietary software-based noise model, CadnaA, which implements the full range of UK noise-based calculation methods. The calculation algorithms set out in ISO 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors – Part 2 General method of calculation have been used and the model assumes:

- A ground absorption factor of 0.5.
- Contour Data to include OS terrain data.
- A reflection factor of 3.

The characteristics of the proposed noise sources as modelled in CadnaA are presented in Table 7-3.

Table 7-3
Plant Characteristics in CadnaA

Plant	X/Y	CadnaA Noise Type	Height above ground	Sound Power dB(A)
Regenerative Thermal Oxidiser (RTO) TO Fan	534862/241554	Point Source	7.2m	83
RTO Stack	534863/241555	Point Source	25m	83
RTO Furnace	Centre 534863/241557	Area and Vertical Sources	7m	83
Chiller	Centre 534847/241539	Area and Vertical Sources	2.6m	90
Ethanol Pump	534852/241539	Point Source	0.5m	83

7.4 Specific Sound Level of Proposed Plant

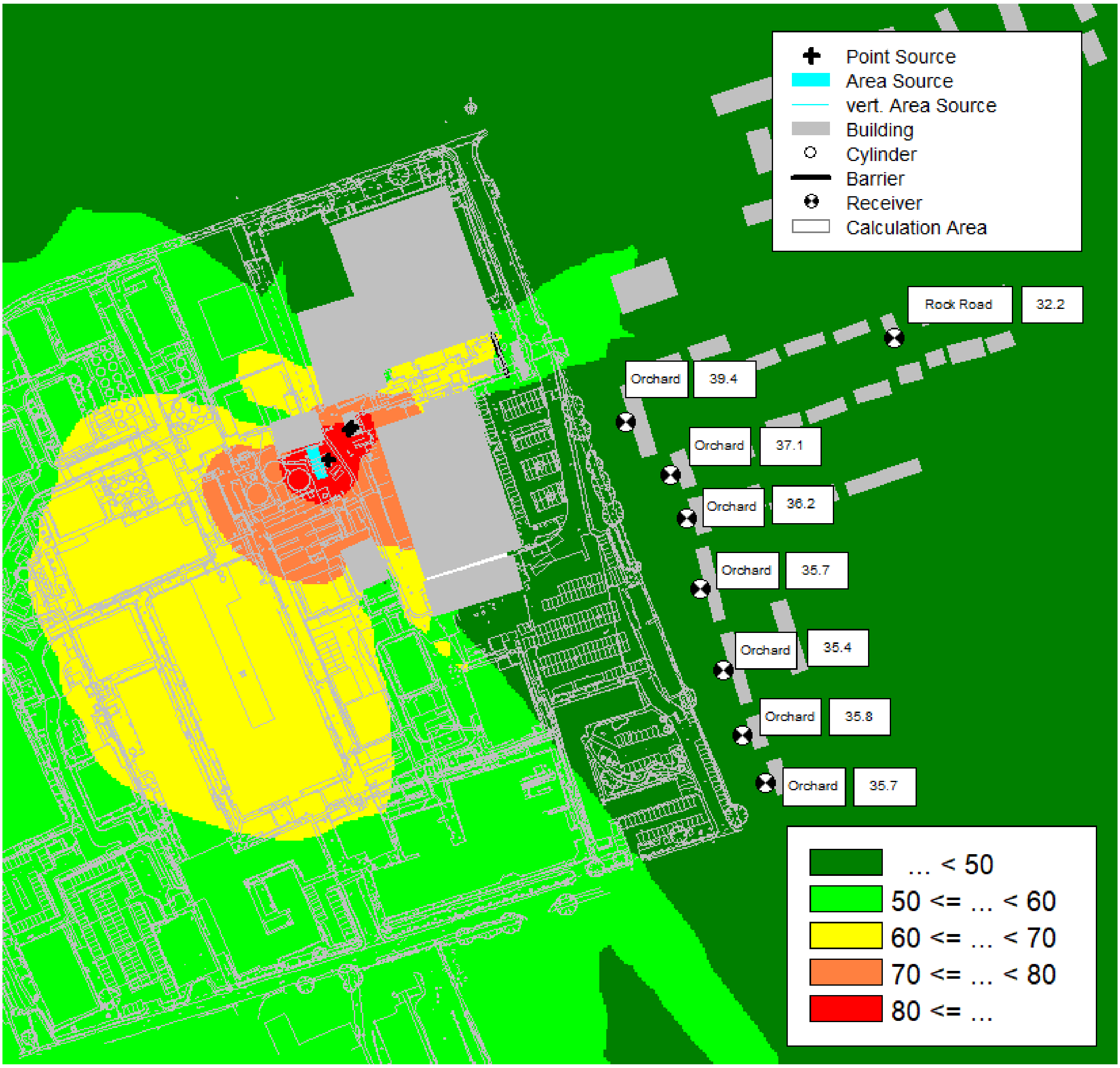
The calculated specific sound level of the proposed plant at each location are presented in Table 7-4. The daytime and night-time CadnaA images of the $L_{Aeq,T}$ dB specific sound level are presented in Figures 7-2 and 7-3. Within Table 7-4 the highest predicted sound level for Orchard Way has been presented.

Table 7-4
Specific Sound Level of Proposed Plant – dB(A)

Receptor	Assessment	Predicted Additional Plant Specific Sound Level, $L_{Aeq,T}$
Orchard Way	Week Daytime	39
	Week Night-Time	39
	Weekend Daytime	39
	Weekend Night-Time	39
Rock Road	Week Daytime	32
	Week Night-Time	32
	Weekend Daytime	32
	Weekend Night-Time	32
Eliot Road	Week Daytime	26
	Week Night-Time	29
	Weekend Daytime	26
	Weekend Night-Time	29

Figure 7-2
Daytime Specific Sound Level at a Height of 1.5m

Figure 7-3
Night-Time Specific Sound Level at a Height of 4m



7.5 Cumulative Sound Level of Existing and Additional Plant

The specific sound level of the exiting plant and additional plant at No.2 Orchard is presented in Table 7-5.

Table 7-5
Cumulative Specific Sound Level of Existing and Proposed Plant – dB(A)

Receptor	Assessment	Predicted Existing Plant Specific Sound Level, $L_{Aeq,T}$	Predicted Additional Plant Specific Sound Level, $L_{Aeq,T}$	Cumulative Plant Specific Sound Level, $L_{Aeq,T}$
Orchard Way	Week Daytime	54	39	54
	Week Night-Time	50	39	50
	Weekend Daytime	54	39	54
	Weekend Night-Time	50	39	50
Rock Road	Week Daytime	37	32	38
	Week Night-Time	34	32	36
	Weekend Daytime	37	32	38
	Weekend Night-Time	34	32	36
Eliot Road	Week Daytime	31	26	32
	Week Night-Time	25	29	30
	Weekend Daytime	31	26	32
	Weekend Night-Time	25	29	30

7.6 Cumulative Site BS4142 Assessment Results

The corrections described in Section 6-4 have been added to the specific sound levels shown in Table 7-5 to derive the rating levels at the nearest noise-sensitive receptor, on Orchard Way.

The rating level has then been compared to the derived background sound level.

The result of the cumulative BS4142:2014+A1:2019 assessment is shown in Table 7-6. It must be noted that the rating levels and the representative background sound levels have been rounded to the nearest decibel.

Table 7-6
Cumulative Site BS4142 Assessment, dB

Receptor	Assessment	Predicted Cumulative Specific Sound Level, $L_{Aeq,T}$	Predicted Cumulative Rating Level, $L_{Ar,T}$	Derived Background Sound Level L_{A90}	Difference
Orchard Way	Week Daytime	54	59	41	+18
	Week Night-Time	50	55	40	+15
	Weekend Daytime	54	59	43	+16
	Weekend Night-Time	50	55	41	+14
Rock Road	Week Daytime	38	43	40	+3
	Week Night-Time	36	41	38	+3
	Weekend Daytime	38	43	42	+1
	Weekend Night-Time	36	41	39	+2
Eliot Road	Week Daytime	32	35	38	-3
	Week Night-Time	30	33	34	-1
	Weekend Daytime	32	35	39	-4
	Weekend Night-Time	30	33	34	-1

From a comparison between Table 6-2 and 7-6 it can be seen that the additional plant is not predicted to increase the difference between the existing Site's rating level and the baseline background sound level at Orchard Way.

At Rock Road and Eliot Road, the variation will increase the rating level, but the level difference compared to the baseline background sound level. is no more than +3dB(A) at Rock Road, and -1dB(A) at Eliot Road. The increase is not therefore considered be significant.

Whilst the rating level at Orchard Way is more than the baseline background sound level by more than 10dB(A), it must be noted that the baseline background sound level was completed at a proxy location that shielded the noise meter, not just from the Johnson Matthey Site, but also commercial and industrial noise from other premises. Had it been possible for the Johnson Matthey Site to cease operations temporarily, the meter would have been placed in a garden abutting the Johnson Matthey Site.

At the measurement location other non-site related noise, as referenced above, may have elevated the baseline background sound level.

A higher baseline background sound level may therefore be more typical at the boundary of the Site with Orchard Way, and the assessment may be considered robust given the lower proxy reference level used for the assessment.

With regards to context BS4142 allows for a review of the absolute sound level. is relevant to consider the absolute level of predicted plant emissions at the receptor when considering the night-time period.

From an analysis of the baseline survey data, the existing baseline ambient noise levels at Orchard Way are between 40dB(A)and 49dB(A) which internally, assuming a typical 26dB R_w deduction of a standard glazed window, would equate to 14dB(A) to 23dB(A). Cumulatively, with the addition of the specific sound level, as a worst case the total

$L_{Aeq,T}$ inside a bedroom would equate to 27dB(A)[15]. This level is below the recommended limit for sleeping by the World Health Organisation of 30dB(A).

With a partially open window the limit would be exceeded, however, as the variation proposals do not elevate the specific sound level of the Facility above that which is already occurring, it is therefore not expected that the variation will cause a change in noise impact at Orchard Way.

In context therefore it is proposed that the application will not have a significant impact.

Furthermore, whilst the identified difference between the rating level and the baseline background sound level may appear high, the absence of noise complaints associated with the Site, indicates that the Site is operating with a low noise impact.

On this basis it is considered that the permit variation should be permitted.

[15] Log add 49dB(A) and 50dB(A) = 53dB(A). Minus 26dB(A) = 27dB(A).

8.0 Conclusion

Johnson Matthey has appointed SLR to undertake an assessment of the noise impact of new plant to be installed at the Johnson Matthey Site.

Due to the potential for the new plant to increase noise levels in the area the Environment Agency (EA) has requested that an application to vary the site's Permit is made, and that the application includes a Noise Impact Assessment.

This Report has been completed by Michelle Dawson a Corporate Member of the Institute of Acoustics (MIOA).

This Report has presented a BS4142 assessment of the existing Plant and a cumulative assessment including the plant associated with the permit variation.

The Report concludes that as the additional plant is not predicted to increase the difference between the existing Site's rating level and the baseline background sound level at the NSR locations assessed. Whilst the identified difference between the rating level and the baseline background sound level may appear high, the absence of noise complaints associated with the Site, and the robust assessment presented, indicates that the Site is operating with a low noise impact. On this basis it is considered that the permit variation should be permitted.

