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Ferrybridge 1 Line 3

enfinium Ferrybridge 1 Limited

Dispersion Modelling Assessment

ENGINEERING + CONSULTING

Document approval

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Management Summary

Fichtner Consulting Engineers Ltd ("Fichtner") has been engaged by enfinium Ferrybridge 1 Limited (enfinium) to undertake a Dispersion Modelling Assessment to support the application for a variation to the Environmental Permit (EP) for the Ferrybridge 1 Energy from Waste Facility (the Facility). The current EP for the Facility permits the operation of two waste incineration lines (L1 and L2) with a total permitted plant capacity of 725,000 tonnes per annum (tpa). It is proposed to vary the EP to increase the design point of L1 and L2 from 106% of maximum continuous rating (MCR) to 108% of MCR, and to add a third line (L3).

This assessment has considered the following scenarios:

- the "Operational Facility" – the model has been set up with data from the operational plant and this has been used to evaluate the impact of the Facility as it is currently operated; and
- the "Proposed Facility" – operational data factored to represent operation of L1 and L2 at 108% of MCR, and the addition of L3 including associated infrastructure.

Dispersion Modelling of Emissions

The ADMS dispersion model is routinely used for air quality assessments to the satisfaction of the Environment Agency (EA). The model uses weather data from the local area to predict the spread and movement of the exhaust gases from the stack for each hour over a five year period. The model takes account of wind speed, wind direction, temperature, humidity and the amount of cloud cover, as all of these factors influence the dispersion of emissions. The model also takes account of the effects of buildings and terrain on the movement of air. To set up the model, it has been assumed that the Facility operates for the whole year and continuously releases emissions at the emission limits set in the existing EP for L1 and L2, and at emission limits appropriate for new plants for L3.

The model has been used to predict concentration of pollutants on a long-term and short-term basis across a grid of points. In addition, concentrations have been predicted at the identified sensitive receptors.

Approach and Assessment of Impact on Air Quality – Protection of Human Health

The air quality impact on human health has been assessed using a standard approach based on guidance provided by the EA. Using this approach, in relation to the AQALs set for the protection of human health the following can be concluded from the assessment.

1. Emissions from the operation of the Proposed Facility will not cause a breach of any AQAL.
2. For all pollutants the change in impact as a result of the EP variation can be screened out as 'insignificant'.
3. For all pollutants the overall impact of the Proposed Facility can either be screened out as 'insignificant' or is 'not significant' when the total concentration is taken into consideration.

Approach and Assessment of Impact on Air Quality – Protection of Ecosystems

The impact of air quality on ecology has been assessed using a standard approach based on guidance provided by the EA. Using this approach, in relation to the Critical Level and Critical Loads set for the protection of ecology the following can be concluded from the assessment.

1. At the only European and UK designated ecological receptor (the Fairburn and Newton Ings Site of Special Scientific Interest, "SSSI") the change in impact can be screened out as 'insignificant' as it is less than 1% of the long term Critical Levels and Critical Loads and less than 10% of the short term Critical Levels.
2. The total impact of emissions from the Proposed Facility cannot be screened out as 'insignificant' at the Fairburn and Newton Ings SSSI. However, as the EP variation is predicted to result in a reduction in nitrogen deposition impacts and an imperceptible change in acid deposition impacts at this site, it is considered that there would be no significant effects on the integrity of the SSSI.
3. The change in impact and the overall impact of the Proposed Facility at all local nature sites are both less than 100% of the Critical Levels and Loads and can be screened out as 'insignificant'.

Summary and Conclusions

In summary, the assessment has shown that the change in air quality impact associated with the proposed EP variation is insignificant. Emissions would not have a significant impact on local air quality, the general population or the local community. As such there should be no air quality constraint in granting a variation to the existing EP as proposed.

Contents

1 Introduction

1.1 Background

Fichtner Consulting Engineers Ltd ("Fichtner") has been engaged by enfinium Ferrybridge 1 Limited (enfinium) to undertake a Dispersion Modelling Assessment to support the application for a variation to the Environmental Permit (EP) for the Ferrybridge 1 Energy from Waste Facility (the Facility). The current EP for the Facility permits the operation of two waste incineration lines (L1 and L2) with a total permitted plant capacity of 725,000 tonnes per annum (tpa). The proposed changes to the EP are as follows:

- the addition of a third line (L3) of nominal capacity of 240,000 tonnes per annum (assuming continual operation); and
- to increase the operating capacity of L1 and L2 from current operation at 106% of design maximum continuous rating (MCR) to 108% of MCR.

This assessment has considered the following scenarios:

- the "Operational Facility" – the model has been set up with data from the operational plant and this is used to evaluate the impact of the Facility as it is currently operated; and
- the "Proposed Facility" – operational data factored to represent operation of L1 and L2 at 108% of MCR, and the addition of L3 including associated infrastructure.

The existing EP (Ref: EPR/SP3239FU) includes emission limits for emissions to air based on the Industrial Emissions Directive (IED) (Directive 2010/75/EU) and the Waste Incineration BREF[1] for 'existing plants'. The varied EP will include emission limits based on those prescribed in the Waste Incineration BREF for 'new plants' for the proposed L3.

When considering the impact on human health, the predicted atmospheric concentrations have been compared to the Air Quality Assessment Levels (AQALs) for the protection of human health. It is noted that for dioxins the AQAL is a Tolerable Daily Intake (TDI) which considered the combination of the intake from inhalation and ingestion. As such it is not possible to demonstrate compliance with the assessment level with just reference to the air concentration. A separate Dioxin Pathway Intake Assessment has been undertaken to assess the pathway intake of these pollutants and impacts compared to the TDI.

When considering the impact on ecosystems the predicted atmospheric concentrations have been compared to the Critical Levels for the protection of ecosystems. Deposition of emissions over a prolonged period can have nutrification and acidification impacts. An assessment of the long-term deposition of pollutants has been undertaken and the results compared to the habitat specific Critical Loads.

1.2 Structure of the report

This report has the following structure.

- National and international air quality legislation and guidance are considered in section 2.
- The baseline ambient air quality is described in section 3.
- The residential properties and ecological receptors which are sensitive to changes in air quality associated with the Facility are identified in section 4.

[1] Best Available Techniques (BAT) Reference Document for Waste Incineration - 2019

- The inputs used for the dispersion model are contained in section 5.
- Details of the sensitivity analysis carried out is presented in section 6
- The assessment methodology and results of the assessment of the impact of emissions on human health is presented in section 7.
- The assessment methodology and results of the assessment of the impact of emissions at ecological sites is presented in section 8.
- The conclusions of the assessment are set out in section 9.
- The Appendices include illustrative figures and detailed results tables.

2 Legislation Framework and Policy

2.1 Air quality assessment levels

In the UK, Ambient Air Directive (AAD) Limit Values, Targets, and air quality standards and objectives for major pollutants are described in The Air Quality Strategy (AQS). In addition, the Environment Agency include Environmental Assessment Levels (EALs) for other pollutants in the environmental management guidance 'Air Emissions Risk Assessment for your Environmental Permit'[2] ("Air Emissions Guidance"), which are also considered. The long-term and short-term EALs from these documents have been used when the AQS does not contain relevant objectives. Standards and objectives for the protection of sensitive ecosystems and habitats are also contained within the Air Emissions Guidance and the Air Pollution Information System (APIS).

AAD Target and Limit Values, AQS Objectives, and EALs are set at levels well below those at which significant adverse health effects have been observed in the general population and in particularly sensitive groups. For the remainder of this report these are collectively referred to as AQALs. Table 1 to Table 3 summarise the air quality objectives and guidelines used in this assessment.

Table 1: Air Quality Assessment Levels (AQALs)

Pollutant	Limit value (µg/m³)	Averaging period	Frequency of exceedances	Source
Nitrogen dioxide	200	1 hour	18 times per year (99.79th percentile)	AAD Limit Value
	40	Annual	-	AAD Limit Value
Sulphur dioxide	266	15 minutes	35 times per year (99.9th percentile)	AQS Objective
	350	1 hour	24 times per year (99.73rd percentile)	AAD Limit Value
	125	24 hours	3 times per year (99.18th percentile)	AAD Limit Value
Particulate matter (PM_{10})	50	24 hours	35 times per year (90.41st percentile)	AAD Limit Value
	40	Annual	-	AAD Limit Value
Particulate matter ($PM_{2.5}$)	10	Annual	-	Environmental Targets (fine particulate matter) (England) Regulations 2023
Carbon monoxide	10,000	8 hours, running	-	AAD Limit Value
	30,000	1 hour		Air Emissions Guidance
Hydrogen chloride	750	1 hour	-	Air Emissions Guidance
Hydrogen fluoride	160	1 hour	-	Air Emissions Guidance

[2] https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit#environmental-standards-for-air-emissions

Pollutant	Limit value (µg/m³)	Averaging period	Frequency of exceedances	Source
	16	Annual	-	Air Emissions Guidance
Ammonia	2,500	1 hour	-	Air Emissions Guidance
	180	Annual	-	Air Emissions Guidance
Lead	0.25	Annual	-	AQS Objective
Benzene	5.00	Annual	-	AQS Objective
	30	24 hour	-	Air Emissions Guidance
PCBs	6	1-hour	-	Air Emissions Guidance
	0.2	Annual	-	Air Emissions Guidance
PAHs	0.00025	Annual	-	AQS Objective

Table 2: Environmental Assessment Levels (EALs) for Metals

Pollutant	AQAL (ng/m³)	Averaging Period	Source
Arsenic (As)	-	1 hour	-
	6	Annual	Air Emissions Guidance
Antimony (Sb)	150,000	1 hour	Air Emissions Guidance
	5,000	Annual	Air Emissions Guidance
Cadmium (Cd)	30	24 hour	Air Emissions Guidance
	5	Annual	AAD Target Value
Chromium (III) (Cr)	2,000	24 hour	Air Emissions Guidance
	-	Annual	-
Chromium (VI) (Cr (VI))	-	1 hour	-
	0.25	Annual	Air Emissions Guidance
Cobalt (Co)	-	1 hour	-
	-	Annual	-
Copper (Cu)	50	24 hour	Air Emissions Guidance
	-	Annual	-
Lead (Pb)	-	1 hour	-
	250	Annual	AQS Target
Manganese (Mn)	1,500,000	1 hour	Air Emissions Guidance
	150	Annual	Air Emissions Guidance
Mercury (Hg)	600	1 hour	Air Emissions Guidance
	60	24 hour	Air Emissions Guidance
	-	Annual	-
Nickel (Ni)	700	1 hour	Air Emissions Guidance
	20	Annual	AAD Limit

Pollutant	AQAL (ng/m³)	Averaging Period	Source
Vanadium (V)	1,000	24 hours	Air Emissions Guidance
	-	Annual	-

Table 3: Critical Levels for the Protection of Vegetation and Ecosystems

Pollutant	Concentration (µg/m³)	Measured as	Source
Nitrogen oxides (as nitrogen dioxide)	75 / 200*	Daily mean	Air Emissions Guidance
	30	Annual mean	AQS Objective
Sulphur dioxide	10	Annual mean, for the protection of lichens and bryophytes	Air Emissions Guidance
	20	Annual mean for all higher plants	AQS Objective
Hydrogen fluoride	5	Daily mean	Air Emissions Guidance
	0.5	Weekly mean	Air Emissions Guidance
Ammonia	1	Annual mean, for the protection of lichens and bryophytes	Air Emissions Guidance
	3	Annual mean For all higher plants	Air Emissions Guidance

Note:
**The higher Critical Level of 200 µg/m³ is only for detailed assessments where ozone is below the AOT40 critical level and sulphur dioxide is below the lower Critical Level of 10 µg/m³*
The *AOT40 for ozone is 3,000 ppb.h (6,000 µg/m³.h) calculated from accumulated hourly ozone concentrations – AOT40 means the sum of the difference between each hourly daytime (08:00 to 20:00 Central European Time, CET) ozone concentration greater than 80 µg/m³ (40 ppb) and 80 µg/m³, for the period between 1 May and 31 July.*

In addition to the Critical Levels set out in Table 3, provides habitat specific Critical Loads for nitrogen and acid deposition. Full details of the habitat specific Critical Loads can be found in Appendix C.

2.2 Areas of relevant exposure

The AQALs apply only at areas of exposure relevant to the assessment level. The following table extracted from Local Authority Air Quality Technical Guidance (LAQM.TG(22)) explains where the AQALs apply.

Table 4: Guidance on Where AQALs Apply

Averaging period	AQALs should apply at:	AQALs should generally not apply at:
Annual mean	All locations where members of the public might be regularly exposed. Building façades of residential	Building façades of offices or other places of work where members of

Averaging period	AQALs should apply at:	AQALs should generally not apply at:
	properties, schools, hospitals, care homes etc.	the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties. Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short-term.
24-hour mean and 8-hour mean	All locations where the annual mean AQAL would apply, together with hotels. Gardens of residential properties.	Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short-term.
1-hour mean	All locations where the annual mean and 24 and 8-hour mean AQALs apply. Kerbside sites (for example, pavements of busy shopping streets). Those parts of car parks, bus stations and railway stations etc. which are not fully enclosed, where members of the public might reasonably be expected to spend one hour or more. Any outdoor locations where members of the public might reasonably be expected to spend one hour or longer.	Kerbside sites where the public would not be expected to have regular access.
15-minute mean	All locations where members of the public might reasonably be exposed for a period of 15 minutes or longer.	