APPENDIX 01

Glossary of Terminology

Glossary of Terminology

In order to assist the understanding of acoustic terminology and the relative change in noise, the following background information is provided.

The human ear can detect a very wide range of pressure fluctuations, which are perceived as sound. In order to express these fluctuations in a manageable way, a logarithmic scale called the decibel, or dB scale is used. The decibel scale typically ranges from 0dB (the threshold of hearing) to over 120dB. An indication of the range of sound levels commonly found in the environment is given in the following table.

Table 1
Sound Levels Commonly Found in the Environment

Sound Level	Location
0dB(A)	Threshold of hearing
20 to 30dB(A)	Quiet bedroom at night
30 to 40dB(A)	Living room during the day
40 to 50dB(A)	Typical office
50 to 60dB(A)	Inside a car
60 to 70dB(A)	Typical high street
70 to 90dB(A)	Inside factory
100 to 110dB(A)	Burglar alarm at 1m away
110 to 130dB(A)	Jet aircraft on take off
140dB(A)	Threshold of Pain

Acoustic Terminology

dB (decibel) — The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure ($2x10^{-5}$Pa).

dB(A) — A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.

L_{Aeq} — L_{Aeq} is defined as the notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the A - weighted fluctuating sound measured over that period.

L_{10} & L_{90} — If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The L_n indices are used for this purpose, and the term refers to the level exceeded for n% of the time. Hence L_{10} is the level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, L_{90} is the 'average minimum level' and is often used to describe the background noise. It is common practice to use the L_{10} index to describe traffic noise.

L_{Amax} — L_{Amax} is the maximum A - weighted sound pressure level recorded over the period stated. L_{Amax} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.

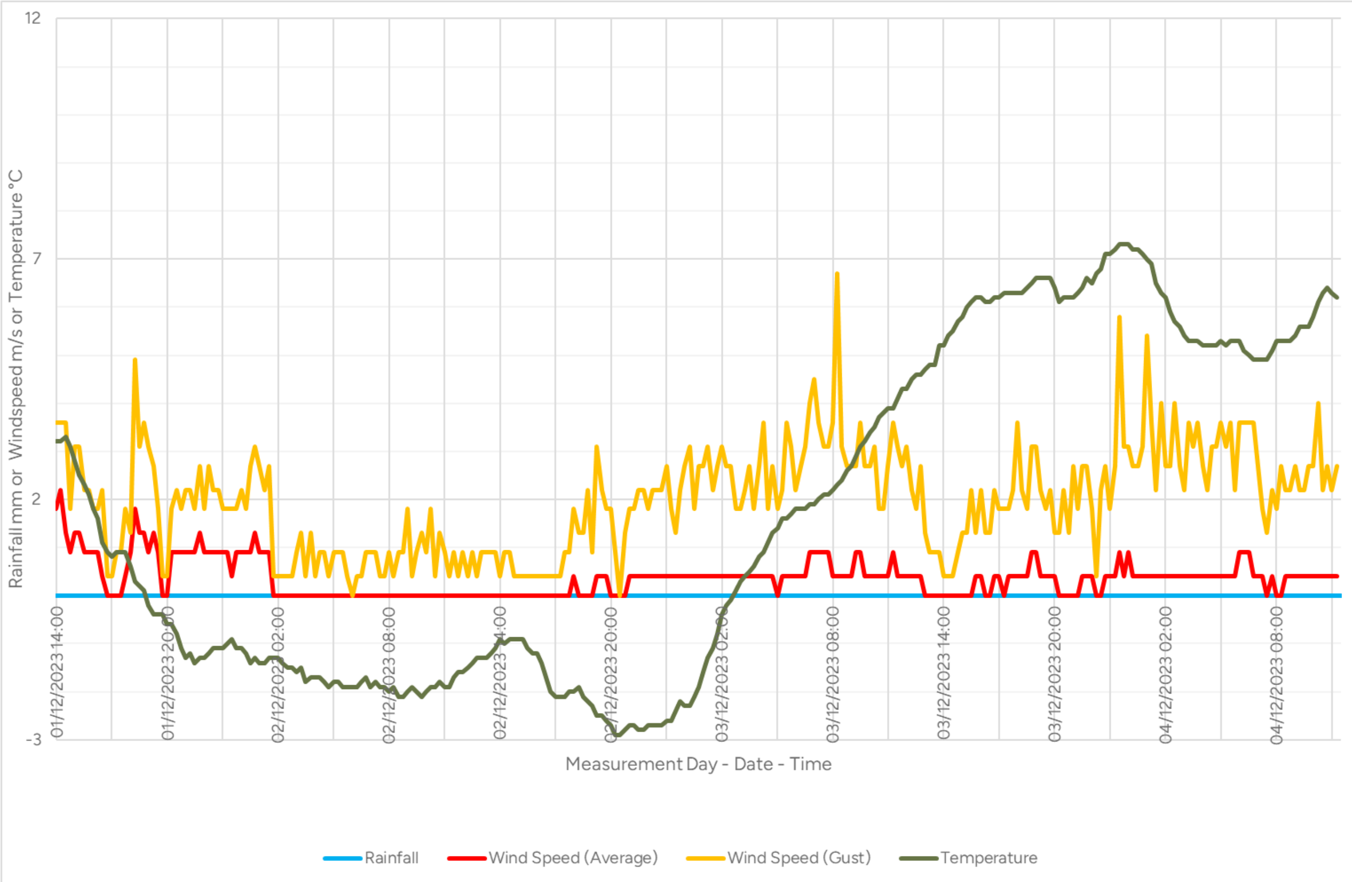
APPENDIX 02

2020 Survey Data

Position	Year	Time	Date (dd/mm/yy)	Start Time (hh:mm)	Stop Time (hh:mm)	Duration (hh:mm)	L_{A90} (dB)	L_{A50} (dB)	L_{Aeq} (dB)	L_{A10} (dB)	L_{Amax} (dB)
2 Orchard Way	2020	Afternoon	14/09/20	13:30	13:35	00:05	41.0	48.0	60.2	61.0	84.0
				13:35	13:40	00:05	40.0	47.0	53.8	58.5	67.1
				13:40	13:45	00:05	40.0	44.0	53.6	58.0	69.1
		Mean	14/09/20	13:35	13:40	00:05	40.3	46.3	55.9	59.2	73.4
		Std Dev	0	00:05	00:05	00:00	0.6	2.1	3.8	1.6	9.2
		Night	17/09/20	00:40	00:45	00:05	36.0	38.0	38.4	39.5	47.7
				00:45	00:50	00:05	37.0	38.5	39.2	40.5	50.3
				00:50	00:55	00:05	36.5	38.5	38.8	40.0	49.1
		Mean	17/09/20	00:45	00:50	00:05	36.5	38.3	38.8	40.0	49.0
		Std Dev	0	00:05	00:05	00:00	0.5	0.3	0.4	0.5	1.3
22 Rock Road	2020	Morning	16/09/20	07:10	07:15	00:05	46.5	48	49.1	49.5	61.9
				07:15	07:20	00:05	47.5	48.5	50.8	53	62.4
				07:20	07:25	00:05	47.0	48.5	50.0	51.5	62.2
		Mean	16/09/20	07:15	07:20	00:05	47.0	48.3	50.0	51.3	62.2
		Std Dev	0	00:05	00:05	00:00	0.5	0.3	0.9	1.8	0.3
		Night	17/09/20	01:00	01:05	00:05	37.0	38.5	40.8	41.0	60.6
				01:05	01:10	00:05	37.0	38.5	41.1	41.5	61.2
				01:10	01:15	00:05	37.0	38.5	40.6	40.5	60.0
		Mean	17/09/20	01:05	01:10	00:05	37.0	38.5	40.8	41.0	60.6
		Std Dev	0	00:05	00:05	00:00	0.0	0.0	0.3	0.5	0.6
Eliot Road	2018	Morning	21/08/18	12:15	12:20	00:05	46.0	48.5	51.9	54.0	68.9
				12:20	12:25	00:05	46.0	49.5	54.8	57.0	73.3
				12:25	12:30	00:05	46.5	49.5	53.8	56.5	69.3
		Afternoon	21/08/18	15:40	15:45	00:05	41.5	45.0	53.9	57.5	70.0
				15:45	15:50	00:05	44.0	48.5	55.5	57.5	75.1
				15:50	15:55	00:05	45.0	47.0	54.6	57.5	65.6
		Mean	21/08/18	14:02	14:07	00:05	44.8	48.0	54.1	56.7	70.4
		Std Dev	0	01:42	01:42	00:00	1.7	1.6	1.1	1.2	3.1
		Night	21/08/18	00:55	01:00	00:05	39.5	41.0	50.9	44.0	71.7
				01:00	01:05	00:05	40.0	41.5	42.3	44.0	54.6
				01:05	01:10	00:05	38.5	40.0	40.7	42.0	42.6
		Mean	21/08/18	01:00	01:05	00:05	39.3	40.8	44.6	43.3	56.3
		Std Dev	0	00:04	00:04	00:00	0.6	0.6	4.5	0.9	11.9
	2020	Afternoon	15/09/20	15:55	16:00	00:05	40.5	50.0	61.8	60.5	83.7
				16:00	16:05	00:05	40.0	47.0	65.3	64.5	87.3
				16:05	16:10	00:05	38.5	45.0	52.0	56.5	69.3
		Mean	15/09/20	16:00	16:05	00:05	39.7	47.3	59.7	60.5	80.1
		Std Dev	0	00:05	00:05	00:00	1.0	2.5	6.9	4.0	9.5
		Night	17/09/20	01:15	01:20	00:05	30.0	30.0	34.4	37.0	50.4
				01:20	01:25	00:05	30.0	30.0	34.7	36.5	51.5
				01:25	01:30	00:05	30.0	30.0	34.1	37.5	49.4
		Mean	17/09/20	01:20	01:25	00:05	30.0	30.0	34.4	37.0	50.4
		Std Dev	0	00:05	00:05	00:00	0.0	0.0	0.3	0.5	1.1

APPENDIX 03

Weather


12
7
2
-3
Rainfall mm or Windspeed m/s or Temperature °C
01/12/2023 14:00
01/12/2023 20:00
02/12/2023 02:00
02/12/2023 08:00
02/12/2023 14:00
02/12/2023 20:00
03/12/2023 02:00
03/12/2023 08:00
03/12/2023 14:00
03/12/2023 20:00
04/12/2023 02:00
04/12/2023 08:00
Measurement Day - Date - Time
Rainfall
Wind Speed (Average)
Wind Speed (Gust)
Temperature