Source: Box 1.1 LAQM.TG(22)

2.3 Industrial pollution regulation

Atmospheric emissions from industrial processes are controlled in England through the Environmental Permitting Regulations (2016) (and subsequent amendments). The Facility currently has an EP to operate. The EP includes conditions to ensure that the environmental impact of the operations is minimised. This includes conditions to prevent fugitive emissions of dust and odour beyond the boundary of the permitted activity, and limits on emissions to air.

The Industrial Emissions Directive (IED) (Directive 2010/75/EU), was adopted on 07 January 2013, and is the key European Directive which covers almost all regulation of industrial processes in the

European Union (EU). Within the IED, the requirements of the relevant sector BREF become binding as BAT guidance, as follows.

- Article 15, paragraph 2, of the IED requires that Emission Limit Values (ELVs) are based on best available techniques, referred to as BAT.
- Article 13 of the IED, requires that 'the Commission' develops BAT guidance documents (referred to as BREFs).
- Article 21, paragraph 3, of the IED, requires that when updated BAT conclusions are published, the Competent Authority (in England this is the EA) has up to four years to revise permits for facilities covered by that activity to comply with the requirements of the sector specific BREF.

The EA explain that ‘BAT’ means the available techniques which are the best for preventing or minimising emissions and impacts on the environment where ‘techniques’ include both the technology used and the way the installation is designed, built, maintained, operated and decommissioned.

2.4 Local air quality management

In accordance with Section 82 of the Environment Act (1995) (Part IV), local authorities are required to periodically review and assess air quality within their area of jurisdiction, under the system of Local Air Quality Management (LAQM). This review and assessment of air quality involves assessing present and likely future ambient pollutant concentrations against AQALs. If it is predicted that levels at the façade of buildings where members of the public are regularly present (normally residential properties) are likely to be exceeded, then the local authority is required to declare an Air Quality Management Area (AQMA). For each AQMA, the local authority is required to produce an Air Quality Action Plan (AQAP), the objective of which is to reduce pollutant levels in pursuit of the relevant AQALs.

3 Baseline Air Quality

The Facility is located in Ferrybridge on the site of the former Ferrybridge coal-fired power station, within the administrative area of Wakefield Metropolitan District Council (WMDC). The boundary with the administrative area of North Yorkshire Council (NYC) lies along the course of the River Aire, approximately 1 km to the east. The immediate surroundings comprise industrial uses, with the A1(M) motorway immediately to the west and enfinium's Ferrybridge 2 Facility (F2) immediately to the north. The location of the Facility is shown on Figure 1 of Appendix A.

3.1 Contribution from the Facility and Ferrybridge 2

F2 is an energy from waste facility located less than 400 m north of the Facility. It has the same maximum annual processing capacity as the Facility, albeit the stack is 19 m taller at 119 m, so would contribute a similar level to baseline pollutant concentrations as the Facility.

Local modelled and monitoring data includes the existing contribution from both the Facility and F2. Nonetheless, as a conservative measure the contribution from F2 to baseline concentrations has been modelled and included in the baseline data. The contribution from F2 is small, so as a further conservative measure the maximum annual mean contribution from F2 at any location has been added to the annual mean baseline concentrations for all pollutants.

The model input data used to represent emissions from F2 is presented in Appendix B and the modelled contribution to baseline concentrations is presented in Table 12.

3.2 Air quality review and assessment

Under Section 82 of the Environment Act (1995) (Part IV), local authorities are required to undertake an ongoing exercise to review air quality within their area of jurisdiction. There are four AQMAs within 5 km of the Facility, details of which are provided in Table 5.

Table 5: Air Quality Management Areas

AQMA name	Distance from Site	Local Authority	Reason for Declaration	Years compliant with AQAL (to 2023)
Knottingley AQMA	1.2 km	Wakefield	Annual mean nitrogen dioxide	8
A1 AQMA	1.4 km	Wakefield	Annual mean nitrogen dioxide	7
Pontefract AQMA	3.1 km	Wakefield	Annual mean nitrogen dioxide	10
Castleford AQMA	3.3 km	Wakefield	Annual mean nitrogen dioxide	9

Source: WMDC 2024 Air Quality Annual Status Report

All other AQMAs declared by WMDC and NYC are considered to be outside of the area where emissions from the Facility may be significant.

3.3 National modelling – mapped background data

The Department for Environment Food and Rural Affairs (Defra) provides modelled background concentrations of pollutants across the UK on a 1 km by 1 km grid under the Modelling of Ambient Air Quality (MAAQ) contract. This model is based on known pollution sources and background measurements and provides a source of background concentrations in lieu of suitable monitoring data. Mapped background concentrations have been downloaded for the grid squares containing the Proposed Development and immediate surroundings. In addition, mapped atmospheric concentrations of ammonia are available from Defra via the National Environment Research Council (NERC) Centre for Ecology and Hydrology (CEH) throughout the UK.

The mapped background data is calibrated against monitoring data. The most recently available 2023 mapped background concentrations are based on 2023 meteorological data and are calibrated against monitoring undertaken in 2023.

Concentrations will vary over the modelling domain area. Therefore, the maximum mapped background concentrations from within 5 km of the Site have been calculated, as presented in Table 6, together with the concentrations at the Site.

Table 6: Mapped Background Data

Pollutant	Annual mean concentration (µg/m³)		Dataset
	At the Site	Max within 5 km	
Nitrogen dioxide	11.27	14.65	Defra 2023 Dataset
Sulphur dioxide	1.76	2.82	Defra 2023 Dataset
Particulate matter (as PM_{10})	15.07	17.11	Defra 2023 Dataset
Particulate matter (as $PM_{2.5}$)	7.26	7.83	Defra 2023 Dataset
Carbon monoxide	218	230	Defra 2010 Dataset(1)
Benzene	0.36	0.45	Defra 2023 Dataset
Ammonia	1.60	1.90	APIS 2020 – 2022 average

Notes
(1) CO mapping has not been updated since 2010.

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3.4 AURN and LAQM monitoring data

The UK Automatic Urban and Rural Network (AURN) is a country-wide network of air quality monitoring stations operated on behalf of the Defra. This includes automatic monitoring of oxides of nitrogen, nitrogen dioxide, sulphur dioxide, ozone, carbon monoxide and particulates.

Monitoring sites are broadly categorised into 'background' sites and 'roadside' sites. Background sites are positioned that they are not influenced significantly by any single source or street but rather by the contribution from all sources upwind of the station and are considered broadly representative for several square kilometres. Roadside sites are predominately determined by emissions from nearby traffic and are only representative of air quality for the immediate area of the analyser. As such, background sites within 5 km of the Facility and roadside sites within 3 km of the Facility have been considered in this analysis.

The nearest AURN monitoring station is approximately 30 km from the Facility in York and is not considered representative of the surroundings of the Site. Therefore, AURN monitoring has not been considered further in this analysis.

In addition to the national AURN, local authorities undertake monitoring of a range of pollutants as part of the LAQM review process. A review of the most recent Air Quality Annual Status Reports (ASRs) published by WMDC and NYC shows that there are two background sites within 5 km of the Facility and two roadside sites within 3 km of the Facility. A summary of this monitoring data is shown in Table 7.

Table 7: Diffusion Tube Monitoring Data

ID	Site type(1)	Distance (km)	Annual mean nitrogen dioxide concentration (µg/m³)				
			2019	2020	2021	2022	2023
Background Monitoring							
94	UB	3.2	27.8	20.5	22.0	21.7	19.5
176	UB	4.1	29.1	23.5	20.9	17.7	18.3
Roadside Monitoring							
174	R	2.1	33.8	27.7	25.3	24.4	21.9
207	R	2.1	-	-	27.1	27.1	25.8
Note: (1) *UB = urban background, R = roadside, K = kerbside*							

Source: Wakefield Council 2024 LAQM Annual Status Report

As shown, the monitored concentrations are all well below the AQAL of 40 µg/m³. The two urban background locations are in Castleford and are not representative of the more rural immediate surroundings of the Facility.

In the first instance, the maximum mapped background nitrogen dioxide concentration from within 5 km of the Site (14.65 µg/m³) has been used as the baseline concentration for the assessment. The monitoring data and spatial variations in mapped background data has been used to define location-specific baseline concentrations at any locations where the impact at areas of relevant exposure cannot be screened out as 'insignificant'.

3.5 Other national monitoring networks data

Neither the Defra mapped background dataset, AURN or LAQM include monitoring of other pollutants released from the Facility such as hydrogen chloride, hydrogen fluoride, VOCs, metals or dioxins. As such reference has been made to national modelling to determine a suitable baseline concentration.

3.5.1 Hydrogen chloride

Hydrogen chloride was measured until the end of 2015 on behalf of Defra as part of the UK Eutrophying and Acidifying Atmospheric Pollutants (UKEAP) project. This consolidates the previous Acid Deposition Monitoring Network (ADMN), and National Ammonia Monitoring Network (NAMN). Monitoring of hydrogen chloride ceased at the end of 2015 and none of the historic sites were located within 10 km of the Site. Prior to the cessation of the monitoring concentrations were fairly constant.

The maximum annual average monitored within the UK between 2011 and 2015 was 0.76 µg/m³. In lieu of any recent representative monitoring this has been used as the baseline concentration for this assessment as a conservative estimate.

3.5.2 Hydrogen fluoride

Baseline concentrations of hydrogen fluoride are not measured locally or nationally, since these are not generally of concern in terms of local air quality. However, the EPAQS report 'Guidelines for halogens and hydrogen halides in ambient air for protecting human health against acute irritancy effects' contains some estimates of baseline levels, reporting that measured concentrations have been in the range of 0.036 µg/m³ to 2.35 µg/m³.

In lieu of any local monitoring, the maximum measured baseline hydrogen fluoride concentration has been used for the purpose of this assessment as a conservative estimate.

3.5.3 Ammonia

Ammonia is also measured as part of the UKEAP project at rural background locations. There are no UKEAP monitoring locations within 10 km of the Site. In lieu of any local UKEAP monitoring, the maximum mapped background value from APIS from within 5 km of the Site has been used for the purpose of this assessment as set out in Table 6. This value is 1.9 µg/m³.

3.5.4 Volatile Organic Compounds

As part of the Automatic and Non-Automatic Hydrocarbon Network, benzene concentrations are measured at sites co-located with the AURN across the UK. There are no monitoring locations within 10 km of the Site.

In lieu of any local monitoring of benzene, the maximum mapped background concentrations within 5 km of the Site (0.45 µg/m³, as presented in Table 6) has been used as the baseline concentration.

3.5.5 Metals

Metals are measured as part of the Rural Metals and UK Urban/Industrial Networks (previously the Lead, Multi-Element and Industrial Metals Networks). In lieu of any local monitoring data, the maximum from across the UK background monitoring sites has been used. A summary of the maximum annual data across all UK urban and rural background monitoring sites is presented in the following table.

Table 8: Metals Monitoring Maximum of all Background Sites – Urban and Rural

Substance	Annual mean concentration (ng/m³)						Max (as % of AQAL)
	AQAL	2020	2021	2022	2023	2024	
Arsenic	6	1.00	0.98	0.90	0.80	0.94	16.7%
Cadmium	5	0.42	0.35	0.29	0.29	0.25	8.4%
Chromium	-	3.70	4.80	4.60	4.80	4.60	-
Cobalt	-	0.84	0.65	1.50	0.86	0.56	-
Copper	-	18.00	16.00	18.00	15.00	13.00	-
Lead	250	7.80	15.00	8.00	7.60	5.40	6.0%

Substance	**Annual mean concentration (ng/m³)**						**Max (as % of AQAL)**
	AQAL	**2020**	**2021**	**2022**	**2023**	**2024**	
Manganese	150	10.00	7.60	8.50	8.00	7.00	6.7%
Nickel	20	1.70	2.20	2.50	2.40	1.80	12.5%
Vanadium	-	3.00	3.00	1.90	1.90	1.20	-
Notes: *Excludes data from Sheffield Tinsley and Swansea Coedgwilym – although classified as urban background sites, these are located close to large industrial sources of metals and as such has high levels of these pollutants far greater than those monitored at other sites.*							

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As shown, the concentrations monitored between 2020 and 2024 were well below the AQALs at all monitoring sites considered.

The surroundings of the Site is a mixture of rural and suburban areas and some light industrial uses. No significant emission sources of metals have been identified in the local area, so it is deemed appropriate to use the maximum metal concentrations from 2020 – 2024 across all urban and rural background sites (excluding Sheffield Tinsley and Swansea Coedgwilym, which are close to significant sources of metals) as the baseline concentrations within this assessment, in lieu of any representative local monitoring.

No data is available for antimony and mercury as monitoring of these metals across the UK ceased at the end of 2013, except for at London Westminster and Runcorn Weston Point where mercury was monitored until the end of 2018. Runcorn is not representative of the surroundings of the Proposed Development due to elevated local concentrations from industrial sources in Weston Point. The concentration monitored at London Westminster in 2018 (2.80 ng/m³) has been used as the baseline mercury concentration for the assessment.

The maximum monitored concentration of antimony at a background location in 2013 was 1.30 ng/m³ at Detling, which has been used as the baseline concentration for the assessment. This value is only 0.026% of the annual mean AQAL of 5,000 ng/m³.

3.5.6 Dioxins, furans and polychlorinated biphenyl (PCBs)

Dioxins, furans and PBCs were monitored at a number of urban and rural stations in the UK as part of the Toxic Organic Micro Pollutants (TOMPs) network. Monitoring of dioxins ceased at the end of 2016 and monitoring of PCBs ceased at the end of 2018. None of the monitoring locations were located within 10 km of the Proposed Development.

A summary of dioxin and furan and PCB concentrations from all monitoring sites across the UK is presented in Table 9 and Table 10.

Table 9: TOMPS – Dioxin and Furans Monitoring

Site	**Annual mean concentration (fgTEQ/m³)**				
	2012	**2013**	**2014**	**2015**	**2016**
Auchencorth Moss	0.13	0.86	0.01	0.01	0.13
Hazelrigg	8.75	2.02	2.61	5.27	4.59
High Muffles	4.32	0.6	1.07	0.54	2.73
London Nobel House	15.42	3.47	2.89	4.34	21.27

Site	Annual mean concentration (fgTEQ/m³)				
	2012	2013	2014	2015	2016
Manchester Law Courts	32.99	10.19	16.52	5.94	12.23
Weybourne	9.30	2.34	1.61	1.42	16.32

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Table 10: TOMPS – PCB Monitoring

Site	Annual mean concentration (pg/m³)				
	2014	2015	2016	2017	2018
Auchencorth Moss	23.23	24.27	25.32	19.09	12.31
Hazelrigg	25.84	41.68	52.58	33.15	22.22
High Muffles	26.11	33.43	37.76	31.63	8.86
London Nobel House	107.49	121.39	110.46	121.87	46.63
Manchester Law Courts	128.93	97.99	92.60	97.27	40.10
Weybourne	17.00	20.95	38.61	32.26	11.23

Source: © Crown 2025 copyright Defra via uk-air.defra.gov.uk, licenced under the Open Government Licence (OGL).

As shown, the concentrations vary significantly between sites and years. As there are no monitoring sites located within close proximity of the Site or any mapped background datasets, the maximum monitored concentration from the past 5 years has been used as the background concentration within this assessment. These values are 32.99 fg/TEQ/m³ for dioxins and furans and 128.93 pg/m³ for PCBs.

3.5.7 Polycyclic Aromatic Hydrocarbons (PAHs)

Polycyclic Aromatic Hydrocarbons (PAHs) are monitored at a number of stations in the UK as part of the PAH network. For the purpose of this assessment, benzo(a)pyrene is considered as this is the only PAH which an AQAL has been set.

There are no monitoring locations within 10 km of the Site. This assessment has considered monitored data from all background sites, shown in Table 11.

Table 11: Benzo(a)pyrene

Site	AQAL (ng/m³)	Annual mean concentration (ng/m³)				
		2020	2021	2022	2023	2024
Min	0.25	0.01	0.02	0.02	0.01	0.01
Max		0.55	0.68	0.60	0.62	0.52
Average		0.16	0.19	0.19	0.16	0.12

Source: © Crown 2025 copyright Defra via uk-air.defra.gov.uk, licenced under the Open Government Licence (OGL).

As shown, the maximum at any background site exceeds the AQAL. A major source of PAHs in the UK is domestic wood burning. However, this is unlikely to be a significant source in the vicinity of the Facility. As such, the highest annual mean concentration from the last five years of monitoring data, averaged across all background sites (0.19 ng/m³), is considered to be a conservative estimate of benzo(a)pyrene concentrations in the vicinity of the Facility.

3.6 Summary

Table 12 outlines the values for the annual average baseline concentrations that have been used to evaluate the impact of the Facility, showing the baseline concentration obtained from modelled data, monitoring data, or published literature, and the modelled contribution from F2. The choice of baseline concentration will be considered further if the impact of the Facility cannot be screened out as 'insignificant'.

Table 12: Summary of Baseline Concentrations

Pollutant	Annual mean concentration			Units	Justification
	Back-ground	F2	Total		
Nitrogen dioxide	14.65	0.36	15.01	µg/m³	Maximum mapped background concentration within 5 km (2023 Defra dataset)
Sulphur dioxide	2.82	0.11	2.93	µg/m³	
Particulate matter (as PM_{10})	17.11	0.01	17.12	µg/m³	
Particulate matter (as $PM_{2.5}$)	7.83	0.01	7.84	µg/m³	
Benzene	0.45	0.03	0.48	µg/m³	
Carbon monoxide	230	0.14	230.14	µg/m³	Maximum mapped background concentration within 5 km (2010 Defra dataset)
Hydrogen chloride	0.76	0.02	0.78	µg/m³	Maximum monitored concentration across the UK 2011 to 2015
Hydrogen fluoride	2.35	0.003	2.35	µg/m³	Maximum measured concentration from EPAQS report
Ammonia	1.90	0.04	1.94	µg/m³	Maximum mapped background concentration within 5 km, APIS 2020 – 2022 three year average
Mercury	2.80	0.06	2.86	ng/m³	Maximum monitored annual mean concentration from London Westminster 2018
Antimony	1.30	0.03	1.33	ng/m³	Maximum monitored across UK in most recent year of monitoring data (2013)
Arsenic	1.00	0.07	1.07	ng/m³	Maximum monitored at a background site 2020 – 2024. Chromium VI assumed to be 20% of total chromium in line with EA guidance. Contribution from F2 apportioned assuming emissions at the maximum monitored in the EA's metals guidance – refer to section 7.2.5.
Cadmium	0.42	0.06	0.48	ng/m³	
Chromium	4.80	0.26	5.06	ng/m³	
Chromium VI	0.96	0.05	1.01	ng/m³	
Cobalt	1.50	0.02	1.52	ng/m³	
Copper	18.0	0.08	18.08	ng/m³	
Lead	15.0	0.14	15.14	ng/m³	
Manganese	10.0	0.17	10.17	ng/m³	
Nickel	2.50	0.63	3.13	ng/m³	

Pollutant	Annual mean concentration			Units	Justification
	Back-ground	F2	Total		
Vanadium	3.00	0.02	3.02	ng/m³	
Dioxins and furans	32.99	0.17	33.16	fg/m³	Maximum UK monitored concentration between 2012 and 2016
Polychlorinated biphenyl (PCBs)	128.93	14.3	143.20	pg/m³	Maximum UK monitored concentration between 2014 and 2018
Benzo(a)pyrene (PAHs)	0.19	0.001	0.19	ng/m³	Maximum annual average across all background sites 2020 – 2024.

4 Sensitive Receptors

4.1 Human sensitive receptors

The general approach to the assessment is to evaluate the highest predicted process contribution to concentrations across an output grid of points at a height of 1.5 m, to represent typical breathing height. In addition, the predicted process contribution at a number of sensitive receptors has been evaluated. These sensitive receptors have been selected to represent the residential dwellings and schools most likely to be impacted by emissions from the Facility. The receptors are displayed in Figure 2 of Appendix A and listed in Table 13.

Table 13: Human Sensitive Receptors

ID	Name	Location	
		X (m)	Y (m)
R1	Holmfield Farm Cottages	446855	424734
R2	Willow Lane 1	446773	424982
R3	Willow Lane 2	446843	425180
R4	Fryston Hall Farm	446975	426489
R5	Hall Court	448083	425780
R6	Low Street 1	448236	425613
R7	Carpenters Yard	448245	425376
R8	Low Street 2	448405	425261
R9	Primrose Dene	448903	425093
R10	The Square	448378	424367
R11	Stranglands Lane	447860	424451
R12	Willow Green Academy	447606	424174
R13	Oyster Park Primary Academy	445795	425933
R14	Brotherton and Byram Community Primary Academy	448386	425405

4.2 Ecological sensitive receptors

The EA has provided a nature and heritage conservation screening report to identify the following sites of ecological importance in accordance with Air Emissions Guidance criteria:

- Special Protection Areas (SPAs), Special Areas of Conservation (SACs), or Ramsar sites within 10 km of the Facility;
- Sites of Special Scientific Interest (SSSIs) within 2 km of the Facility; and
- Local Nature Sites[3] within 2 km of the Facility.

The sensitive ecological receptors identified are presented by distance from the stack in Table 14 and are displayed in Figure 3 of Appendix A.

3 National Nature Reserves (NNR), Local Nature Reserves (LNRs), Local Wildlife Sites and ancient woodlands.

Table 14: Sensitive Ecological Receptors

ID	Site	Desig-nation[1]	Location X (m)	Location Y (m)	Lichens/ bryophytes present[1]
European and UK Designated Sites					
E1	Fairburn and Newton Ings	SSSI	447256	427242	Yes
Local nature sites					
E2	Well Wood	LNR	445749	426662	Yes
E3	Orchard head	LWS[2]	446147	423522	Yes
E4	Fryston Park	LWS[2]	446927	425475	Yes
E5	Former Fryston Colliery	LWS[2]	446627	427128	Yes
E6	Bank River Aire	LWS[2]	447660	426112	Yes
E7	Byram Park	LWS[2]	448516	426544	Yes

Notes:
[1] APIS does not hold any information on local nature sites. As a conservative measure it has been assumed that lichens and bryophytes are present at all local nature sites.
[2] Some ecological receptors are designated as sites of importance for nature conservation (SINCs). As these are locally designated they are considered equivalent to local wildlife sites.

For each of the designated sites the maximum PC at ground level from all grid points within the site has been assessed.

5 Modelling Methodology

5.1 Selection of model

Detailed dispersion modelling has been undertaken using the model ADMS 6, developed and supplied by Cambridge Environmental Research Consultants (CERC). This is a new generation dispersion model, which characterises the atmospheric boundary layer in terms of the atmospheric stability and the boundary layer height. In addition, the model uses a skewed Gaussian distribution for dispersion under convective conditions, to take into account the skewed nature of turbulence. The model also includes modules to take account of the effect of buildings and complex terrain.

ADMS is routinely used for modelling of emissions for planning and Environmental Permitting purposes to the satisfaction of the EA and local authorities.

5.2 Source and emissions data

The source and emissions input data utilised within the modelling are presented in Table 15 to Table 18. The data for the Operational Facility has been taken from data recorded by the continuous emissions monitoring system (CEMS) for the full calendar years of 2022 and 2023. Data on the waste throughput and NCV recorded at the Facility for this time period has been used to ensure that the data is representative of operation at 106% of MCR, i.e. 124.4 MWth per line. To represent the Proposed Facility operating at 108% MCR, the average flue gas flow rate recorded by the CEMS has been increased by a factor of 108/106. Data for L3 has been factored from operational data from L1 and L2 to represent the proposed thermal input of 95.4 MWth for L3; this is considered appropriate as L3 will be of similar design to L1 and L2. The stack for L3 has been sized to achieve a similar efflux velocity to L1 and L2, subject to detailed design.

Table 15: Source Data

Item	Unit	Operational L1 and L2 106% MCR (each)	Proposed L1 and L2 108% MCR (each)	Proposed L3
Stack data				
Height	m			100
Internal diameter	m		2.2	2.1
Location	m, m		447240, 424987	447244, 424989
Flue gas conditions				
Temperature	°C			136
Exit moisture content	% v/v			17.3%
Exit oxygen content	% v/v dry			7.0%
Reference oxygen content	% v/v dry			11%
Volume at reference conditions (dry, ref O_2)	Nm^3/h	302,389	308,095	231,896
	Nm^3/s	84.0	85.6	64.4
Volume at actual conditions	Am^3/h	391,123	398,502	299,945

Item	Unit	Operational L1 and L2 106% MCR (each)	Proposed L1 and L2 108% MCR (each)	Proposed L3
	Am^3/s	108.6	110.7	83.3
Flue gas exit velocity	m/s	28.6	29.1	25.0

L1 and L2 have been entered into the model as a single combined source of effective internal diameter of 3.11 m; Line 3 has been included as an additional source. The stack of L3 is sufficiently close to the stacks of L1 and L2 that they can be considered a single source; therefore, the 'combine multiple flues' function has been used within the ADMS model for the Proposed Facility.