APPENDIX 04

Photographs

Location 4, Blake Road

Location 5, Rock Road

Location 6, Orchard Way

APPENDIX 05

2023 Survey

Location Four Blake Close

Date	Duration	LAeq	LAFmax	LAF,Perc4	LAF,Perc6
01/12/2023	00:13:54	51.9	77.9	50.4	42.8
01/12/2023	00:14:58	46.5	66.2	47.9	43.9
01/12/2023	00:14:58	45.4	51.8	47.1	43.0
01/12/2023	00:14:58	46.7	59.0	49.2	43.2
01/12/2023	00:14:58	49.7	61.5	51.8	45.6
01/12/2023	00:14:58	49.1	80.6	49.7	44.3
01/12/2023	00:14:58	47.6	58.0	50.0	44.5
01/12/2023	00:14:58	48.3	57.6	49.7	46.2
01/12/2023	00:14:58	49.2	57.3	51.1	46.9
01/12/2023	00:14:58	49.5	57.7	51.3	47.1
01/12/2023	00:14:58	48.2	62.4	49.5	46.0
01/12/2023	00:14:58	49.6	61.2	51.0	46.7
01/12/2023	00:14:58	52.2	71.9	51.8	46.4
01/12/2023	00:14:58	49.4	54.7	50.8	48.0
01/12/2023	00:14:58	49.9	72.2	50.3	47.5
01/12/2023	00:14:58	48.2	53.2	49.4	46.7
01/12/2023	00:14:58	47.6	54.9	48.9	46.1
01/12/2023	00:14:58	48.9	78.4	48.5	43.4
01/12/2023	00:14:58	49.6	77.0	50.7	42.9
01/12/2023	00:14:58	47.5	68.8	47.6	42.6
01/12/2023	00:14:58	50.2	70.1	50.2	42.7
01/12/2023	00:14:58	49.7	82.3	49.9	42.6
01/12/2023	00:14:58	44.2	56.1	45.9	41.7
01/12/2023	00:14:58	45.5	52.9	47.6	42.3
01/12/2023	00:14:58	43.7	58.2	46.0	40.4
01/12/2023	00:14:58	46.5	65.3	47.2	39.2
01/12/2023	00:14:58	46.5	64.3	48.8	36.3
01/12/2023	00:14:58	43.7	59.9	47.2	34.5
01/12/2023	00:14:58	40.1	55.9	42.8	35.2
01/12/2023	00:14:58	43.9	58.0	47.6	38.2
01/12/2023	00:14:58	43.3	54.5	46.7	37.6

Date	Duration	LAeq	LAFmax	LAF,Perc4	LAF,Perc6
01/12/2023	00:14:58	44.9	62.9	48.2	35.8
01/12/2023	00:14:58	37.5	50.7	40.0	32.7
01/12/2023	00:14:58	48.6	84.7	37.8	31.6
01/12/2023	00:14:58	37.6	52.7	39.8	33.1
01/12/2023	00:14:58	39.2	55.9	41.7	33.1
01/12/2023	00:14:58	42.4	58.9	41.4	33.1
01/12/2023	00:14:58	41.8	58.3	43.5	34.4
01/12/2023	00:14:58	36.7	47.6	39.2	33.3
01/12/2023	00:14:58	36.0	48.2	38.7	32.2
01/12/2023	00:14:58	36.6	48.2	38.9	32.7
01/12/2023	00:14:58	36.9	56.2	38.1	31.2
01/12/2023	00:14:58	39.5	54.9	43.0	31.2
01/12/2023	00:14:58	45.3	81.2	39.4	30.7
01/12/2023	00:14:58	44.5	62.0	43.4	30.4
02/12/2023	00:14:57	37.8	52.7	42.7	31.6
02/12/2023	00:14:58	39.7	52.5	43.8	32.8
02/12/2023	00:14:58	37.4	52.1	41.3	30.4
02/12/2023	00:14:58	31.2	51.7	32.7	28.2
02/12/2023	00:14:58	39.3	56.5	39.0	28.6
02/12/2023	00:14:58	33.8	50.2	35.2	28.9
02/12/2023	00:14:58	38.3	54.6	38.1	28.8
02/12/2023	00:14:58	33.4	53.9	34.1	27.6
02/12/2023	00:14:58	34.0	53.1	35.5	28.3
02/12/2023	00:14:58	32.2	53.6	32.2	28.1
02/12/2023	00:14:58	32.1	52.7	32.7	27.8
02/12/2023	00:14:58	33.6	51.0	35.7	28.6
02/12/2023	00:14:58	36.8	56.6	40.6	28.3
02/12/2023	00:14:58	33.1	59.6	31.9	27.9
02/12/2023	00:14:58	35.4	51.9	38.3	28.2
02/12/2023	00:14:58	32.4	51.0	33.5	28.5
02/12/2023	00:14:58	33.0	52.5	33.9	27.9
02/12/2023	00:14:58	35.1	53.0	37.3	28.9

Date	Duration	LAeq	LAFmax	LAF,Perc4	LAF,Perc6
02/12/2023	00:14:58	34.9	54.2	35.7	29.5
02/12/2023	00:14:58	37.1	55.1	39.3	29.2
02/12/2023	00:14:58	40.6	56.9	44.8	29.1
02/12/2023	00:14:58	36.0	55.5	37.6	29.1
02/12/2023	00:14:58	40.4	58.3	43.4	29.4
02/12/2023	00:14:58	42.2	62.5	46.1	31.9
02/12/2023	00:14:58	40.5	58.4	44.5	30.3
02/12/2023	00:14:58	39.1	57.8	41.1	31.7
02/12/2023	00:14:58	36.2	53.3	37.9	32.5
02/12/2023	00:14:58	40.7	52.1	45.2	33.5
02/12/2023	00:14:58	41.5	57.6	45.6	34.0
02/12/2023	00:14:58	37.3	51.9	39.3	34.0
02/12/2023	00:14:58	43.8	64.1	44.8	33.7
02/12/2023	00:14:58	40.4	57.6	42.3	36.8
02/12/2023	00:14:58	42.5	63.2	42.9	36.5
02/12/2023	00:14:58	42.8	60.8	44.8	37.7
02/12/2023	00:14:58	40.6	53.3	42.2	38.1
02/12/2023	00:14:58	40.6	59.6	41.9	37.1
02/12/2023	00:14:58	41.5	64.9	42.8	37.1
02/12/2023	00:14:58	41.7	54.7	43.6	38.3
02/12/2023	00:14:58	40.9	61.8	42.7	38.0
02/12/2023	00:14:58	41.2	51.4	42.8	39.2
02/12/2023	00:14:58	44.4	58.9	47.4	39.5
02/12/2023	00:14:58	42.4	53.2	45.0	38.5
02/12/2023	00:14:58	40.8	52.7	42.4	38.3
02/12/2023	00:14:58	42.2	56.1	44.6	37.7
02/12/2023	00:14:58	40.5	60.3	42.9	36.4
02/12/2023	00:14:58	40.2	56.4	42.4	36.6
02/12/2023	00:14:58	41.7	54.1	45.4	37.4
02/12/2023	00:14:58	42.2	56.9	44.3	37.3
02/12/2023	00:14:58	40.0	53.9	41.6	37.2
02/12/2023	00:14:58	41.6	54.1	44.9	36.9

Date	Duration	LAeq	LAFmax	LAF,Perc4	LAF,Perc6
02/12/2023	00:14:58	38.6	52.9	40.6	35.8
02/12/2023	00:14:58	41.0	58.7	42.9	37.4
02/12/2023	00:14:58	52.0	74.3	46.5	38.2
02/12/2023	00:14:58	40.8	64.0	41.7	37.1
02/12/2023	00:14:58	40.0	64.4	41.6	36.4
02/12/2023	00:14:58	45.0	65.0	47.0	38.4
02/12/2023	00:14:58	42.1	62.6	44.6	38.1
02/12/2023	00:14:58	43.5	61.6	46.0	39.0
02/12/2023	00:14:58	43.3	59.2	46.6	38.3
02/12/2023	00:14:58	43.2	61.8	46.5	38.4
02/12/2023	00:14:58	44.0	59.2	46.6	39.6
02/12/2023	00:14:58	44.0	57.8	46.8	39.6
02/12/2023	00:14:58	42.0	55.3	44.6	38.6
02/12/2023	00:14:58	41.6	55.9	44.1	38.9
02/12/2023	00:14:58	42.6	55.5	45.6	39.2
02/12/2023	00:14:58	43.4	64.7	44.9	39.9
02/12/2023	00:14:58	43.5	69.8	45.2	39.7
02/12/2023	00:14:58	42.4	58.7	44.4	39.7
02/12/2023	00:14:58	43.9	58.0	44.0	40.6
02/12/2023	00:14:58	43.3	59.0	44.7	41.4
02/12/2023	00:14:58	45.8	55.9	47.8	43.3
02/12/2023	00:14:58	45.9	51.0	47.4	44.0
02/12/2023	00:14:56	46.4	53.9	48.2	44.3
02/12/2023	00:14:58	45.5	51.6	46.8	43.8
02/12/2023	00:14:58	46.1	57.3	47.8	44.0
02/12/2023	00:14:58	46.9	54.6	48.8	44.8
02/12/2023	00:14:58	47.4	54.1	48.8	45.7
02/12/2023	00:14:58	46.5	53.4	48.4	44.3
02/12/2023	00:14:58	45.9	50.8	47.6	43.6
02/12/2023	00:14:58	46.5	53.3	48.5	44.2
02/12/2023	00:14:58	46.2	58.3	47.9	43.7
02/12/2023	00:14:58	45.2	52.6	47.8	42.0

Date	Duration	LAeq	LAFmax	LAF,Perc4	LAF,Perc6
02/12/2023	00:14:58	47.1	57.1	49.3	44.5
02/12/2023	00:14:58	47.4	58.3	48.7	45.0
02/12/2023	00:14:58	48.8	81.3	48.1	44.7
02/12/2023	00:14:58	47.1	59.0	48.1	44.6
02/12/2023	00:14:58	45.6	50.2	47.0	43.8
02/12/2023	00:14:58	49.2	82.4	47.9	44.7
02/12/2023	00:14:58	47.1	55.4	48.7	44.8
02/12/2023	00:14:58	47.1	53.8	48.6	45.1
02/12/2023	00:14:58	46.7	57.6	48.2	44.8
02/12/2023	00:14:58	46.3	55.8	47.7	44.6
02/12/2023	00:14:58	47.5	58.0	49.0	44.5
02/12/2023	00:14:58	45.9	53.4	47.7	43.7
02/12/2023	00:14:58	48.2	81.2	47.2	43.9
02/12/2023	00:14:58	45.8	61.1	47.4	43.5
03/12/2023	00:14:57	46.7	67.4	47.6	43.9
03/12/2023	00:14:58	45.0	51.9	46.5	43.0
03/12/2023	00:14:58	45.2	62.6	46.5	42.7
03/12/2023	00:14:58	42.7	49.9	44.7	39.6
03/12/2023	00:14:58	42.7	50.0	44.6	40.2
03/12/2023	00:14:58	42.5	51.2	44.5	39.9
03/12/2023	00:14:58	41.9	50.1	43.9	39.3
03/12/2023	00:14:58	41.2	48.1	43.3	38.6
03/12/2023	00:14:58	41.4	52.1	43.3	38.9
03/12/2023	00:14:58	40.9	50.5	43.2	37.2
03/12/2023	00:14:58	39.9	53.6	42.1	36.2
03/12/2023	00:14:58	39.2	49.7	41.8	35.6
03/12/2023	00:14:58	37.6	50.4	39.7	34.0
03/12/2023	00:14:58	37.8	49.3	40.1	33.6
03/12/2023	00:14:58	38.0	55.7	40.1	35.1
03/12/2023	00:14:58	41.6	47.3	43.7	37.2
03/12/2023	00:14:58	42.7	52.7	44.3	40.0
03/12/2023	00:14:58	41.5	48.7	43.1	39.1