Table 16: Stack Emissions Data – Daily or Periodic ELV – Lines 1 and 2

Pollutant	Daily or periodic	Operational L1 and L2 106% MCR (combined)	Proposed L1 and L2 108% MCR (combined)
	Conc. (mg/Nm^3)	Release rate (g/s)	
Oxides of nitrogen (as NO_2)	180	30.24	30.81
Sulphur dioxide	40	6.720	6.847
Carbon monoxide[(1)]	50	8.400	8.558
Fine particulate matter (PM)[(2)]	5	0.840	0.856
Hydrogen chloride	8	1.344	1.369
Volatile organic compounds (as TOC)	10	1.680	1.712
Hydrogen fluoride	1	0.168	0.171
Ammonia	15	2.520	2.567
Cadmium and thallium	0.02	3.360 mg/s	3.423 mg/s
Mercury	0.02	3.360 mg/s	3.423 mg/s
Other metals[(3)]	0.3	50.40 mg/s	51.35 mg/s
Benzo(a)pyrene (PAHs)[(4)]	0.2 µg/Nm^3	33.60 µg/s	34.23 µg/s
Dioxins and furans[(5)]	0.06 ng/Nm^3	10.08 ng/s	10.27 ng/s
PCBs[(6)]	5 µg/Nm^3	0.840 mg/s	0.856 mg/s

Notes:

All emissions are expressed at reference conditions of dry gas, 11% oxygen, 273.15K.

(1) Averaging period for carbon monoxide is 95% of all 10-minute averages in any 24-hour period.

(2) As a worst-case it has been assumed that the entire PM emissions consist of either PM_{10} or $PM_{2.5}$ for comparison with the relevant AQALs.

(3) Other metals consist of antimony (Sb), arsenic (As), lead (Pb), chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni) and vanadium (V).

(4) 0.2 µg/m^3 is the maximum recorded at a UK plant (2019 Waste Incineration BREF, Figure 8.121). This is assumed to be the emission concentration for the Facility.

(5) The EP includes a limit of 0.06 ng I-TEQ/Nm³ as an average over a minimum of 6 hours, and a limit of 0.08 ng I-TEQ/Nm³ as a long-term average over a minimum of 2 weeks. The long-term average sampling is only required if it cannot be demonstrated that emissions are low and stable. It has been assumed that the long-term average monitoring will not be required and an emission limit of 0.06 ng I-TEQ/Nm³ is representative of the maximum annual mean emission concentration from L1 and L2 of the Facility.

(6) Table 3.8 of the 2006 Waste Incineration BREF states that the annual average total PCBs is less than 0.005 mg/Nm³ (dry, 11% oxygen, 273K). In lieu of other available operational data, this has been assumed to be the emission concentration for the Facility.

As shown in Table 15, the volumetric flow rate on a normalised and actual basis is greater for the Proposed Facility than the Operational Facility, due to the increase in operational set point from 106% of MCR to 108% of MCR. As a result, a greater quantity of pollutants would be released on a g/s basis from the Proposed Facility due to the increased volume of flue gas through the stack. However, these would be released at a greater velocity.

The emissions data for the new L3 are shown in Table 17. For some pollutants the daily and periodic ELVs are lower than for L1 and L2, because L3 will be classified as a 'new' plant as defined in the WI BREF.

Table 17: Stack Emissions Data – Daily or Periodic ELV – Line 3

Pollutant	**Proposed L3**	
	Conc. (mg/Nm³)	**Release rate (g/s)**
Oxides of nitrogen (as NO_2)	100	6.442
Sulphur dioxide	30	1.932
Carbon monoxide(1)	50	3.221
Fine particulate matter (PM)(2)	5	0.322
Hydrogen chloride	6	0.386
Volatile organic compounds (as TOC)	10	0.644
Hydrogen fluoride	1	0.064
Ammonia	10	0.644
Cadmium and thallium	0.02	1.288 mg/s
Mercury	0.02	1.288 mg/s
Other metals(3)	0.3	19.32 mg/s
Benzo(a)pyrene (PAHs)(4)	0.2 µg/Nm³	12.88 µg/s
Dioxins and furans(5)	0.04 ng/Nm³	2.577 ng/s
PCBs(6)	5 µg/Nm³	0.322 mg/s

Notes:

All emissions are expressed at reference conditions of dry gas, 11% oxygen, 273.15K.

(1) Averaging period for carbon monoxide is 95% of all 10-minute averages in any 24-hour period.

(2) As a worst-case it has been assumed that the entire PM emissions consist of either PM_{10} or $PM_{2.5}$ for comparison with the relevant AQALs.

Pollutant	Proposed L3	
	Conc. (mg/Nm³)	Release rate (g/s)
[3] *Other metals consist of antimony (Sb), arsenic (As), lead (Pb), chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni) and vanadium (V).* [4] *0.2 µg/m³ is the maximum recorded at a UK plant (2019 Waste Incineration BREF, Figure 8.121). This is assumed to be the emission concentration for the Facility.* [5] *The EP will include a limit of 0.04 ng I-TEQ/Nm³ as an average over a minimum of 6 hours, and a limit of 0.06 ng I-TEQ/Nm³ as a long-term average over a minimum of 2 weeks. The long-term average sampling is only required if it cannot be demonstrated that emissions are low and stable. It has been assumed that the long-term average monitoring will not be required and an emission limit of 0.04 ng I-TEQ/Nm³ is representative of the maximum annual mean emission concentration from L3 of the Facility.* [6] *Table 3.8 of the 2006 Waste Incineration BREF states that the annual average total PCBs is less than 0.005 mg/Nm³ (dry, 11% oxygen, 273K). In lieu of other available operational data, this has been assumed to be the emission concentration for the Facility.*		

The existing L1 and L2 and the new L3 will be subject to the same short-term emission limits, resulting in the pollutant release rates shown in Table 18.

Table 18: Stack Emissions Data – Short Term

Pollutant	Half-hourly ELV	Operational L1 and L2	Proposed L1 and L2	Proposed L3
	mg/Nm³	Release rate (g/s)		
Oxides of nitrogen (as NO_2)	400	67.20	68.47	25.77
Sulphur dioxide	200	33.60	34.23	12.88
Carbon monoxide[1]	150	25.20	25.67	9.66
Fine particulate matter (PM)	30	5.040	5.135	1.932
Hydrogen chloride	60	10.08	10.27	3.865
Volatile organic compounds (as TOC)	20	3.360	3.423	1.288
Notes: *All emissions are expressed at reference conditions of dry gas, 11% oxygen, 273.15K.* [1] *Averaging period for carbon monoxide is 95%ile of all 10-minute averages in any 24-hour period.*				

Emissions from F2 have also been modelled to quantify the contribution to baseline concentrations. The model input data used to represent emissions from F2 is presented in Appendix B.

5.3 Other inputs

5.3.1 Modelling domain

Modelling has been undertaken using a nested grid of points; a 5 km x 5 km grid with a spatial resolution of 50 m nested within a 20 km x 20 km grid with a spatial resolution of 200 m, at heights of 1.5 m for human health impacts and 0 m (ground level) for ecological impacts. The high resolution of the finest grid has been chosen to ensure that the gridded output accurately captures the highest modelled concentrations, as the resolution of 50 m is much less than the 1.5 times the stack height recommended in TG(22). Reference should be made to Figure 4 for a graphical representation of the modelling domain used. The extent of the modelling domain is detailed in Table 19.

Table 19: Modelling Domain

Grid Quantity	Fine Grid	Wide Grid
Grid spacing (m)	50	200
Grid points	101	101
Grid Start X (m)	445000	440000
Grid Finish X (m)	450000	460000
Grid Start Y (m)	423000	418000
Grid Finish Y (m)	428000	438000

5.3.2 Meteorological data and surface characteristics

The dispersion modelling has been undertaken using weather data from the Bramham meteorological recording station. Bramham is approximately 17 km to the north of the Site and is the closest and most representative meteorological station available.

The Environment Agency recommends that five years of data are used to take into account inter-annual fluctuations in weather conditions. The period 2018 – 2022 has been used. Wind roses for each year are presented in Figure 5.

The minimum Monin-Obukhov length can be selected in ADMS for both the dispersion site and the meteorological site. This is a measure of the minimum stability of the atmosphere and can be adjusted to account for urban heat island effects which prevent the atmosphere in urban areas from ever becoming completely stable. The minimum Monin-Obukhov length has been set to 10 m for the dispersion site, which is recommended by CERC for “small towns <50,000 [population]” which is considered appropriate for the mix of industrial, suburban and rural land uses surrounding the Site. The minimum Monin-Obukhov length has been set to 1 m for the meteorological site which is recommended by CERC for “rural” areas such as the surroundings of the meteorological site.

The surface roughness length utilised in ADMS can also be selected for both the dispersion site and meteorological site. There is considerable variation in surface roughness across the 20 x 20 km modelling domain. To account for the varying surface roughness length a spatially-varying surface roughness file has been used as a model input. The land-use class for each point in the file has been extracted from the UK Land Cover database[4] and cross-referenced with the most likely surface roughness length value[5].

A surface roughness length of 0.1 m has been selected for the Bramham meteorological site. CERC recommends that this value is the maximum value suitable for “root crops” and is considered representative of the mainly open surroundings of the meteorological site.

The parameters for the spatially-varying surface roughness file are shown in Table 20 and a visual representation provided in Figure 6.

4 UK Centre for Ecology and Hydrology, UK Land Cover Map for 2021.

5 Taken from “Roughness length classification of Corine Land Cover classes”, Megajoule Consultants, 2007.

Table 20: Spatially Varying Surface Roughness File Parameters

Parameter	Value
Grid spacing (m)	100
Grid points	222 x 222
Modelled resolution	64 x 64
Grid Start X (m)	438950
Grid Finish X (m)	461050
Grid Start Y (m)	438950
Grid Finish Y (m)	461050

Table 21: Surface Roughness Lengths Used for Different Land Use Classes

Land Use Classification	UK Land Cover Identifier	Surface Roughness Length (m)
Urban	20	1.2
Deciduous woodland, Coniferous woodland	1, 2	0.75
Suburban	21	0.5
Arable, Fen	3, 8	0.05
Improved grassland, neutral grassland, Calcareous grassland, acid grassland, heather, heather grassland	4, 5, 6, 7, 9, 10	0.03
Bog	11	0.0005
Water(1)	14	0.0001
Note: *(1) The 'most likely' value for water is given as zero. ADMS cannot model a surface roughness length of zero, so areas of water have been assigned a roughness length of 0.0001 m which is the value recommended by CERC for 'sea'.*		

A summary of the meteorological parameters used in the dispersion modelling is shown in Table 22

Table 22: Meteorological parameters

Parameter	Dispersion Site Value (m)	Met Site Value (m)
Surface roughness length	Spatially varying	0.1
Minimum Monin-Obukhov length	10	1

The sensitivity of the modelling results to the choice of surface roughness has been considered in section 6.1.

5.3.3 Terrain

CERC recommends that, where gradients within 500 m of the modelling domain are greater than 1 in 10, the complex terrain module within ADMS (FLOWSTAR) should be used. A review of the local area has deemed that the effect of terrain should be taken into account in the modelling.

A terrain file large enough to cover the output grid of points was created using Ordnance Survey Terrain 50 data. The parameters of the terrain file used the same as for the surface roughness file detailed in Table 20, and a graphical representation of the file provided in Figure 7.

The sensitivity of the modelling results to the inclusion of terrain has been considered in section 6.2.

5.3.4 Buildings

The presence of adjacent buildings can significantly affect the dispersion of the atmospheric emissions in various ways:

- Wind blowing around a building distorts the flow and creates zones of turbulence. The increased turbulence can cause greater plume mixing.
- The rise and trajectory of the plume may be depressed slightly by the flow distortion. This downwash leads to higher ground level concentrations closer to the stack than those which would be present without the building.

The Environment Agency recommends that buildings should be included in the modelling if they are both:

- Within 5L of the stack (where L is the smaller of the building height and maximum projected width of the building); and
- Taller than 40% of the stack.

The ADMS 6 user guide also states that buildings less than one third of the stack height will not have any effect on the dispersion calculations in the model.

A review of the Site layout has been undertaken and the details of the existing buildings which may affect dispersion are presented in Table 23, and the revised buildings for the Proposed Facility are presented in Table 24. The buildings have been modelled at the height of the highest point of the structure. A site plan showing which buildings have been included in the model is presented in Figure 8.

Table 23: Existing Building Details

Buildings	Centre Point		Height (m)	Length (m)	Width (m)	Angle (°)
	X (m)	Y (m)				
F1 Boiler[1]	447175	424946	50	50	50	328
F1 Bunker	447136	424921	42	87	45	328
F1 FGT	447213	424971	34	35	25	328

Note:
[1] The boiler has been selected as the main building.

Table 24: Proposed Building Details

Buildings	Centre Point		Height (m)	Length (m)	Width (m)	Angle (°)
	X (m)	Y (m)				
F1 Boiler (existing)[(1)]	447175	424946	50	50	50	328
F1 L3 Boiler (new)	447146	424981	50	40	38	328
F1 Bunker (extended)	447130	424930	42	110	45	328
F1 FGT	447213	424971	34	35	25	328

Note:
[(1)] The existing boiler has been selected as the main building.

The sensitivity of the modelling results to the inclusion of terrain has been considered in section 6.2.

5.3.5 Wind turbines

Wind turbine wakes have the potential to interfere with dispersion of pollutants when the stack is within 12 – 15 rotor diameters of the turbine, with the wind turbine effects becoming more noticeable when the stack is within a few rotor diameters of the turbine. There are no wind farms within 10 km of the Facility, so wind turbine effects have been excluded from the model.

5.4 Chemistry

The Facility will release nitric oxide (NO) and nitrogen dioxide (NO_2) which are collectively referred to as oxides of nitrogen (NOx). In the atmosphere, NO will be converted to NO_2 in a reaction with ozone (O_3) which is influenced by solar radiation. Since the AQALs are expressed in terms of NO_2, it is important to be able to assess the conversion rate of NO to NO_2.

Ground level NOx concentrations have been predicted through dispersion modelling. NO_2 concentrations reported in the results section assume 70% conversion from NOx to NO_2 for annual means and a 35% conversion for short term (hourly) concentrations, based upon the worst-case scenario specified in the EA's guidance for dispersion modelling[6] which is appropriate where the primary NO_2 to NOx ratio is less than 10%. Given the short travel time to the areas of maximum concentrations, this approach is considered conservative.

5.5 Baseline concentrations

Baseline concentrations for the assessment have been derived from monitoring and national mapping as summarised in Table 12; the contribution from F2 has been modelled and added to the baseline concentrations as a conservative measure.

For short term averaging periods, the baseline concentration has been assumed to be twice the long-term ambient concentration following the Environment Agency's recommendation within the Air Emission Guidance.

6 https://www.gov.uk/guidance/environmental-permitting-air-dispersion-modelling-reports

6 Sensitivity Analysis

The sensitivity of the dispersion modelling results to various input parameters has been tested in accordance with Environment Agency guidance on dispersion modelling reports[7]. This has been undertaken using meteorological data for 2020, which is the year which results in the maximum annual mean impact.

6.1 Surface roughness

The sensitivity of the results to using varying surface roughness length has been considered by running the model with a variety of surface roughness lengths for the dispersion site. For all sensitivity analyses the impact of changing model parameters on the maximum annual mean and short-term concentrations of oxides of nitrogen have been considered.

The following parameters have been kept constant:

- Scenario – Proposed Facility;
- Grid – nested 5 km x 5 km at 50 m resolution within wider 20 km x 20 km at 200 m resolution;
- Buildings – included;
- Terrain file – included at 64 x 64 resolution;
- Meteorological site surface roughness – 0.1 m;
- Dispersion site Monin-Obukhov length – 10 m;
- Meteorological site Monin-Obukhov length – 1 m; and
- Meteorological data used – Bramham 2020.

The contribution of the Facility to the ground level concentrations of oxides of nitrogen at the point of maximum impact and at the maximum impacted receptor are presented in Table 25, noting that the point of maximum annual mean impact lies very close to the receptor that experiences the maximum predicted impact.

Table 25: Surface Roughness Sensitivity Analysis

Surface roughness (m)	Oxides of nitrogen PC (µg/m³)			
	Point of maximum impact		Maximum impacted receptor	
	Annual mean	Max 1-hour mean	Annual mean	Max 1-hour mean
Variable	0.87	36.80	0.87	28.46
0.1	0.71	31.53	0.70	28.42
0.3	0.88	36.75	0.88	27.75
0.5	0.97	34.83	0.97	26.52
0.7	1.04	32.10	1.04	26.28
% Change from Variable				
0.1	-18.6%	-14.3%	-19.3%	-0.1%
0.3	0.5%	-0.1%	0.7%	-2.5%
0.5	11.2%	-5.3%	11.5%	-6.8%

[7] https://www.gov.uk/guidance/environmental-permitting-air-dispersion-modelling-reports

Surface roughness (m)	Oxides of nitrogen PC (µg/m³)			
	Point of maximum impact		Maximum impacted receptor	
	Annual mean	Max 1-hour mean	Annual mean	Max 1-hour mean
0.7	19.2%	-12.8%	19.4%	-7.7%

As shown, higher surface roughness lengths result in higher annual mean concentrations, but has a smaller effect on short-term concentrations. The use of a spatially varying surface roughness file results in similar annual mean impacts to a constant surface roughness of 0.3 m.

Due to the sensitivity of the maximum results to the choice of surface roughness length it is considered appropriate to use the spatially varying surface roughness file in the main model runs as this most accurately represents the variations in land use and surface roughness around the Facility.

6.2 Terrain

The sensitivity of the results to the effect of terrain has been considered by running the model with and without the terrain file.

The following parameters have been kept constant:

- Scenario – Proposed Facility;
- Grid – nested 5 km x 5 km at 50 m resolution within wider 20 km x 20 km at 200 m resolution;
- Buildings – included;
- Surface roughness – spatially varying at 64 x 64 resolution;
- Meteorological site surface roughness – 0.1 m;
- Dispersion site Monin-Obukhov length – 10 m;
- Meteorological site Monin-Obukhov length – 1 m; and
- Meteorological data used – Bramham 2020.

The contribution of the Proposed Facility to the ground level concentrations of oxides of nitrogen at the point of maximum predicted concentration and maximum impacted receptor are presented in Table 26 for each scenario.

Table 26: Effect of Terrain

Scenario	Oxides of nitrogen PC (µg/m³)			
	Point of maximum impact		Maximum impacted receptor	
	Annual mean	Max 1-hour mean	Annual mean	Max 1-hour mean
Including terrain	0.87	36.80	0.87	28.46
Excluding terrain	0.87	30.26	0.86	27.51
% Change	-0.9%	-17.8%	-1.3%	-3.3%

With the exception of the point of maximum 1-hour NO_2 impact across the modelled grid, terrain has a small effect on the annual mean and maximum 1-hour concentrations. The main model runs have included the effect of complex terrain as this is the most realistic scenario. Terrain also results in the most conservative estimated concentrations, strengthening the case for inclusion.

6.3 Building parameters

ADMS 6 has a buildings effects module to account for the impact of buildings when it calculates the air flow and dispersion of pollutants from a source. The sensitivity of the results to the effect of buildings has been considered by running the model with the building presented in Table 23 and with no buildings at all.

The following parameters have been kept constant:

- Scenario – Proposed Facility;
- Grid – nested 5 km x 5 km at 50 m resolution within wider 20 km x 20 km at 200 m resolution;
- Terrain – included at 64 x 64 resolution;
- Surface roughness – spatially varying at 64 x 64 resolution;
- Meteorological site surface roughness – 0.1 m;
- Dispersion site Monin-Obukhov length – 10 m;
- Meteorological site Monin-Obukhov length – 1 m; and
- Meteorological data used – Bramham 2020.

The contribution of the Proposed Facility to the ground level concentrations of oxides of nitrogen at the point of maximum predicted concentration and maximum impacted receptor are presented in Table 27 for each scenario.

Table 27: Effect of Buildings

Scenario	Oxides of nitrogen PC (µg/m³)			
	Point of maximum impact		Maximum impacted receptor	
	Annual Mean	Max 1-hour mean	Annual Mean	Max 1-hour mean
Including buildings	0.87	36.80	0.87	28.46
Excluding buildings	0.54	26.26	0.46	23.19
% Change	-37.8%	-28.6%	-46.7%	-18.5%

As shown, modelling the presence of buildings results in higher annual mean and short-term concentrations at the point of maximum impact and the maximum impacted receptor. Building effects have been included in the dispersion model as this is the most realistic scenario.

6.4 Operating below the design point

Dispersion modelling has been undertaken using the emission parameters based on the revised design point for L1 and L2 of the Facility, and including the proposed L3. The Facility is operated as a commercial plant, so it is beneficial to operate at full capacity. If the Facility was operated below the design point, the volumetric flow rate and the exit velocity of the exhaust gases would reduce. The effect of this would be to decrease the quantity of pollutants emitted but also to reduce the buoyancy of the plume due to momentum. The reduction in buoyancy, which would lead to reduced dispersion, would be more than offset by the decrease in the quantity of pollutants being emitted, and the impact of the Facility when operating below the design point would be lower than compared to operating at the design point.

7 Impact on Human Health

7.1 Screening criteria

The predicted PCs have been compared to the AQALs detailed in section 2.1. The Air Emissions Guidance states that to screen out 'insignificant' PCs:

- *the long-term PC must be less than 1% of the long-term environmental standard; and*
- *the short-term PC must be less than 10% of the short-term environmental standard.*

If either of the above criteria are not met, a second stage of screening is applied to determine the impact of the predicted environmental concentration (PEC). To screen out a PEC for any substance, the PEC must meet both of the following criteria:

- the short-term PC is less than 20% of the short-term environmental standard minus twice the long-term background concentration for the substance.
- the long-term PEC is less than 70% of the long-term environmental standard for the substance.

It is considered appropriate to apply the same screening criteria to dispersion modelling results. The long-term 1% PC threshold is based on the judgement that:

- It is unlikely that an emission at this level will make a significant contribution to air quality even if an AQAL is exceeded.
- For long-term releases, it is usually the existing background concentration of a substance that dominates, rather than the long-term PC.
- As the proposed 1% criterion is two orders of magnitude below the AQAL that represents maximum acceptable concentration for the protection of the environment, a substantial safety factor is built in.
- Even if the existing ambient quality meant that an AQAL was already at risk due to releases from other sources, a contribution from the process of less than 1% (which is in itself likely to be an overestimate) would be only a small proportion of the total.

The short-term 10% PC threshold is based on the judgement that:

- Differences in spatial and temporal conditions mean that the PCs themselves are more likely to dominate and not the ambient environmental concentrations.
- If a maximum error factor of 10 is assumed for the estimation of short-term contributions, it suggested that those emissions below 100% of the short term EAL are unlikely to lead to breaches of a short-term benchmark.

For impacts that cannot be screened out based on either the PC or the PEC, consideration is given to the full range of factors influencing the dispersion modelling results to assess the risk of exceedance of an AQAL.

7.2 Results

Table 28 and Table 29 present the results of the dispersion modelling of process emissions from the Operational Facility and the Proposed Facility at the point of maximum impact. This is a summary of the maximum predicted impact across all five years of weather data. Detailed results tables for each year of weather data are provided in Appendix E. Results are presented as the maximum predicted concentration based on the following:

- Grid – nested 5 x 5 km at 50 m resolution within wider 20 x 20 km grid at 200 m resolution;

- Buildings – included;
- Stack height – 100 m;
- Spatially varying terrain and surface roughness – included;
- 5 years of weather data 2018 to 2022 from the Bramham meteorological recording station;
- Operation at the long term ELVs for the entire year;

Operation at the short term ELVs during the worst-case conditions for dispersion of emissions (Table 29 only);

- The Environment Agency's worst case conversion of NOx to nitrogen dioxide;
- The entire dust emissions consist of either PM_{10} of $PM_{2.5}$;
- The entire VOC emissions are assumed to consist of benzene; and
- Cadmium is released at the combined emission limit for cadmium and thallium.

Process contributions that cannot be screened out as 'insignificant' are highlighted. Where the process contribution cannot be screened out as 'insignificant', further analysis has been undertaken.

Table 28: Dispersion Modelling Results – Point of Maximum Impact - Daily ELVs

Pollutant	Quantity	Units	AQAL	Bg conc.	Operational Facility		Proposed Facility				Change in max PC	
					Max PC	Max PC as % of AQAL	Max PC	Max PC as % of AQAL	Max PEC	Max PEC as % of AQAL	Conc.	as % of AQAL
Nitrogen dioxide	Annual mean	µg/m³	40	15.01	0.56	**1.40%**	0.61	**1.53%**	15.62	39.06%	0.05	0.14%
	99.79th %ile of hourly means	µg/m³	200	30.02	7.32	3.66%	9.98	4.99%	40.00	20.00%	2.66	1.33%
Sulphur dioxide	99.18th %ile of daily means	µg/m³	125	5.87	2.24	1.79%	3.05	2.44%	8.92	7.13%	0.81	0.65%
	99.73rd %ile of hourly means	µg/m³	350	5.87	4.58	1.31%	6.63	1.89%	12.50	3.57%	2.05	0.59%
	99.9th %ile of 15 min. means	µg/m³	266	5.87	5.55	2.09%	7.53	2.83%	13.40	5.04%	1.98	0.74%
PM_{10}	Annual mean	µg/m³	40	17.12	0.02	0.06%	0.03	0.07%	17.15	42.88%	0.01	0.01%
	90.41st %ile of daily means	µg/m³	50	34.25	0.09	0.18%	0.11	0.22%	34.36	68.71%	0.02	0.04%
$PM_{2.5}$	Annual mean	µg/m³	10	7.84	0.02	0.22%	0.03	0.28%	7.87	78.72%	0.01	0.06%
Carbon monoxide	8 hour running mean	µg/m³	10,000	460.3	5.83	0.06%	8.14	0.08%	468.43	4.68%	2.31	0.02%
	Hourly mean	µg/m³	30,000	460.3	10.45	0.03%	13.32	0.04%	473.61	1.58%	2.87	0.01%
Hydrogen chloride	Hourly mean	µg/m³	750	1.57	1.67	0.22%	1.98	0.26%	3.55	0.47%	0.31	0.04%
Hydrogen fluoride	Annual mean	µg/m³	16	2.35	0.004	0.03%	0.01	0.03%	2.36	14.74%	0.001	0.01%
	Hourly mean	µg/m³	160	4.71	0.21	0.13%	0.27	0.17%	4.97	3.11%	0.06	0.04%
Ammonia	Annual mean	µg/m³	180	1.94	0.07	0.04%	0.08	0.04%	2.02	1.12%	0.01	0.01%
	Hourly mean	µg/m³	2,500	3.89	3.14	0.13%	3.63	0.15%	7.52	0.30%	0.50	0.02%