Date	Duration	LAeq	LAFmax	LAF,Perc4	LAF,Perc6
03/12/2023	00:14:58	39.3	53.9	41.5	36.8
03/12/2023	00:14:58	37.9	48.1	40.1	35.2
03/12/2023	00:14:58	40.1	56.4	42.3	35.7
03/12/2023	00:14:58	41.0	49.4	43.3	37.6
03/12/2023	00:14:58	39.5	47.6	41.5	36.4
03/12/2023	00:14:58	40.0	49.1	42.0	37.3
03/12/2023	00:14:58	40.6	48.0	42.4	38.4
03/12/2023	00:14:58	42.1	52.4	43.7	39.8
03/12/2023	00:14:58	43.1	52.6	45.0	40.5
03/12/2023	00:14:58	44.1	56.6	45.5	41.6
03/12/2023	00:14:58	43.2	52.3	44.9	41.1
03/12/2023	00:14:58	44.9	54.5	47.1	41.8
03/12/2023	00:14:58	44.1	54.0	45.7	42.2
03/12/2023	00:14:58	44.9	55.6	46.4	43.2
03/12/2023	00:14:58	44.8	57.1	46.5	42.6
03/12/2023	00:14:58	46.0	54.9	47.6	43.9
03/12/2023	00:14:58	46.2	55.2	47.5	44.4
03/12/2023	00:14:58	47.4	60.3	48.9	45.4
03/12/2023	00:14:58	47.7	57.3	49.5	45.0
03/12/2023	00:14:58	47.6	53.9	49.0	46.1
03/12/2023	00:14:58	47.8	54.9	49.0	46.3
03/12/2023	00:14:58	51.3	71.0	52.7	47.1
03/12/2023	00:14:58	48.1	54.6	49.2	46.8
03/12/2023	00:14:58	48.8	61.5	50.2	46.9
03/12/2023	00:14:58	49.0	56.3	50.0	47.9
03/12/2023	00:14:58	49.2	57.3	50.2	47.9
03/12/2023	00:14:58	50.5	73.3	50.9	48.1
03/12/2023	00:14:58	51.0	69.4	53.2	48.3
03/12/2023	00:14:58	49.4	54.8	50.4	48.2
03/12/2023	00:14:58	49.6	57.5	50.4	48.2
03/12/2023	00:14:58	50.1	58.1	51.2	48.7
03/12/2023	00:14:58	51.2	57.1	52.2	49.8

Date	Duration	LAeq	LAFmax	LAF,Perc4	LAF,Perc6
03/12/2023	00:14:58	50.0	58.0	51.1	48.7
03/12/2023	00:14:58	49.0	57.5	50.0	47.7
03/12/2023	00:14:58	48.9	65.4	49.7	47.6
03/12/2023	00:14:58	49.9	65.1	50.1	47.9
03/12/2023	00:14:58	50.0	68.4	50.7	47.8
03/12/2023	00:14:58	49.5	58.8	51.0	47.4
03/12/2023	00:14:58	50.3	65.3	51.2	48.5
03/12/2023	00:14:58	49.7	56.3	50.8	48.2
03/12/2023	00:14:58	49.5	61.4	50.6	47.4
03/12/2023	00:14:58	47.7	52.6	48.7	46.5
03/12/2023	00:14:58	47.5	55.0	48.5	46.3
03/12/2023	00:14:58	48.2	60.7	49.0	46.7
03/12/2023	00:14:58	47.8	64.5	48.4	46.2
03/12/2023	00:14:58	46.2	59.1	47.2	44.5
03/12/2023	00:14:58	47.5	58.5	49.2	45.3
03/12/2023	00:14:58	46.8	59.1	47.8	45.4
03/12/2023	00:14:58	47.7	60.8	48.3	45.3
03/12/2023	00:14:58	46.8	53.8	47.9	45.6
03/12/2023	00:14:58	46.3	61.0	47.2	44.8
03/12/2023	00:14:58	47.5	58.2	49.2	45.1
03/12/2023	00:14:58	48.3	60.5	50.9	45.3
03/12/2023	00:14:58	48.7	63.2	49.6	45.4
03/12/2023	00:14:58	48.1	59.7	48.8	46.0
03/12/2023	00:14:58	47.3	56.5	48.5	46.0
03/12/2023	00:14:58	47.3	53.9	48.5	45.9
03/12/2023	00:14:58	46.9	65.1	47.6	44.2
03/12/2023	00:14:58	46.6	66.9	47.4	43.7
03/12/2023	00:14:58	46.6	65.5	48.5	44.0
03/12/2023	00:14:58	45.2	53.8	46.6	43.7
03/12/2023	00:14:58	48.1	67.9	47.3	43.3
03/12/2023	00:14:58	46.0	56.7	47.6	44.0
03/12/2023	00:14:58	44.9	54.0	46.5	43.0

Date	Duration	LAeq	LAFmax	LAF,Perc4	LAF,Perc6
03/12/2023	00:14:58	48.2	82.8	45.3	41.7
03/12/2023	00:14:58	42.8	48.9	44.3	41.1
03/12/2023	00:14:58	43.6	59.4	44.9	41.7
03/12/2023	00:14:58	43.6	58.1	44.0	40.4
03/12/2023	00:14:58	43.0	59.8	44.6	41.0
03/12/2023	00:14:58	41.7	53.8	43.2	39.2
03/12/2023	00:14:58	42.4	53.4	44.0	40.2
03/12/2023	00:14:58	41.7	48.7	43.5	39.1
03/12/2023	00:14:58	41.7	47.7	43.8	39.2
03/12/2023	00:14:58	40.5	51.2	42.6	37.4
03/12/2023	00:14:58	41.0	46.9	42.6	39.1
03/12/2023	00:14:58	41.7	53.0	43.4	38.8
03/12/2023	00:14:58	42.2	52.9	44.9	37.2
03/12/2023	00:14:58	42.8	51.8	44.0	41.3
04/12/2023	00:14:57	44.2	51.5	45.7	42.4
04/12/2023	00:14:58	42.3	56.0	43.9	39.9
04/12/2023	00:14:58	40.4	52.4	42.5	38.0
04/12/2023	00:14:58	41.0	52.8	43.5	37.5
04/12/2023	00:14:58	40.4	51.5	42.2	38.2
04/12/2023	00:14:58	40.4	51.9	42.3	38.0
04/12/2023	00:14:58	40.7	54.0	42.7	37.8
04/12/2023	00:14:58	40.8	52.5	43.0	38.1
04/12/2023	00:14:58	41.0	48.5	43.3	38.4
04/12/2023	00:14:58	41.4	51.8	43.5	38.3
04/12/2023	00:14:58	40.0	54.5	42.1	37.1
04/12/2023	00:14:58	41.4	51.0	43.3	38.0
04/12/2023	00:14:58	46.4	52.4	47.9	43.6
04/12/2023	00:14:58	47.1	57.0	48.2	45.7
04/12/2023	00:14:58	43.9	57.0	46.7	40.7
04/12/2023	00:14:58	42.2	54.4	44.0	39.8
04/12/2023	00:14:58	41.1	53.4	43.3	37.6
04/12/2023	00:14:58	43.0	52.8	45.2	40.1

Date	Duration	LAeq	LAFmax	LAF,Perc4	LAF,Perc6
04/12/2023	00:14:58	43.8	52.4	45.8	41.0
04/12/2023	00:14:58	42.7	54.0	44.9	40.0
04/12/2023	00:14:58	44.6	63.0	46.2	40.4
04/12/2023	00:14:58	44.8	54.5	46.7	42.3
04/12/2023	00:14:58	46.3	60.4	48.3	43.6
04/12/2023	00:14:58	47.0	55.5	48.8	44.7
04/12/2023	00:14:58	46.8	62.9	48.4	44.9
04/12/2023	00:14:58	48.1	54.6	49.7	46.0
04/12/2023	00:14:58	48.2	57.0	49.7	46.1
04/12/2023	00:14:58	49.4	57.9	50.8	47.5
04/12/2023	00:14:58	49.6	56.5	50.9	47.7
04/12/2023	00:14:58	49.7	60.0	51.2	47.8
04/12/2023	00:14:58	50.1	67.8	51.3	48.4
04/12/2023	00:14:58	50.3	57.4	51.6	48.7
04/12/2023	00:14:58	50.2	58.7	51.4	48.6
04/12/2023	00:14:58	50.9	61.0	51.8	48.9
04/12/2023	00:14:58	50.2	57.1	51.3	48.8
04/12/2023	00:14:58	50.5	57.3	51.8	49.0
04/12/2023	00:14:58	49.9	61.4	51.5	47.7
04/12/2023	00:14:58	50.0	58.3	51.7	48.1
04/12/2023	00:14:58	51.1	65.7	52.2	47.5
04/12/2023	00:14:58	50.4	64.6	50.8	47.7
04/12/2023	00:14:58	49.8	62.6	51.0	47.6
04/12/2023	00:14:58	49.3	58.3	50.6	47.1
04/12/2023	00:14:58	49.6	62.8	51.0	47.4
04/12/2023	00:14:58	49.8	58.6	51.2	47.6
04/12/2023	00:14:58	49.5	58.3	51.0	47.6
04/12/2023	00:14:58	49.8	60.8	51.5	47.5
04/12/2023	00:14:58	49.2	57.4	50.7	47.0
04/12/2023	00:11:35	49.9	67.0	52.0	47.3

Location 5 – 25 Rock Road

Time	Duration	LAeq (dB)	LAFMax (dB)	Ln3 (10) (dB)	Ln5 (90) (dB)
01/12/2023 13:15	00:15:00	61.3	93.1	54.2	45.4
01/12/2023 13:30	00:15:00	47.8	54.5	49.5	45.6
01/12/2023 13:45	00:15:00	49.6	63.6	50	45.5
01/12/2023 14:00	00:15:00	49.1	69	50.9	45.7
01/12/2023 14:15	00:15:00	47.5	65.2	49.4	44.8
01/12/2023 14:30	00:15:00	50.6	65.5	52.2	48.1
01/12/2023 14:45	00:15:00	52.2	60	53.7	50.2
01/12/2023 15:00	00:15:00	53.4	60.1	55.1	51.2
01/12/2023 15:15	00:15:00	53.2	61	54.7	51.1
01/12/2023 15:30	00:15:00	52.5	60.3	53.9	50.4
01/12/2023 15:45	00:15:00	53.8	71	55.2	50.8
01/12/2023 16:00	00:15:00	52.5	63.4	53.7	50.9
01/12/2023 16:15	00:15:00	51.2	65	52.5	49.1
01/12/2023 16:30	00:15:00	49.8	54.3	50.9	48.5
01/12/2023 16:45	00:15:00	51.2	56.3	52.4	49.5
01/12/2023 17:00	00:15:00	48.8	63.8	50.5	45.8
01/12/2023 17:15	00:15:00	48.8	62	50	46.5
01/12/2023 17:30	00:15:00	46.9	54.2	48.4	45.1
01/12/2023 17:45	00:15:00	48.8	66.2	50.6	45.3
01/12/2023 18:00	00:15:00	49.9	72.9	51	47
01/12/2023 18:15	00:15:00	46.7	53.8	48.5	44.4
01/12/2023 18:30	00:15:00	46.1	55.8	48.1	43.2
01/12/2023 18:45	00:15:00	46.1	57.5	47.8	43.4
01/12/2023 19:00	00:15:00	43.7	51.5	45.3	41.4
01/12/2023 19:15	00:15:00	41.7	52.4	43	39.6
01/12/2023 19:30	00:15:00	42.2	66	42.8	39.1
01/12/2023 19:45	00:15:00	42.9	54.2	44.9	40.2
01/12/2023 20:00	00:15:00	46.5	56.5	49.8	41.6
01/12/2023 20:15	00:15:00	46	53.1	49.4	41.9
01/12/2023 20:30	00:15:00	45.3	55.5	48.1	41.2
01/12/2023 20:45	00:15:00	42	55.5	43.4	39.8
01/12/2023 21:00	00:15:00	41.4	51.2	42.6	39.5
01/12/2023 21:15	00:15:00	42.1	54.7	42.8	40.2
01/12/2023 21:30	00:15:00	41.9	55	42.4	39.3
01/12/2023 21:45	00:15:00	45.3	61.7	44.1	40.1