Pollutant	Quantity	Units	AQAL	Bg conc.	Operational Facility		Proposed Facility				Change in max PC	
					Max PC	Max PC as % of AQAL	Max PC	Max PC as % of AQAL	Max PEC	Max PEC as % of AQAL	Conc.	as % of AQAL
VOCs (as benzene)	Annual mean	µg/m³	5	0.48	0.04	0.89%	0.06	**1.11%**	0.53	10.68%	0.01	0.22%
	Daily mean	µg/m³	30	0.96	0.79	2.65%	1.08	3.61%	2.04	6.80%	0.29	0.96%
Mercury	Daily mean	ng/m³	60	5.71	1.59	2.65%	2.16	3.61%	7.88	13.13%	0.58	0.96%
	Hourly mean	ng/m³	600	5.71	4.18	0.70%	5.33	0.89%	11.04	1.84%	1.15	0.19%
Cadmium	Annual mean	ng/m³	5	0.48	0.09	**1.77%**	0.11	**2.22%**	0.59	11.76%	0.02	0.44%
	Daily mean	ng/m³	30	0.95	1.59	5.30%	2.16	7.21%	3.12	10.40%	0.58	1.92%
PAHs	Annual mean	pg/m³	250	190.6	0.89	0.35%	1.11	0.44%	191.68	76.67%	0.22	0.09%
Dioxins	Annual mean	fg/m³	-	33.16	0.27	-	0.30	-	33.46	-	0.04	-
PCBs	Annual mean	ng/m³	200	0.14	0.02	0.01%	0.03	0.01%	0.17	0.09%	0.01	0.003%
	Hourly mean	ng/m³	6,000	0.29	1.05	0.02%	1.33	0.02%	1.62	0.03%	0.29	0.005%

Notes:
All assessment is based on the maximum PC using all five years of weather data.

Table 29: Dispersion Modelling Results – Point of Maximum Impact - Short-Term ELVs

Pollutant	Quantity	Units	AQAL	Bg conc.	Operational Facility		Proposed Facility				Change in max PC	
					Max PC	Max PC as % of AQAL	Max PC	Max PC as % of AQAL	Max PEC	Max PEC as % of AQAL	Conc.	as % of AQAL
Nitrogen dioxide	99.79th %ile of hourly means	µg/m³	200	30.02	16.27	8.13%	25.24	**12.62%**	55.26	27.63%	8.97	4.49%
Sulphur dioxide	99.73rd %ile of hourly means	µg/m³	350	5.87	22.89	6.54%	35.58	**10.17%**	41.45	11.84%	12.69	3.63%
	99.9th %ile of 15 min. means	µg/m³	266	5.87	27.76	**10.44%**	40.43	**15.20%**	46.29	17.40%	12.67	4.76%
Carbon monoxide	8 hour running mean	µg/m³	10,000	460.3	17.49	0.17%	24.42	0.24%	484.71	4.85%	6.94	0.07%
	Hourly mean	µg/m³	30,000	460.3	31.36	0.10%	39.96	0.13%	500.25	1.67%	8.61	0.03%
Hydrogen chloride	Hourly mean	µg/m³	750	1.57	12.54	1.67%	15.99	2.13%	17.55	2.34%	3.44	0.46%

Note:

All assessment is based on the maximum PC using all five years of weather data and operation of all lines at the short-term ELV during worst-case weather conditions for dispersion.

As shown, the change in impact is less than 10% of the short-term AQAL and less than 1% of the annual mean AQAL and can be screened out as 'insignificant' for all pollutants and averaging periods.

The total impact of the Proposed Facility is less than 10% of the short-term AQAL and less than 1% of the annual mean AQAL for all pollutants considered, and can be screened out as 'insignificant', with the exception of the of the following:

- Annual mean nitrogen dioxide;
- Annual mean VOCs as benzene;
- Annual mean cadmium;
- Hourly mean nitrogen dioxide;
- Hourly mean sulphur dioxide; and
- 15-minute mean sulphur dioxide.

Further analysis of these impacts at areas of relevant exposure has been undertaken to define the significance of these impacts.

7.2.1 Further analysis – annual mean nitrogen dioxide

As shown in Table 28, the change in maximum annual mean nitrogen dioxide concentrations is only 0.14% of the AQAL. Therefore, the change in impact can be screened out as insignificant as it is less than 1% of the AQAL.

The PC from the Operational Facility and the Proposed Facility at receptor locations is presented in Table 30, along with the PEC for the Proposed Facility.

Table 30: Annual Mean Nitrogen Dioxide at Receptor Locations

Receptor	Operational Facility PC		Proposed Facility PC		Proposed Facility PEC		Change	
	µg/m³	% AQAL	µg/m³	% AQAL	µg/m³	% AQAL	µg/m³	% AQAL
R1	0.04	0.11%	0.03	0.08%	15.04	37.60%	-0.01	-0.03%
R2	0.06	0.14%	0.04	0.10%	15.05	37.63%	-0.02	-0.04%
R3	0.08	0.21%	0.06	0.15%	15.07	37.68%	-0.02	-0.06%
R4	0.21	0.52%	0.19	0.49%	15.20	38.01%	-0.01	-0.03%
R5	0.40	**1.01%**	0.37	0.93%	15.38	38.46%	-0.03	-0.07%
R6	0.46	**1.16%**	0.47	1.17%	15.48	38.70%	0.01	0.02%
R7	0.54	**1.36%**	0.60	1.49%	15.61	39.02%	0.06	0.14%
R8	0.54	**1.34%**	0.59	1.46%	15.59	38.99%	0.05	0.12%
R9	0.49	**1.22%**	0.50	1.26%	15.51	38.79%	0.02	0.04%
R10	0.11	0.27%	0.10	0.24%	15.11	37.77%	-0.01	-0.02%
R11	0.09	0.23%	0.08	0.20%	15.09	37.72%	-0.01	-0.03%
R12	0.14	0.35%	0.11	0.28%	15.12	37.81%	-0.03	-0.07%
R13	0.17	0.42%	0.16	0.40%	15.17	37.92%	-0.01	-0.02%
R14	0.56	**1.39%**	0.61	1.53%	15.62	39.05%	0.05	0.13%

Figure 9 of Appendix A shows the contour plot of impacts. As shown, the area of impact greater than 1% of the AQAL for the Proposed Facility is larger than the Operational Facility, but due to the change in the dispersion pattern (as a result of the additional flue gas volume), some receptors are predicted to experience a decrease in concentrations.

In addition, there are no sensitive receptors within the 1% contour for the Proposed Facility that are close to busy roads which may result in a locally-elevated PEC. Therefore, the PEC is less than 70% of the AQAL at all areas of relevant exposure where the PC from the Proposed Facility is predicted to exceed 1% of the AQAL, so the absolute impact of the Proposed Facility is 'not significant'.

7.2.2 Further analysis – annual mean benzene

As shown in Table 28, the change in maximum annual mean VOC concentrations (as benzene) is only 0.22% of the AQAL. Therefore, the change in impact can be screened out as insignificant as it is less than 1% of the AQAL.

The PC from the Operational Facility and the Proposed Facility at receptor locations is presented in Table 31, along with the PEC for the Proposed Facility.

Table 31: Annual Mean Benzene at Receptor Locations

Receptor	Operational Facility PC		Proposed Facility PC		Proposed Facility PEC		Change	
	µg/m³	% AQAL	µg/m³	% AQAL	µg/m³	% AQAL	µg/m³	% AQAL
R1	0.003	0.07%	0.003	0.06%	0.48	9.63%	-0.001	-0.01%
R2	0.004	0.09%	0.004	0.07%	0.48	9.65%	-0.001	-0.02%
R3	0.007	0.13%	0.006	0.11%	0.48	9.68%	-0.001	-0.02%
R4	0.016	0.33%	0.018	0.35%	0.50	9.92%	0.001	0.02%
R5	0.032	0.64%	0.034	0.68%	0.51	10.25%	0.002	0.04%
R6	0.037	0.73%	0.042	0.85%	0.52	10.42%	0.006	0.12%
R7	0.043	0.86%	0.054	**1.08%**	0.53	10.65%	0.011	0.22%
R8	0.043	0.85%	0.053	**1.06%**	0.53	10.63%	0.010	0.21%
R9	0.039	0.77%	0.046	0.91%	0.52	10.48%	0.007	0.14%
R10	0.008	0.17%	0.009	0.18%	0.49	9.75%	0.000	0.01%
R11	0.007	0.15%	0.007	0.14%	0.49	9.71%	0.000	0.00%
R12	0.011	0.22%	0.010	0.21%	0.49	9.78%	-0.001	-0.02%
R13	0.013	0.27%	0.014	0.29%	0.49	9.86%	0.001	0.02%
R14	0.044	0.88%	0.055	**1.10%**	0.53	10.67%	0.011	0.22%

The PEC is less than 70% of the AQAL at all areas of relevant exposure where the PC from the Proposed Facility is predicted to exceed 1% of the AQAL, so the absolute impact of the Proposed Facility is 'not significant'. Figure 10 illustrates annual mean impacts of VOCs compared to the AQAL for benzene for the Operational and Proposed Facility.

7.2.3 Further analysis – annual mean cadmium

As shown in Table 28, the change in annual mean cadmium impacts is only 0.44% of the AQAL at the point of maximum impact. Therefore, the change in impact can be screened out as insignificant as it is less than 1% of the AQAL. This conservatively assumes that the Operational Facility and Proposed Facility operate at the combined ELV for cadmium and thallium and the entire emissions consist only of cadmium. Under this assumption, the maximum annual mean impact from the Proposed Facility is 2.21% of the AQAL.

The PC from the Operational Facility and the Proposed Facility at receptor locations is presented in Table 32, along with the PEC for the Proposed Facility.

Table 32: Annual Mean Cadmium at Receptor Locations

Receptor	Operational Facility PC		Proposed Facility PC		Proposed Facility PEC		Change	
	ng/m³	% AQAL	ng/m³	% AQAL	ng/m³	% AQAL	ng/m³	% AQAL
R1	0.007	0.14%	0.006	0.11%	0.48	9.65%	-0.001	-0.02%
R2	0.009	0.18%	0.007	0.15%	0.48	9.69%	-0.002	-0.03%
R3	0.013	0.27%	0.011	0.22%	0.49	9.76%	-0.002	-0.04%
R4	0.033	0.66%	0.035	0.70%	0.51	10.25%	0.002	0.05%
R5	0.064	**1.28%**	0.068	**1.35%**	0.54	10.89%	0.004	0.07%
R6	0.073	**1.47%**	0.085	**1.70%**	0.56	11.24%	0.012	0.23%
R7	0.086	**1.72%**	0.108	**2.16%**	0.59	11.70%	0.022	0.44%
R8	0.085	**1.70%**	0.106	**2.11%**	0.58	11.66%	0.021	0.41%
R9	0.077	**1.55%**	0.091	**1.82%**	0.57	11.36%	0.014	0.27%
R10	0.017	0.34%	0.018	0.35%	0.49	9.89%	0.001	0.01%
R11	0.015	0.29%	0.014	0.29%	0.49	9.83%	0.000	-0.01%
R12	0.022	0.45%	0.021	0.41%	0.50	9.95%	-0.002	-0.04%
R13	0.027	0.54%	0.029	0.58%	0.51	10.12%	0.002	0.04%
R14	0.088	**1.77%**	0.110	**2.20%**	0.59	11.75%	0.022	0.44%

The PEC is less than 70% of the AQAL at all areas of relevant exposure where the PC from the Proposed Facility is predicted to exceed 1% of the AQAL, so the absolute impact of the Proposed Facility is 'not significant'. Figure 11 of Appendix A shows the contour plot of impacts. As shown, the area of impact greater than 1% of the AQAL for the Proposed Facility is slightly larger than the Operational Facility.

7.2.4 Further analysis – short-term impacts

As shown in Table 29 when the Proposed Facility operates at the half-hourly ELV during the worst-case weather conditions for dispersion, the PC at the point of maximum impact is predicted to be 12.62% of the AQAL for the 99.79th percentile of hourly mean nitrogen dioxide, 10.17% of the AQAL for the 99.73rd percentile of hourly mean sulphur dioxide, and 15.20% of the AQAL for the 99.9th percentile of 15-minute mean sulphur dioxide. The change in impact between the Operational Facility and the Proposed Facility is less than 10% of the AQAL for all pollutants and is 'insignificant'.

Figure 12 and Figure 13 of Appendix A show the contour plot of short term impacts for hourly mean nitrogen dioxide and 15-minute mean sulphur dioxide (the area exceeding 10% of the AQAL for hourly mean sulphur dioxide is too small to show accurately on a contour plot). These illustrate the areas where the PC from the Operational Facility and the Proposed Facility cannot be screened out as 'insignificant'.

Consideration has also been given to the headroom for each pollutant for the Operational Facility and the results presented in Table 33.