Time	Duration	LAeq (dB)	LAFMax (dB)	Ln3 (10) (dB)	Ln5 (90) (dB)
01/12/2023 22:00	00:15:00	44.9	59.8	45.4	40.9
01/12/2023 22:15	00:15:00	41.4	52.9	42.5	39.8
01/12/2023 22:30	00:15:00	41.5	51.6	42.8	39.6
01/12/2023 22:45	00:15:00	41.9	53.5	43	40
01/12/2023 23:00	00:15:00	41.7	53.6	42	39.5
01/12/2023 23:15	00:15:00	42.3	58.6	42.3	39.6
01/12/2023 23:30	00:15:00	41.6	53	42.7	39.8
01/12/2023 23:45	00:15:00	45.4	61	46.5	38.9
02/12/2023 00:00	00:15:00	42.8	53.6	45.7	40
02/12/2023 00:15	00:15:00	44.1	52.2	47.4	40.5
02/12/2023 00:30	00:15:00	42.5	54.5	44.2	39.4
02/12/2023 00:45	00:15:00	40.2	49.7	41	38.9
02/12/2023 01:00	00:15:00	43.1	56.6	43.7	39.6
02/12/2023 01:15	00:15:00	40.7	45.3	41.6	39.7
02/12/2023 01:30	00:15:00	42	53.8	41.8	39.6
02/12/2023 01:45	00:15:00	40.6	48.8	41.3	39.5
02/12/2023 02:00	00:15:00	41	46.4	41.9	39.9
02/12/2023 02:15	00:15:00	40.6	45.6	41.3	39.7
02/12/2023 02:30	00:15:00	40.7	44.2	41.6	39.4
02/12/2023 02:45	00:15:00	41.7	47.4	43	40.3
02/12/2023 03:00	00:15:00	41.1	50.7	42	39.7
02/12/2023 03:15	00:15:00	41.3	47.8	42.3	39.9
02/12/2023 03:30	00:15:00	41.2	46.7	42	40
02/12/2023 03:45	00:15:00	41.8	49.8	42.9	40.4
02/12/2023 04:00	00:15:00	41	47.3	41.8	40
02/12/2023 04:15	00:15:00	40.8	49.3	41.5	39.8
02/12/2023 04:30	00:15:00	41.3	48.5	42.3	40.1
02/12/2023 04:45	00:15:00	41.8	52.1	42.7	40.7
02/12/2023 05:00	00:15:00	41.4	45.8	42.1	40.4
02/12/2023 05:15	00:15:00	41.5	47.9	42.4	40.4
02/12/2023 05:30	00:15:00	41.2	49.2	42.3	40
02/12/2023 05:45	00:15:00	42.1	48.7	43.2	40.8
02/12/2023 06:00	00:15:00	43.6	70.3	42.8	40.6
02/12/2023 06:15	00:15:00	43.3	52.1	44.5	41.8

Time	Duration	LAeq (dB)	LAFMax (dB)	Ln3 (10) (dB)	Ln5 (90) (dB)
02/12/2023 06:30	00:15:00	43.5	59.6	44.4	42
02/12/2023 06:45	00:15:00	45.1	58.2	47.3	42
02/12/2023 07:00	00:15:00	44.7	57.5	46.9	42.3
02/12/2023 07:15	00:15:00	44.1	58.8	45.7	41.6
02/12/2023 07:30	00:15:00	46.7	65.3	47.8	41.7
02/12/2023 07:45	00:15:00	46.7	67.7	46.5	42.8
02/12/2023 08:00	00:15:00	45.5	68.1	47.1	42.7
02/12/2023 08:15	00:15:00	53.9	66.5	57.8	44
02/12/2023 08:30	00:15:00	47.2	73.7	47.8	44.2
02/12/2023 08:45	00:15:00	45.2	61.6	47.2	41.8
02/12/2023 09:00	00:15:00	47.7	77.5	48.7	43
02/12/2023 09:15	00:15:00	46.1	60.6	47.7	43.8
02/12/2023 09:30	00:15:00	45.4	61.7	47	43.2
02/12/2023 09:45	00:15:00	46.2	64.3	47.2	44.2
02/12/2023 10:00	00:15:00	46.2	58.2	47.5	43.1
02/12/2023 10:15	00:15:00	45.7	62.5	47.6	43.1
02/12/2023 10:30	00:15:00	45.5	64.5	47.3	43.1
02/12/2023 10:45	00:15:00	45.5	61.8	48.1	42.5
02/12/2023 11:00	00:15:00	43.8	67.8	45.9	40.5
02/12/2023 11:15	00:15:00	44.3	60.2	46.8	41.4
02/12/2023 11:30	00:15:00	44.5	63.2	47	41.5
02/12/2023 11:45	00:15:00	44.2	58.4	46.4	42
02/12/2023 12:00	00:15:00	45.4	69.2	47	41.8
02/12/2023 12:15	00:15:00	44.9	58.3	46.6	40.9
02/12/2023 12:30	00:15:00	43.4	64.2	44.3	40.2
02/12/2023 12:45	00:15:00	46.3	76.6	46.9	41.7
02/12/2023 13:00	00:15:00	45.4	60.4	48	42.3
02/12/2023 13:15	00:15:00	43.2	52.1	44	41.7
02/12/2023 13:30	00:15:00	43.9	62.1	45.4	41.4
02/12/2023 13:45	00:15:00	45.8	65.1	47.8	41.4
02/12/2023 14:00	00:15:00	44.3	56	47.5	41.1
02/12/2023 14:15	00:15:00	45.4	57.3	48.4	42.1
02/12/2023 14:30	00:15:00	45.7	66.3	47.3	41.5
02/12/2023 14:45	00:15:00	44.4	53.7	47.2	41.4
02/12/2023 15:00	00:15:00	44.2	60.4	46.5	41.2

Time	Duration	LAeq (dB)	LAFMax (dB)	Ln3 (10) (dB)	Ln5 (90) (dB)
02/12/2023 15:15	00:15:00	44.2	69.4	45	42
02/12/2023 15:30	00:15:00	48.1	70.5	47.6	41.7
02/12/2023 15:45	00:15:00	43.8	60.6	45.6	40.9
02/12/2023 16:00	00:15:00	44.5	63.1	46.5	41.8
02/12/2023 16:15	00:15:00	45.1	55.6	47.6	42.3
02/12/2023 16:30	00:15:00	44.5	54.3	46	42.5
02/12/2023 16:45	00:15:00	47.5	78.1	46	42.8
02/12/2023 17:00	00:15:00	45.8	58.5	46	42.5
02/12/2023 17:15	00:15:00	44.4	57.9	45.9	42.4
02/12/2023 17:30	00:15:00	46	71.1	47.8	43.1
02/12/2023 17:45	00:15:00	44.9	53.8	47.6	42.2
02/12/2023 18:00	00:15:00	43.7	55.9	44.5	42.1
02/12/2023 18:15	00:15:00	43.6	54.1	44.2	42.3
02/12/2023 18:30	00:15:00	43.3	49.5	44.3	42.2
02/12/2023 18:45	00:15:00	45.5	62.8	47.5	42.5
02/12/2023 19:00	00:15:00	45.2	57.4	46.5	43.2
02/12/2023 19:15	00:15:00	44.9	60.1	46.2	42.5
02/12/2023 19:30	00:15:00	44.4	54.7	45.6	42.5
02/12/2023 19:45	00:15:00	43.3	52	44.5	41.8
02/12/2023 20:00	00:15:00	44.7	69.2	45.2	42
02/12/2023 20:15	00:15:00	45.6	55.8	48.9	42.1
02/12/2023 20:30	00:15:00	46.8	55.1	49.6	43
02/12/2023 20:45	00:15:00	46.2	62.3	47	42.1
02/12/2023 21:00	00:15:00	44.2	53.9	45.6	41.9
02/12/2023 21:15	00:15:00	46.4	60.5	47.2	42
02/12/2023 21:30	00:15:00	43.2	49.4	44.8	41.2
02/12/2023 21:45	00:15:00	43.4	49.6	45	41.4
02/12/2023 22:00	00:15:00	43.5	53.1	45.2	41
02/12/2023 22:15	00:15:00	43.9	61.1	45.5	40.9
02/12/2023 22:30	00:15:00	43.4	54.2	45	40.8
02/12/2023 22:45	00:15:00	42.8	51.2	44.5	40.9
02/12/2023 23:00	00:15:00	46	65.2	46.1	40.6
02/12/2023 23:15	00:15:00	43.2	54.5	44.3	41.2
02/12/2023 23:30	00:15:00	42.7	49.4	44.5	40.5
02/12/2023 23:45	00:15:00	41.8	50.5	42.9	40.5

Time	Duration	LAeq (dB)	LAFMax (dB)	Ln3 (10) (dB)	Ln5 (90) (dB)
03/12/2023 00:00	00:15:00	42.4	56.5	43.5	40.1
03/12/2023 00:15	00:15:00	41.6	53.7	42.7	39.9
03/12/2023 00:30	00:15:00	40.8	51.7	42.1	39.3
03/12/2023 00:45	00:15:00	40.2	49.7	41.2	38.7
03/12/2023 01:00	00:15:00	40.1	49.1	41.1	39
03/12/2023 01:15	00:15:00	39.8	44.4	40.7	38.6
03/12/2023 01:30	00:15:00	40.2	52.5	41.5	38.8
03/12/2023 01:45	00:15:00	39.6	45.3	40.6	38.5
03/12/2023 02:00	00:15:00	39.6	44.8	40.4	38.6
03/12/2023 02:15	00:15:00	39.1	42.6	40	38.1
03/12/2023 02:30	00:15:00	39.6	59.2	40.1	38
03/12/2023 02:45	00:15:00	39.4	52.5	40.3	38
03/12/2023 03:00	00:15:00	38.6	45.4	39.5	37.5
03/12/2023 03:15	00:15:00	39.1	48.5	40	37.7
03/12/2023 03:30	00:15:00	39.5	53.1	40.3	38.3
03/12/2023 03:45	00:15:00	43.4	65.4	44.7	39.8
03/12/2023 04:00	00:15:00	43.2	66.5	44.3	39.4
03/12/2023 04:15	00:15:00	41.8	62.5	43	38.4
03/12/2023 04:30	00:15:00	38.9	51	39.6	37.9
03/12/2023 04:45	00:15:00	38.9	48.5	39.7	37.8
03/12/2023 05:00	00:15:00	41.2	56.6	41.8	38.5
03/12/2023 05:15	00:15:00	40.5	55	41.4	39
03/12/2023 05:30	00:15:00	39.5	46.4	40.4	38.5
03/12/2023 05:45	00:15:00	39.9	45.6	40.8	38.9
03/12/2023 06:00	00:15:00	40.8	49.9	41.7	39.6
03/12/2023 06:15	00:15:00	41.6	55.2	42.5	40.1
03/12/2023 06:30	00:15:00	41.7	56.3	42.7	40.2
03/12/2023 06:45	00:15:00	43.3	58.6	43.6	40.3
03/12/2023 07:00	00:15:00	42.3	55.2	43.8	40.3
03/12/2023 07:15	00:15:00	43.2	57.8	44.9	40.1
03/12/2023 07:30	00:15:00	42.2	67	42.6	39.8
03/12/2023 07:45	00:15:00	41.8	55.9	42.5	40.2
03/12/2023 08:00	00:15:00	44.8	74.3	46.1	39.9
03/12/2023 08:15	00:15:00	42.1	55.5	42.9	40.2
03/12/2023 08:30	00:15:00	43.1	62	43.8	41

Time	Duration	LAeq (dB)	LAFMax (dB)	Ln3 (10) (dB)	Ln5 (90) (dB)
03/12/2023 08:45	00:15:00	44.8	61.9	46.5	41.6
03/12/2023 09:00	00:15:00	45.3	62.3	47.3	41.5
03/12/2023 09:15	00:15:00	47.7	71.3	48.4	43.7
03/12/2023 09:30	00:15:00	45.9	58.4	47.4	43.7
03/12/2023 09:45	00:15:00	46.6	62.2	47.4	42.8
03/12/2023 10:00	00:15:00	45.5	62.6	47.3	42.4
03/12/2023 10:15	00:15:00	45.4	61.4	46.8	42.5
03/12/2023 10:30	00:15:00	45.2	68.8	46.2	43.2
03/12/2023 10:45	00:15:00	44.9	55.1	46	43.3
03/12/2023 11:00	00:15:00	46	60.9	48	43.7
03/12/2023 11:15	00:15:00	49.2	65.8	51	43.8
03/12/2023 11:30	00:15:00	44.8	58.4	45.8	43.3
03/12/2023 11:45	00:15:00	45.8	67.2	46.8	43.1
03/12/2023 12:00	00:15:00	46	57.2	47.2	44.2
03/12/2023 12:15	00:15:00	49	64.1	50.5	46.7
03/12/2023 12:30	00:15:00	46.2	57	47.5	44.3
03/12/2023 12:45	00:15:00	45.6	55.6	46.9	44
03/12/2023 13:00	00:15:00	46.7	65.6	48.1	43.9
03/12/2023 13:15	00:15:00	46.1	59.3	47.8	43.1
03/12/2023 13:30	00:15:00	45.1	62.6	46.5	42.3
03/12/2023 13:45	00:15:00	45	61.4	47	42
03/12/2023 14:00	00:15:00	45.3	65	46.4	43.4
03/12/2023 14:15	00:15:00	44.8	61.6	45.4	42.6
03/12/2023 14:30	00:15:00	45.8	60.6	46.3	42.5
03/12/2023 14:45	00:15:00	50.1	76.2	48.4	42.4
03/12/2023 15:00	00:15:00	45.3	64.6	45.5	42.9
03/12/2023 15:15	00:15:00	46.2	63.6	47	43.4
03/12/2023 15:30	00:15:00	44.7	57.1	45.5	43.4
03/12/2023 15:45	00:15:00	43.7	54.9	44.7	42.4
03/12/2023 16:00	00:15:00	45.4	57.5	47.7	42.9
03/12/2023 16:15	00:15:00	44.2	62.6	45.4	42.5
03/12/2023 16:30	00:15:00	47.5	76.9	47.3	42.7
03/12/2023 16:45	00:15:00	44.9	58.8	46	42.9
03/12/2023 17:00	00:15:00	44.3	58.8	44.6	42.7
03/12/2023 17:15	00:15:00	45.7	56.8	48.1	42.9

Time	Duration	LAeq (dB)	LAFMax (dB)	Ln3 (10) (dB)	Ln5 (90) (dB)
03/12/2023 17:30	00:15:00	47.8	62	51.5	42.7
03/12/2023 17:45	00:15:00	47.5	63.3	48.8	43.2
03/12/2023 18:00	00:15:00	48.1	74.2	46.7	43.3
03/12/2023 18:15	00:15:00	46.2	62.2	47.3	43.6
03/12/2023 18:30	00:15:00	45	55.4	46.4	43.2
03/12/2023 18:45	00:15:00	45.3	61.9	45.3	42.4
03/12/2023 19:00	00:15:00	43.4	61.6	44.4	41.4
03/12/2023 19:15	00:15:00	43	55.3	44.2	41.3
03/12/2023 19:30	00:15:00	42.8	55.2	43.6	41.1
03/12/2023 19:45	00:15:00	45.9	63.3	46	40.7
03/12/2023 20:00	00:15:00	42.3	52.8	43.7	40.4
03/12/2023 20:15	00:15:00	40.8	54.1	42.2	38.8
03/12/2023 20:30	00:15:00	40.5	52.9	41.4	38.8
03/12/2023 20:45	00:15:00	40.5	50.5	41.4	39
03/12/2023 21:00	00:15:00	43.7	72.9	41.8	39.4
03/12/2023 21:15	00:15:00	42.8	59.5	42.1	39.1
03/12/2023 21:30	00:15:00	39.8	49	40.6	38.5
03/12/2023 21:45	00:15:00	39.3	55	39.7	37.9
03/12/2023 22:00	00:15:00	39.3	50.8	40.2	37.9
03/12/2023 22:15	00:15:00	38.6	50.2	39.3	37.3
03/12/2023 22:30	00:15:00	38.5	49.7	39.1	37.3
03/12/2023 22:45	00:15:00	38.4	51.4	38.9	37.1
03/12/2023 23:00	00:15:00	39.6	57.8	40.4	38.2
03/12/2023 23:15	00:15:00	40.2	56.4	40.5	37.5
03/12/2023 23:30	00:15:00	41	58.6	43.4	37.5
03/12/2023 23:45	00:15:00	42.8	59.7	43.9	40.7
04/12/2023 00:00	00:15:00	43	58.1	44.4	40.8
04/12/2023 00:15	00:15:00	39.8	55.9	41	37.9
04/12/2023 00:30	00:15:00	39.7	59.3	40.7	37.6
04/12/2023 00:45	00:15:00	39	57.2	39.9	37.3
04/12/2023 01:00	00:15:00	40.4	56.7	41.7	38.1
04/12/2023 01:15	00:15:00	40.3	56.4	41.5	38.4
04/12/2023 01:30	00:15:00	39.8	53.3	40.9	37.9
04/12/2023 01:45	00:15:00	39.9	59.4	40.9	38.1
04/12/2023 02:00	00:15:00	41.1	65.2	41.8	38.2

Time	Duration	LAeq (dB)	LAFMax (dB)	Ln3 (10) (dB)	Ln5 (90) (dB)
04/12/2023 02:15	00:15:00	39	55.9	40	37.4
04/12/2023 02:30	00:15:00	39.5	56	40.6	37.2
04/12/2023 02:45	00:15:00	40.5	60.4	41.7	37.7
04/12/2023 03:00	00:15:00	47.9	67.4	49.3	42.2
04/12/2023 03:15	00:15:00	48.2	69.3	49.3	44.9
04/12/2023 03:30	00:15:00	42.6	64.1	44.2	39.1
04/12/2023 03:45	00:15:00	41	57	42.1	38.7
04/12/2023 04:00	00:15:00	38.8	52.8	39.8	37.4
04/12/2023 04:15	00:15:00	40.9	62.6	42.4	38.3
04/12/2023 04:30	00:15:00	41.7	66.1	43.2	38.6
04/12/2023 04:45	00:15:00	39.6	53.6	40.4	38.1
04/12/2023 05:00	00:15:00	39.7	53.3	40.7	38
04/12/2023 05:15	00:15:00	40.4	51.9	41.3	39
04/12/2023 05:30	00:15:00	41.9	54.3	42.8	40.3
04/12/2023 05:45	00:15:00	42	53.9	43	40.7
04/12/2023 06:00	00:15:00	42.4	61.7	43.4	40.6
04/12/2023 06:15	00:15:00	42.8	56	43.7	41.2
04/12/2023 06:30	00:15:00	43	53.5	44.4	41.1
04/12/2023 06:45	00:15:00	45.3	59.7	48	42.1
04/12/2023 07:00	00:15:00	47.4	74.5	45.1	42.2
04/12/2023 07:15	00:15:00	44.9	68.2	46.4	42.3
04/12/2023 07:30	00:15:00	43.8	64.7	44.2	42.4
04/12/2023 07:45	00:15:00	45.5	69	45.2	42.5
04/12/2023 08:00	00:15:00	44.8	63.9	46.1	42.7
04/12/2023 08:15	00:15:00	45.4	60.6	46.7	42.8
04/12/2023 08:30	00:15:00	45.3	61.4	46.2	42.7
04/12/2023 08:45	00:15:00	44.8	60.7	45.7	42.6
04/12/2023 09:00	00:15:00	44.3	57.3	46.1	41.8
04/12/2023 09:15	00:15:00	44.6	63.7	45.7	41.9
04/12/2023 09:30	00:15:00	43.6	61.4	44.4	41.8
04/12/2023 09:45	00:15:00	45.7	68.5	46	41.9
04/12/2023 10:00	00:15:00	44.1	66.4	45.3	41.9
04/12/2023 10:15	00:15:00	43.9	59.1	45.4	41.5
04/12/2023 10:30	00:15:00	45.8	65.1	47	41.5
04/12/2023 10:45	00:15:00	44.1	56.7	45.7	41.8

Time	Duration	LAeq (dB)	LAFMax (dB)	Ln3 (10) (dB)	Ln5 (90) (dB)
04/12/2023 11:00	00:15:00	44.2	63.6	46.2	41.6
04/12/2023 11:15	00:15:00	43.7	59.7	45.6	41.4
04/12/2023 11:30	00:15:00	45.2	72.6	45.7	41.4
04/12/2023 11:45	00:15:00	43.9	56.3	45.6	41.3
04/12/2023 12:00	00:08:36	61.7	93.2	48	41.5