Table 33: Short-Term PC as % of Headroom

Pollutant	Quantity	Headroom (µg/m³)	Proposed Facility PC	
			µg/m³	% of Headroom
Nitrogen dioxide	99.79th%ile of hourly means	169.98	25.24	14.85%
Sulphur dioxide	99.73rd %ile of hourly means	344.13	35.58	10.34%
	99.9th %ile of 15 min. means	260.13	40.43	15.54%

As shown, the PC from the Proposed Facility is less than 20% of the headroom so the absolute impact of the Proposed Facility is considered to be 'not significant'.

7.2.5 Heavy metals – at the point of maximum impact

The assessment of the impact of heavy metals has been undertaken for the Operational Facility; the Proposed Facility; and also the change in impact as a result of the EP variation.

If concentration is greater than 1% of the long-term AQAL or 10% of the short-term AQAL when it is assumed that each metal is emitted at the total metal ELV, further analysis has been undertaken. The Environment Agency's metals guidance details the maximum monitored concentrations of Group 3 metals emitted by Municipal Waste Incinerators and Waste Wood Co-Incinerators as a percentage of the ELV for Group 3 metals. The maximum monitored emission concentrations for each metal presented in the Environment Agency's analysis have been used as a conservative assumption. Detailed results tables are presented in Appendix E.

As shown, if it is assumed that the entire emissions of metals consist of only one metal, the total concentration from the operation of the Proposed Facility is less than 1% of the long-term AQAL and less than 10% of the short-term AQAL, with the exception of annual mean impacts of arsenic, chromium VI, manganese, and nickel, daily mean copper, daily mean chromium, and hourly mean nickel. If it is assumed that the Facility would perform no worse than the maximum monitored concentration from the Environment Agency's metals guidance, the impact of the Proposed Facility would be below 1% of the long-term AQAL and 10% of the short-term AQAL for all metals with the exception of annual mean arsenic and nickel. The PEC is only predicted to exceed the long term AQAL for chromium VI, which is due to the high assumed background concentration, and the total contribution of emissions from the Facility is well below 1% of the AQAL (0.29%). For annual mean arsenic and nickel and daily mean nickel the PEC is well below the AQAL so can be screened out as 'insignificant'.

The change in impact as a result of the EP variation is much less, being less than 1% of the long-term AQAL and less than 10% of the short-term AQAL, with the exception of annual mean nickel. However, as noted above the PEC is well below the AQAL so can be screened out as 'insignificant'.

This analysis has shown there is no risk of exceeding an AQAL for any metals either on a long-term or short-term basis as a result of emissions from the Proposed Facility.

8 Impact at Ecological Receptors

8.1 Screening

The Air Emissions Guidance states that to screen out impacts as 'insignificant' at European and UK statutory designated sites:

- the long-term PC must be less than 1% of the long-term environmental standard (i.e. the Critical Level or Load); and
- the short-term PC must be less than 10% of the short-term environmental standard.

If the above criteria are met, no further assessment is required. If the long-term PC exceeds 1% of the long-term environmental standard, the PEC must be calculated and compared to the standard. If the resulting PEC is less than 70% of the long-term environmental standard, the Air Emissions Guidance states that the emissions are 'insignificant' and further assessment is not required. In accordance with the guidance, calculation of the PEC for short-term standards is not required.

The Air Emissions Guidance states further that to screen out impacts as 'insignificant' at local nature sites:

- the long-term PC must be less than 100% of the long-term environmental standard; and
- the short-term PC must be less than 100% of the short-term environmental standard.

In accordance with the guidance, calculation of the PEC for local nature sites is not required. However, this has been calculated for completeness.

8.2 Methodology

8.2.1 Atmospheric emissions – Critical Levels

The impact of emissions has been compared to the Critical Levels listed in Table 3. Further assessment would be undertaken where the process contribution of a particular pollutant is greater than 1% of the long term or 10% of the short-term Critical Level for European and UK designated sites, and where the process contribution of a particular pollutant is greater than 100% of the Critical Level for local nature sites.

8.2.2 Deposition of emissions – Critical Loads

In addition to the Critical Levels for the protection of ecosystems, habitat specific Critical Loads for nature conservation sites at risk from acidification and nitrogen deposition (eutrophication) are outlined in APIS. In terms of acid deposition, the APIS Database contains a maximum critical load for sulphur (CLmaxS), a minimum Critical Load for nitrogen (CLminN) and a maximum Critical Load for nitrogen (CLmaxN). These components define the Critical Load function for acid deposition. Where the acid deposition flux falls within the area under the Critical Load function, no exceedances are predicted.

An assessment has been made for the most sensitive habitat features identified in APIS for the specific sites. The site-specific features tool in the APIS app has been used to identify the feature habitats and the habitat specific Critical Load for the specific points assessed within the designated sites. The relevant Critical Loads are presented in Appendix C. The lowest Critical Loads for each designated site have been used to ensure a robust assessment.

8.2.3 Calculation methodology

8.2.3.1 Nitrogen deposition

The impact of deposition has been assessed using the methodology detailed within the Habitats Directive AQTAG 6 (March 2014). The steps to this method are as follows.

1. Determine the annual mean ground level concentrations of nitrogen dioxide and ammonia at each site.
2. Calculate the dry deposition flux (µg/m^2/s) at each site by multiplying the annual mean ground level concentration by the relevant deposition velocity presented in Table 34.
3. Convert the dry deposition flux into units of kgN/ha/yr using the conversion factors presented in Table 34.
4. Compare this result to the nitrogen deposition Critical Load.

Table 34: Deposition Factors

Pollutant	Deposition velocity (m/s)		Conversion factor (µg/m^2/s to kg/ha/year)
	Grassland	Woodland	
Nitrogen dioxide	0.0015	0.003	96.0
Sulphur dioxide	0.0120	0.024	157.7
Ammonia	0.0200	0.030	259.7
Hydrogen chloride	0.0250	0.060	306.7

Source: AQTAG 6 (March 2014)

8.2.3.2 Acidification

Deposition of nitrogen, sulphur, hydrogen chloride and ammonia can cause acidification and should be taken into consideration when assessing the impact of the proposed development.

The steps to determine the acid deposition flux are as follows.

1. Determine the dry deposition rate in kg/ha/yr of nitrogen, sulphur, hydrogen chloride and ammonia using the methodology outlined in section 8.2.3.1.
2. Apply the conversion factor for N outlined in Table 34 to the nitrogen and ammonia deposition rate in kg/ha/year to determine the total keq N/ha/year.
3. Apply the conversion factor for S to the sulphur deposition rate in kg/ha/year to determine the total keq S/ha/year.
4. Apply the conversion factor for HCl to the hydrogen chloride deposition rate in kg/ha/year to determine the dry keq Cl/ha/year.
5. Add the contribution from S to HCl and treat this sum as the total contribution from S.
6. Plot the results against the Critical Load functions.

Table 35: Conversion Factors

Pollutant	Conversion Factor (kg/ha/year to keq/ha/year)
Nitrogen	Divide by 14
Sulphur	Divide by 16
Hydrogen chloride	Divide by 35.5

The March 2014 version of the AQTAG06 document states that, for installations with an HCl emission, the PC of HCl, in addition to S and N, should be considered in the acidity Critical Load assessment. The H+ from HCl should be added to the S contribution (and treated as S in APIS tool). This should include the contribution of HCl from wet deposition.

Consultation with AQMAU confirmed that the maximum of the wet or dry deposition rate for HCl should be included in the calculation. For the purposes of this analysis, it has been assumed that wet deposition of HCl is double dry deposition.

The contribution from the proposed development has been calculated using APIS formula:

Where PEC N Deposition < CLminN:

PC as % of CL function = PC S deposition / CLmaxS

Where PEC N Deposition > CLminN:

PC as % of CL function = (PC S + N deposition) / CLmaxN

8.3 Results

8.3.1 Atmospheric emissions - Critical Levels

The impact of emissions from the operation of the Operational Facility, the Proposed Facility, and the change in impact have been compared to the Critical Levels, refer to Table 36 and Table 37.

The maximum impact at any point in each designated sites has been assessed at the closest point in each site to the Facility. A screening approach has been used to determine the impacts at the local nature sites where the point of maximum impact has been compared to the relevant Critical Levels. The PC has been calculated based on the maximum predicted using all five years of weather data. This assumes operation at the daily ELVs as set out in Table 16. PCs that cannot be screened out in accordance with the screening criteria detailed in section 8.1 have been highlighted.

Table 36: Assessment Against Annual Mean Critical Levels

Site	Annual mean oxides of nitrogen			Annual mean sulphur dioxide[(1)]			Annual mean ammonia[(1)]		
	Operational	Proposed	Change	Operational	Proposed	Change	Operational	Proposed	Change
Process Contribution as µg/m³									
E1 - Fairburn and Newton Ings SSSI	0.26	0.26	-0.01	0.059	0.061	0.001	0.022	0.022	0.000
E2 - Well Wood LNR	0.26	0.26	-0.01	0.059	0.061	0.002	0.022	0.022	0.000
E3 - Orchard Head LWS	0.14	0.14	-0.01	0.033	0.033	0.000	0.012	0.012	0.000
E4 - Fryston Park LWS	0.29	0.29	-0.03	0.069	0.067	-0.002	0.026	0.025	-0.001
E5 - Former Fryston Colliery LWS	0.27	0.27	-0.01	0.063	0.064	0.001	0.024	0.023	0.000
E6 - Bank River Aire LWS	0.32	0.32	-0.03	0.078	0.076	-0.001	0.029	0.028	-0.001
E7 - Byram Park LWS	0.36	0.36	0.00	0.080	0.085	0.005	0.030	0.031	0.001
Process Contribution as % of Critical Level									
E1 - Fairburn and Newton Ings SSSI	0.89%	0.86%	-0.03%	0.59%	0.61%	0.01%	2.23%	2.22%	-0.01%
E2 - Well Wood LNR	0.88%	0.86%	-0.02%	0.59%	0.61%	0.02%	2.21%	2.22%	0.02%
E3 - Orchard Head LWS	0.50%	0.47%	-0.03%	0.33%	0.33%	0.00%	1.25%	1.21%	-0.03%
E4 - Fryston Park LWS	1.04%	0.95%	-0.09%	0.69%	0.67%	-0.02%	2.60%	2.47%	-0.14%
E5 - Former Fryston Colliery LWS	0.95%	0.91%	-0.04%	0.63%	0.64%	0.01%	2.37%	2.34%	-0.02%
E6 - Bank River Aire LWS	1.17%	1.08%	-0.09%	0.78%	0.76%	-0.01%	2.92%	2.80%	-0.12%
E7 - Byram Park LWS	1.20%	1.20%	0.00%	0.80%	0.85%	0.05%	3.01%	3.10%	0.10%

Note:

[(1)] PCs of sulphur dioxide and ammonia have been assessed against the lower Critical Levels of 10 µg/m³ and 1 µg/m³ respectively.

Table 37: Assessment Against Short-Term Critical Levels

Site	Daily mean oxides of nitrogen			Daily mean hydrogen fluoride			Weekly mean hydrogen fluoride		
	Operational	Proposed	Change	Operational	Proposed	Change	Operational	Proposed	Change
Process Contribution as µg/m³									
E1 - Fairburn and Newton Ings SSSI	6.85	6.86	0.004	0.038	0.043	0.005	0.014	0.016	0.002
E2 - Well Wood LNR	5.22	5.63	0.412	0.029	0.036	0.006	0.010	0.012	0.002
E3 - Orchard Head LWS	4.6	4.23	-0.377	0.026	0.027	0.001	0.008	0.009	0.001
E4 - Fryston Park LWS	8.33	8.91	0.584	0.046	0.056	0.009	0.015	0.017	0.002
E5 - Former Fryston Colliery LWS	5.51	6.32	0.809	0.031	0.040	0.008	0.013	0.015	0.002
E6 - Bank River Aire LWS	7.26	7.31	0.055	0.040	0.046	0.006	0.013	0.015	0.002
E7 - Byram Park LWS	4.48	4.72	0.235	0.025	0.030	0.005	0.010	0.011	0.001
Process Contribution as % of Critical Level									
E1 - Fairburn and Newton Ings SSSI	9.14%	9.14%	0.00%	0.76%	0.87%	0.11%	2.76%	3.25%	0.49%
E2 - Well Wood LNR	6.95%	7.50%	0.55%	0.58%	0.71%	0.13%	1.95%	2.33%	0.39%
E3 - Orchard Head LWS	6.14%	5.64%	-0.50%	0.51%	0.53%	0.02%	1.61%	1.85%	0.24%
E4 - Fryston Park LWS	11.10%	11.88%	0.78%	0.93%	1.13%	0.20%	3.04%	3.37%	0.33%
E5 - Former Fryston Colliery LWS	7.34%	8.42%	1.08%	0.61%	0.80%	0.19%	2.53%	2.99%	0.45%
E6 - Bank River Aire LWS	9.68%	9.75%	0.07%	0.81%	0.92%	0.12%	2.57%	3.03%	0.45%
E7 - Byram Park LWS	5.98%	6.29%	0.31%	0.25%	0.60%	0.10%	1.90%	2.17%	0.26%

As shown, the change in impact at the only European or UK site (the Fairburn and Newton Ings SSSI) for all pollutants is less than 1% of the long-term and 10% of the short-term Critical Levels and is screened out as 'insignificant', and the change in impact at all local nature sites is less than 100% of the Critical Levels and is also screened out as 'insignificant'.