Location 6 21 Orchard Way

Time	Duration	LAeq (dB)	LAFMax (dB)	Ln3 (10) (dB)	Ln5 (90) (dB)
01/12/2023 13:45	00:14:02	50.7	69	52.7	44.1
01/12/2023 14:00	00:15:00	47.3	64.6	49.8	43.1
01/12/2023 14:15	00:15:00	49.1	71.8	48.6	42.5
01/12/2023 14:30	00:15:00	49	65.5	49.1	45.1
01/12/2023 14:45	00:15:00	48.5	63.4	50.3	46.1
01/12/2023 15:00	00:15:00	48.8	62.6	49.5	46.5
01/12/2023 15:15	00:15:00	49.8	72.7	48.7	45.9
01/12/2023 15:30	00:15:00	48	61.2	49.1	45.6
01/12/2023 15:45	00:15:00	51.1	67.8	52.3	46.3
01/12/2023 16:00	00:15:00	48.6	66.6	49.2	46.4
01/12/2023 16:15	00:15:00	48.4	64.3	49.4	46.1
01/12/2023 16:30	00:15:00	49.7	72.8	47.9	45.1
01/12/2023 16:45	00:15:00	50.9	75.1	48.7	45.8
01/12/2023 17:00	00:15:00	48.3	70.8	47.8	43.5
01/12/2023 17:15	00:15:00	50.6	77.6	50	44.2
01/12/2023 17:30	00:15:00	46.1	65.2	45.7	42.9
01/12/2023 17:45	00:15:00	48.1	66.1	47.1	43.1
01/12/2023 18:00	00:15:00	49	67.6	48.4	43.9
01/12/2023 18:15	00:15:00	45.9	65.2	45.9	42.5
01/12/2023 18:30	00:15:00	46.1	64.6	45.3	41.9
01/12/2023 18:45	00:15:00	45.5	65.4	45.1	42.1
01/12/2023 19:00	00:15:00	42.8	60.9	43.1	40.7
01/12/2023 19:15	00:15:00	44.6	63.4	43.4	40.5
01/12/2023 19:30	00:15:00	48.8	77.8	47.6	40.4
01/12/2023 19:45	00:15:00	47.7	69.2	47	40.8
01/12/2023 20:00	00:15:00	46.3	65.2	49.5	41.2
01/12/2023 20:15	00:15:00	46.3	68.7	48.3	41.2

Time	Duration	LAeq (dB)	LAFMax (dB)	Ln3 (10) (dB)	Ln5 (90) (dB)
01/12/2023 20:30	00:15:00	44.5	56.4	47.2	40.9
01/12/2023 20:45	00:15:00	42.6	60.8	43.8	40.6
01/12/2023 21:00	00:15:00	44.1	65	42.2	40.5
01/12/2023 21:15	00:15:00	42.5	53	43.2	40.9
01/12/2023 21:30	00:15:00	41.7	47.2	42.7	40.5
01/12/2023 21:45	00:15:00	45.3	61.1	43.8	41.5
01/12/2023 22:00	00:15:00	44.6	58.7	44.8	41.5
01/12/2023 22:15	00:15:00	42.9	64.3	42.3	40.6
01/12/2023 22:30	00:15:00	44.9	66.1	44.7	41
01/12/2023 22:45	00:15:00	44.4	63.6	44.1	41.4
01/12/2023 23:00	00:15:00	44	67.7	42.8	40.7
01/12/2023 23:15	00:15:00	42.5	55.6	42.9	40.9
01/12/2023 23:30	00:15:00	43.2	59.5	44	41.1
01/12/2023 23:45	00:15:00	46.3	63.6	47.4	40.4
02/12/2023 00:00	00:15:00	43.5	51.8	45.4	41.3
02/12/2023 00:15	00:15:00	44.5	53.6	47.5	41.6
02/12/2023 00:30	00:15:00	43.3	52.6	44.8	40.9
02/12/2023 00:45	00:15:00	41.5	44.6	42.4	40.5
02/12/2023 01:00	00:15:00	43.6	51.9	44.7	41.7
02/12/2023 01:15	00:15:00	42.3	46.6	43.2	41.3
02/12/2023 01:30	00:15:00	42.6	51	43.4	41.2
02/12/2023 01:45	00:15:00	44	65.1	43.4	41.1
02/12/2023 02:00	00:15:00	42.5	52.2	43.4	41.5
02/12/2023 02:15	00:15:00	42.2	46	43	41.2
02/12/2023 02:30	00:15:00	42.5	48.2	44	41
02/12/2023 02:45	00:15:00	43.4	48.9	44.9	41.9
02/12/2023 03:00	00:15:00	42.9	49.1	43.9	41.6
02/12/2023 03:15	00:15:00	43.2	61.1	43.2	41.2
02/12/2023 03:30	00:15:00	42.7	46.6	43.7	41.2
02/12/2023 03:45	00:15:00	43.3	49.1	44.5	42
02/12/2023 04:00	00:15:00	42.4	46.7	43.3	41.3
02/12/2023 04:15	00:15:00	42.3	50	43.1	41.3
02/12/2023 04:30	00:15:00	42.8	49	43.7	41.7
02/12/2023 04:45	00:15:00	45.2	59.6	45.5	41.8
02/12/2023 05:00	00:15:00	46.7	62.9	50.5	41.2

Time	Duration	LAeq (dB)	LAFMax (dB)	Ln3 (10) (dB)	Ln5 (90) (dB)
02/12/2023 05:15	00:15:00	43.2	55.8	43.6	41.6
02/12/2023 05:30	00:15:00	45.4	61.3	47.1	41.3
02/12/2023 05:45	00:15:00	45.1	59.7	46.9	42
02/12/2023 06:00	00:15:00	44.3	60.5	45.7	42
02/12/2023 06:15	00:15:00	47	63.8	47.5	42.8
02/12/2023 06:30	00:15:00	46.3	62.5	47.3	42.7
02/12/2023 06:45	00:15:00	45.4	54.4	47.3	42.8
02/12/2023 07:00	00:15:00	44.7	53.2	46.1	42.6
02/12/2023 07:15	00:15:00	45.1	61	46.9	42.4
02/12/2023 07:30	00:15:00	47.1	63.8	48.7	42.2
02/12/2023 07:45	00:15:00	46.2	63.8	46.7	43.5
02/12/2023 08:00	00:15:00	57.5	88.2	57.4	42.9
02/12/2023 08:15	00:15:00	53	73.3	57.8	47.3
02/12/2023 08:30	00:15:00	63.4	93.3	64.4	48.1
02/12/2023 08:45	00:15:00	47.5	66.1	48.9	42.2
02/12/2023 09:00	00:15:00	52.5	80.6	49.1	43.4
02/12/2023 09:15	00:15:00	48.8	69.8	47.8	43.9
02/12/2023 09:30	00:15:00	45.8	62.2	47.4	42.8
02/12/2023 09:45	00:15:00	47.8	67.8	47.5	44.6
02/12/2023 10:00	00:15:00	47.8	75.1	47.4	43.3
02/12/2023 10:15	00:15:00	49.8	74.7	48.9	43.2
02/12/2023 10:30	00:15:00	52.4	79.4	50.5	43.1
02/12/2023 10:45	00:15:00	48.8	67.9	49.6	43.1
02/12/2023 11:00	00:15:00	48	65.9	48.9	42.6
02/12/2023 11:15	00:15:00	49.5	67.9	49.8	42.4
02/12/2023 11:30	00:15:00	47	68.7	47.7	43
02/12/2023 11:45	00:15:00	46.7	66.3	46.8	42.7
02/12/2023 12:00	00:15:00	46.7	67.4	45.9	42.1
02/12/2023 12:15	00:15:00	48.3	69.2	48.2	41.6
02/12/2023 12:30	00:15:00	48.1	70.5	46.5	40.9
02/12/2023 12:45	00:15:00	51.8	74.4	52.5	42.7
02/12/2023 13:00	00:15:00	45.8	64.2	47.5	42.6
02/12/2023 13:15	00:15:00	47.6	67.4	47.1	42.1
02/12/2023 13:30	00:15:00	44.7	61.9	45.3	42
02/12/2023 13:45	00:15:00	47.2	69.1	47.9	42.1

Time	Duration	LAeq (dB)	LAFMax (dB)	Ln3 (10) (dB)	Ln5 (90) (dB)
02/12/2023 14:00	00:15:00	48.6	80.3	47.7	41.7
02/12/2023 14:15	00:15:00	47.7	67.2	49.7	42.4
02/12/2023 14:30	00:15:00	47.2	65.8	47.6	41.9
02/12/2023 14:45	00:15:00	45.8	67.3	47.7	42
02/12/2023 15:00	00:15:00	53.3	78.1	49.5	42.3
02/12/2023 15:15	00:15:00	45.9	69.1	45.7	42.4
02/12/2023 15:30	00:15:00	50.7	70.1	53.1	44
02/12/2023 15:45	00:15:00	45.7	62.3	46.4	41.4
02/12/2023 16:00	00:15:00	47.3	64.9	49.4	42.2
02/12/2023 16:15	00:15:00	48.6	64.4	50.2	43.4
02/12/2023 16:30	00:15:00	46.7	66.7	46.6	43
02/12/2023 16:45	00:15:00	46.3	64.4	46	43.5
02/12/2023 17:00	00:15:00	48.4	69.2	47.1	43.3
02/12/2023 17:15	00:15:00	47.1	66.6	47	43.1
02/12/2023 17:30	00:15:00	48.8	66.5	50.6	43.8
02/12/2023 17:45	00:15:00	47.9	67	48.4	42.7
02/12/2023 18:00	00:15:00	46.5	65	45.4	42.5
02/12/2023 18:15	00:15:00	46.3	64.3	45.6	43
02/12/2023 18:30	00:15:00	43.8	62.6	44.5	42.7
02/12/2023 18:45	00:15:00	46.5	63.2	47.8	42.8
02/12/2023 19:00	00:15:00	50.5	70.4	49.3	44.4
02/12/2023 19:15	00:15:00	49.3	70.6	47.7	43.5
02/12/2023 19:30	00:15:00	46.7	69.5	46.7	43.4
02/12/2023 19:45	00:15:00	44.8	64.6	45.3	42.2
02/12/2023 20:00	00:15:00	45.7	64.8	46.4	42.7
02/12/2023 20:15	00:15:00	45.2	55.4	47.6	42.5
02/12/2023 20:30	00:15:00	47	54.3	49.4	43.5
02/12/2023 20:45	00:15:00	46.5	59.2	48.2	42.9
02/12/2023 21:00	00:15:00	45.7	61.2	47.5	42.7
02/12/2023 21:15	00:15:00	47	60.3	48.2	43.1
02/12/2023 21:30	00:15:00	44.7	53.2	46.7	42
02/12/2023 21:45	00:15:00	45.8	63.8	46.8	42.6
02/12/2023 22:00	00:15:00	46.5	63.9	46.9	41.9
02/12/2023 22:15	00:15:00	45.1	61.3	46.9	41.9
02/12/2023 22:30	00:15:00	44.5	54.3	46.3	41.6

Time	Duration	LAeq (dB)	LAFMax (dB)	Ln3 (10) (dB)	Ln5 (90) (dB)
02/12/2023 22:45	00:15:00	45.2	64.4	46.2	41.8
02/12/2023 23:00	00:15:00	45.7	60.3	46.5	41.7
02/12/2023 23:15	00:15:00	44.1	53	45.7	42.1
02/12/2023 23:30	00:15:00	43.7	51.9	45.4	41.7
02/12/2023 23:45	00:15:00	42.9	49.4	44.3	41.4
03/12/2023 00:00	00:15:00	47.5	72.4	45.2	41.2
03/12/2023 00:15	00:15:00	43.9	67	43.5	40.5
03/12/2023 00:30	00:15:00	41.5	46.3	42.5	40.2
03/12/2023 00:45	00:15:00	42.6	64.6	42.2	39.8
03/12/2023 01:00	00:15:00	41.4	47.9	42.5	40.1
03/12/2023 01:15	00:15:00	41.2	49.7	42.1	39.9
03/12/2023 01:30	00:15:00	41.5	49.9	42.8	40
03/12/2023 01:45	00:15:00	41.2	52.9	42.2	39.8
03/12/2023 02:00	00:15:00	41	45.3	41.9	39.9
03/12/2023 02:15	00:15:00	40.4	48	41.4	39.2
03/12/2023 02:30	00:15:00	40.6	51.3	41.5	39.3
03/12/2023 02:45	00:15:00	40.7	48.6	41.7	39.4
03/12/2023 03:00	00:15:00	40.1	46.1	41	38.9
03/12/2023 03:15	00:15:00	42	64.1	41.7	39.2
03/12/2023 03:30	00:15:00	41.1	50.8	42	40
03/12/2023 03:45	00:15:00	44.7	60.7	46.3	42
03/12/2023 04:00	00:15:00	43.4	61.3	44.8	41
03/12/2023 04:15	00:15:00	42.2	57.6	43.4	40.4
03/12/2023 04:30	00:15:00	40.5	53.6	41.2	39.5
03/12/2023 04:45	00:15:00	40.6	50.9	41.4	39.5
03/12/2023 05:00	00:15:00	43.4	57.6	44.6	40.5
03/12/2023 05:15	00:15:00	42	50.4	43.3	40.6
03/12/2023 05:30	00:15:00	41	46.3	41.8	40
03/12/2023 05:45	00:15:00	41.5	48.5	42.4	40.4
03/12/2023 06:00	00:15:00	42.9	54.8	44.4	41.1
03/12/2023 06:15	00:15:00	44.8	60.7	46.1	42.8
03/12/2023 06:30	00:15:00	44.7	58.2	46.6	42.3
03/12/2023 06:45	00:15:00	46.1	59	48.6	42.4
03/12/2023 07:00	00:15:00	46	65.3	45.4	42
03/12/2023 07:15	00:15:00	45.5	62.5	46.5	41.6

Time	Duration	LAeq (dB)	LAFMax (dB)	Ln3 (10) (dB)	Ln5 (90) (dB)
03/12/2023 07:30	00:15:00	46.2	67.4	45.3	41.4
03/12/2023 07:45	00:15:00	45	67.9	44.8	41.7
03/12/2023 08:00	00:15:00	49	69.5	47.5	41.6
03/12/2023 08:15	00:15:00	47.2	69.9	45.4	41.9
03/12/2023 08:30	00:15:00	47.6	69.3	45.3	42.2
03/12/2023 08:45	00:15:00	46.4	67.4	47.3	42.6
03/12/2023 09:00	00:15:00	50.5	68.4	52.1	43.1
03/12/2023 09:15	00:15:00	52.9	71.2	53.6	47.2
03/12/2023 09:30	00:15:00	50.8	76.6	50	46.9
03/12/2023 09:45	00:15:00	49.6	76.5	50	44.1
03/12/2023 10:00	00:15:00	50	70.3	50.6	43.4
03/12/2023 10:15	00:15:00	49.7	69.2	48.2	43.5
03/12/2023 10:30	00:15:00	50.3	74.6	48.7	44.5
03/12/2023 10:45	00:15:00	48.8	68.2	47.9	44.5
03/12/2023 11:00	00:15:00	47.6	64.5	48.5	44.7
03/12/2023 11:15	00:15:00	52.3	75.7	54.5	45.5
03/12/2023 11:30	00:15:00	46.3	63.7	46.6	44.4
03/12/2023 11:45	00:15:00	49.1	69	48.3	44.1
03/12/2023 12:00	00:15:00	48.9	68.7	48.1	44.9
03/12/2023 12:15	00:15:00	49.9	67.9	50.1	46.6
03/12/2023 12:30	00:15:00	49.2	67.8	48.4	45.2
03/12/2023 12:45	00:15:00	48.3	68.6	47.3	45.1
03/12/2023 13:00	00:15:00	49.7	69	50	44.8
03/12/2023 13:15	00:15:00	49.5	71.3	47.9	44.4
03/12/2023 13:30	00:15:00	48.9	71.6	46.8	43.5
03/12/2023 13:45	00:15:00	48.2	68.6	47.6	43.3
03/12/2023 14:00	00:15:00	50.1	77.4	47.4	44
03/12/2023 14:15	00:15:00	47.7	69.8	46.1	43.8
03/12/2023 14:30	00:15:00	47.5	63.8	48.4	43.9
03/12/2023 14:45	00:15:00	48.1	72.3	46.4	43.8
03/12/2023 15:00	00:15:00	46.7	65.5	46.9	44.6
03/12/2023 15:15	00:15:00	49	65.1	51.1	45.2
03/12/2023 15:30	00:15:00	47.2	65	47.6	45.1
03/12/2023 15:45	00:15:00	45.6	66	46.1	43.9
03/12/2023 16:00	00:15:00	47	67.4	47.9	44.5

Time	Duration	LAeq (dB)	LAFMax (dB)	Ln3 (10) (dB)	Ln5 (90) (dB)
03/12/2023 16:15	00:15:00	47.8	67.1	46.9	44.3
03/12/2023 16:30	00:15:00	47.5	65.2	47.9	44.2
03/12/2023 16:45	00:15:00	48.9	70.3	47.3	44.5
03/12/2023 17:00	00:15:00	46.3	60.3	46.8	44.2
03/12/2023 17:15	00:15:00	48.7	66.9	49.6	44.6
03/12/2023 17:30	00:15:00	49.1	68.3	50.5	44.8
03/12/2023 17:45	00:15:00	47.8	62.9	48.9	45
03/12/2023 18:00	00:15:00	47.9	60.2	48.9	45.2
03/12/2023 18:15	00:15:00	47.8	61.2	49	45.5
03/12/2023 18:30	00:15:00	50	66.2	49.8	45
03/12/2023 18:45	00:15:00	47.2	62.7	47.6	44
03/12/2023 19:00	00:15:00	47	65.4	46.1	43
03/12/2023 19:15	00:15:00	45.5	66.5	46.5	42.7
03/12/2023 19:30	00:15:00	45.9	66.5	45.5	43
03/12/2023 19:45	00:15:00	46.8	64	46.8	42.1
03/12/2023 20:00	00:15:00	45.8	65.2	45.3	41.7
03/12/2023 20:15	00:15:00	43.5	62.3	43.8	40.4
03/12/2023 20:30	00:15:00	45.4	65.4	44.3	40.3
03/12/2023 20:45	00:15:00	42.4	57.8	42.7	40.5
03/12/2023 21:00	00:15:00	42.3	52.4	43.2	40.9
03/12/2023 21:15	00:15:00	43.6	59.4	43.6	40.8
03/12/2023 21:30	00:15:00	43.8	62.9	42.6	40.1
03/12/2023 21:45	00:15:00	40.8	50.8	41.6	39.4
03/12/2023 22:00	00:15:00	43	63.8	42	39.6
03/12/2023 22:15	00:15:00	40.1	47.3	41	39.1
03/12/2023 22:30	00:15:00	40.1	46.5	41	39.1
03/12/2023 22:45	00:15:00	40.5	49.7	41.5	39
03/12/2023 23:00	00:15:00	41.3	54.9	42.3	39.8
03/12/2023 23:15	00:15:00	42	53.9	43.5	39.5
03/12/2023 23:30	00:15:00	41.9	55.5	43.8	39.6
03/12/2023 23:45	00:15:00	42.9	54.5	43.9	41.5
04/12/2023 00:00	00:15:00	43.3	56.4	44.6	41.5
04/12/2023 00:15	00:15:00	41.5	55.3	42.8	39.6
04/12/2023 00:30	00:15:00	41.4	53.3	42.7	39.8
04/12/2023 00:45	00:15:00	40.8	53.6	41.9	39.1

Time	Duration	LAeq (dB)	LAFMax (dB)	Ln3 (10) (dB)	Ln5 (90) (dB)
04/12/2023 01:00	00:15:00	41.6	54.2	43	39.8
04/12/2023 01:15	00:15:00	43.5	65.2	44.7	40.4
04/12/2023 01:30	00:15:00	41.6	56.4	42.7	39.9
04/12/2023 01:45	00:15:00	41.6	53.4	42.8	39.8
04/12/2023 02:00	00:15:00	41.7	55.6	42.9	39.9
04/12/2023 02:15	00:15:00	40.9	53.1	42	39.3
04/12/2023 02:30	00:15:00	46.2	71.9	42.4	39.1
04/12/2023 02:45	00:15:00	41.4	56.2	42.6	39.3
04/12/2023 03:00	00:15:00	46.4	62	48	42.5
04/12/2023 03:15	00:15:00	47	62.8	48.3	44.8
04/12/2023 03:30	00:15:00	43.4	69.6	44.8	40.8
04/12/2023 03:45	00:15:00	42.2	56.6	43.4	40.4
04/12/2023 04:00	00:15:00	41.6	54.1	42.8	39.7
04/12/2023 04:15	00:15:00	41.9	56.7	43.3	40
04/12/2023 04:30	00:15:00	41.9	55.3	43.3	39.8
04/12/2023 04:45	00:15:00	41.5	57.5	42.7	39.5
04/12/2023 05:00	00:15:00	41.4	60.4	42.5	39.5
04/12/2023 05:15	00:15:00	43.5	61.6	44.1	40
04/12/2023 05:30	00:15:00	43.8	63.6	44.4	40.6
04/12/2023 05:45	00:15:00	42.7	55.3	43.9	40.7
04/12/2023 06:00	00:15:00	44.1	59.6	45.6	41.5
04/12/2023 06:15	00:15:00	44.7	60.9	45.5	41.6
04/12/2023 06:30	00:15:00	47.2	69.3	44.6	41.2
04/12/2023 06:45	00:15:00	46.9	67.1	47.8	42.2
04/12/2023 07:00	00:15:00	46.9	63.8	48.4	43
04/12/2023 07:15	00:15:00	45.1	62.2	46.1	42.5
04/12/2023 07:30	00:15:00	43.5	51	44.2	42.5
04/12/2023 07:45	00:15:00	46.9	71.2	47.3	42.8
04/12/2023 08:00	00:15:00	49	74.6	48.7	43.1
04/12/2023 08:15	00:15:00	47.5	66.3	47.2	43.7
04/12/2023 08:30	00:15:00	53.7	80.4	50.4	43.4
04/12/2023 08:45	00:15:00	49.7	72.3	48.8	43.4
04/12/2023 09:00	00:15:00	51	78.4	49.4	43.3
04/12/2023 09:15	00:15:00	51.1	74.4	48.4	42.4
04/12/2023 09:30	00:15:00	44.2	59.5	45.3	42.5

Time	Duration	LAeq (dB)	LAFMax (dB)	Ln3 (10) (dB)	Ln5 (90) (dB)
04/12/2023 09:45	00:15:00	47.3	69	46.5	42.6
04/12/2023 10:00	00:15:00	46.6	61.9	48.5	42.9
04/12/2023 10:15	00:15:00	47.9	66.9	47	42.1
04/12/2023 10:30	00:15:00	49	68.6	48.5	42.1
04/12/2023 10:45	00:15:00	47	67.7	47.5	42.5
04/12/2023 11:00	00:15:00	49	68.3	49	42.6
04/12/2023 11:15	00:15:00	49.4	68.8	46.7	42.4
04/12/2023 11:30	00:15:00	50.1	68.9	48.2	41.8
04/12/2023 11:45	00:15:00	44.4	60.5	45.5	41.3
04/12/2023 12:00	00:15:00	53.6	74.6	49.4	41.8
04/12/2023 12:15	00:06:34	51	72.4	51.2	42.6

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