The total impact of the Proposed Facility at the Fairburn and Newton Ings SSSI is less than 1% of the long-term and 10% of the short-term Critical Levels and is screened out as 'insignificant', except for annual mean ammonia. However, the EP variation results in a slight reduction in PC at this SSSI, due to the change in dispersion pattern and minimal additional ammonia from L3 (which will have a lower ELV than L1 and L2). As such, this is not considered to be a significant impact. Figure 14 of Appendix A shows the contour plot of impacts.

In addition, the total PC from the Proposed Facility at all local nature sites is less than 100% of the Critical Levels and is screened out as 'insignificant'.

8.3.2 Deposition - Critical Loads

The results of the deposition analysis are presented in Appendix D. This shows that the change in PC as a result of the EP variation is less than 1% of the Critical Loads for all habitats identified at the only European or UK site (the Fairburn and Newton Ings SSSI), and less than 100% of the Critical Loads for the assessment at Local Nature Sites. Therefore, the change in PC can be screened out as 'insignificant'.

The PC from the Proposed Facility exceeds 1% of the lowest applicable Critical Loads for nitrogen and acid deposition at the Fairburn and Newton Ings SSSI. However, the EP variation results in a slight reduction in nitrogen deposition PC at this SSSI, for the same reasons as detailed in section 8.3, and an imperceptible change in acid deposition PC. As such, this is not considered to be a significant impact. Figure 15 of Appendix A shows the contour plot of impacts.

In addition, the total PC from the Proposed Facility at all local nature sites is less than 100% of the Critical Loads and is screened out as 'insignificant'.

9 Conclusions

This Dispersion Modelling Assessment has been undertaken to support an application for a variation to the EP for the Facility. As the Facility is already operational a comparison has been made to the impact of the Operational Facility. To ensure that a direct comparison is being made between the Proposed Facility and Operational Facility dispersion modelling has been carried out for both. In addition, the contribution of the existing F2 to baseline concentrations has been modelled.

This assessment has included a review of baseline pollution levels, dispersion modelling of emissions and quantification of the impact of these emissions on local air quality.

The primary conclusions of the assessment are presented below.

1. In relation to the impact on human health:
    a. Emissions from the operation of the Proposed Facility will not cause a breach of any AQAL.
    b. For all pollutants the change in impact as a result of the EP variation can be screened out as 'insignificant'.
    c. For all pollutants the overall impact of the Proposed Facility can either be screened out as 'insignificant' or is 'not significant' when the total concentration is taken into consideration.
2. In relation to the impact on ecologically sensitive sites:
    a. At the only European and UK designated ecological receptor (the Fairburn and Newton Ings SSSI) the change in impact can be screened out as 'insignificant' as it is less than 1% of the long term Critical Levels and Critical Loads and less than 10% of the short term Critical Levels.
    b. The total impact of the Proposed Facility cannot be screened out as 'insignificant' at the Fairburn and Newton Ings SSSI. However, as the EP variation is predicted to result in a reduction in nitrogen deposition impacts and an imperceptible change in acid deposition impacts at this site, it is considered that there would be no significant effects on the integrity of the SSSI.
    c. The change in impact and the overall impact of the Proposed Facility at all local natures sites are both less than 100% of the Critical Levels and Loads and can be screened out as 'insignificant'.

In summary, the assessment has shown that the change in air quality impact associated with the proposed EP variation is insignificant. Emissions would not have a significant impact on local air quality, the general population or the local community. As such there should be no air quality constraint in granting a variation to the existing EP as proposed.

Appendices

A Figures

Legend

Site location

Client:	enfinium
Site:	Ferrybridge 1
Project:	Line 3 Air Quality Assessment
Title:	

Figure 1. Site Location

Drawn by: SMN	Date:

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0 0.3 0.6 1.2 km

N

Scale: 1:30,000

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Legend

- Stack
- Human sensitive receptors
- AQMAs

Client:	enfinium
Site:	Ferrybridge 1
Project:	Line 3 Air Quality Assessment

Title:

Figure 2. Human Sensitive Receptors

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0 0.25 0.5 1 km

Scale: 1:25,000

N

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Fax: 0161 474 0618

Legend

- Stack
- Ecological sensitive receptors
- Fairburn and Newton Ings SSSI

Client:	enfinium
Site:	Ferrybridge 1
Project:	Line 3 Air Quality Assessment
Title:	Figure 3. Ecological Sensitive Receptors
Drawn by: SMN	Date:

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0 0.2 0.4 0.8 km

N

Scale: 1:20,000

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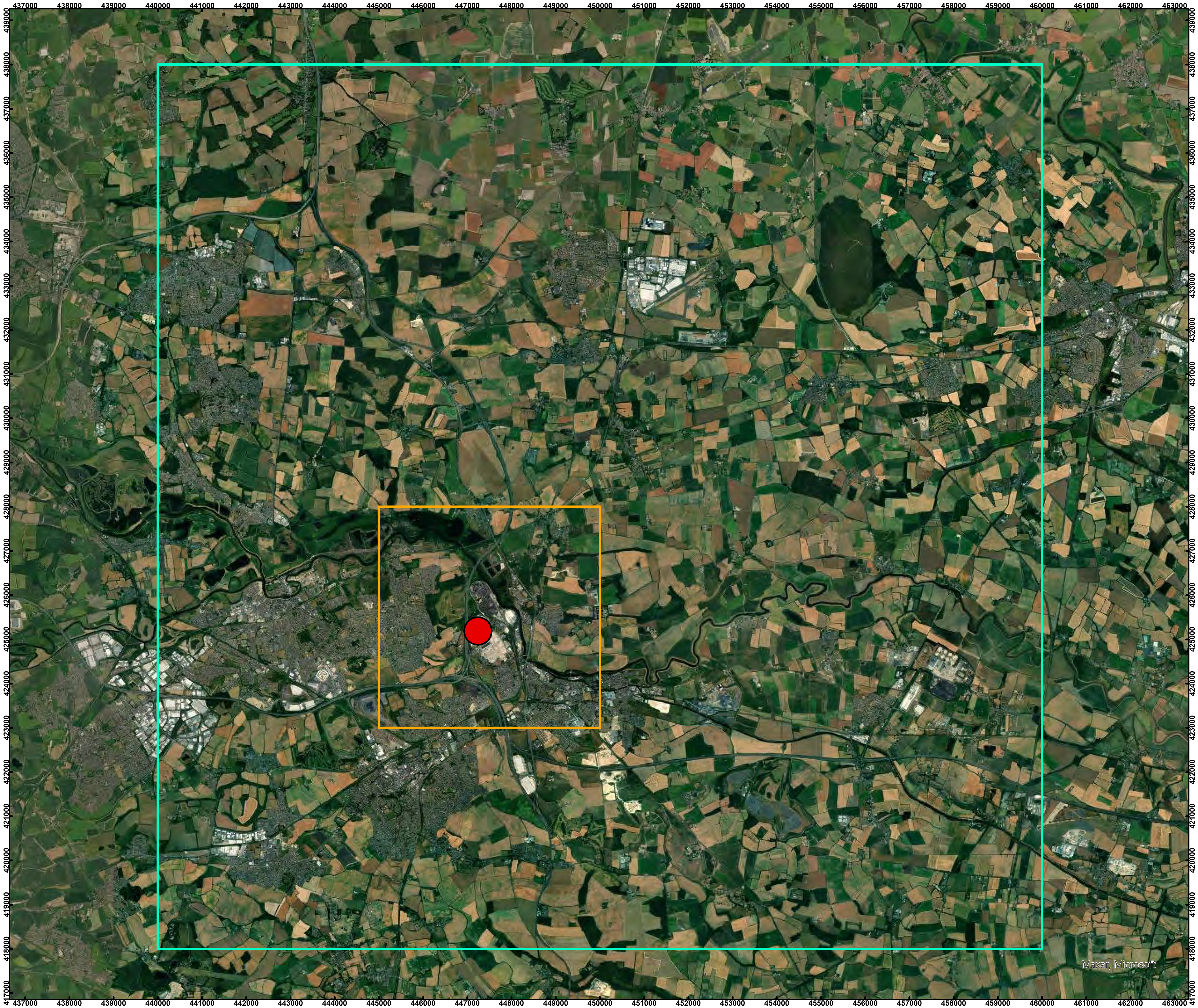

Legend

- Site location
- Wide grid extent
- Fine grid extent

Client:	enfinium
Site:	Ferrybridge 1
Project:	Line 3 Air Quality Assessment
Title:	Figure 4. Modelling Domain
Drawn by: SMN	Date:

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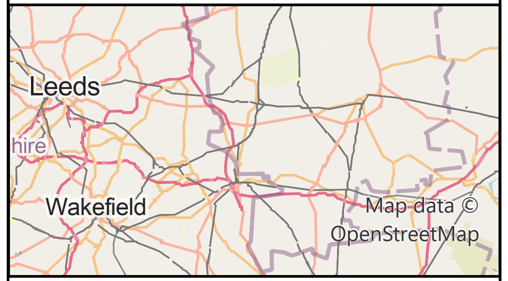

0 0.75 1.5 3 km

N

Scale: 1:80,000

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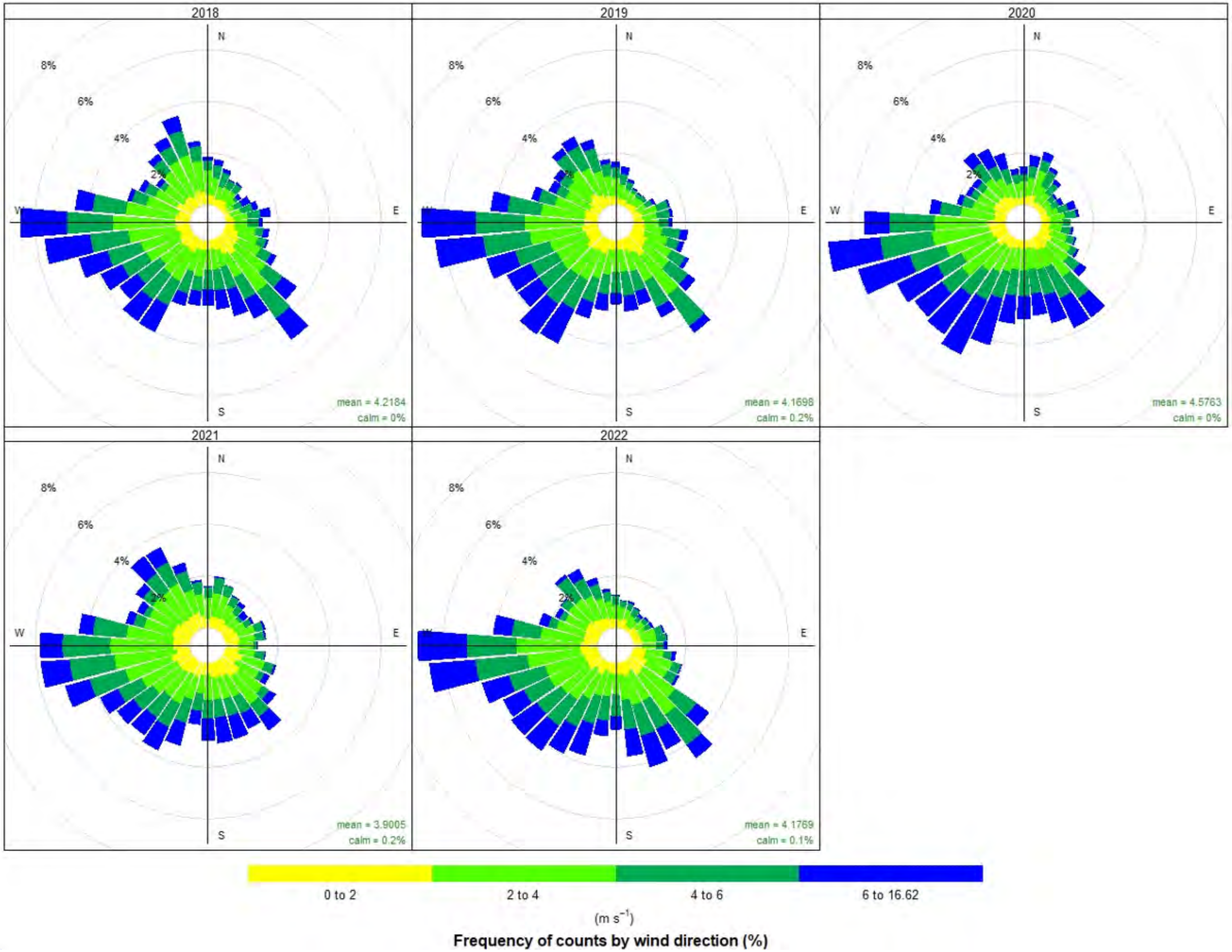

Client:	enfinium
Site:	Ferrybridge 1
Project:	Line 3 Air Quality Assessment

Title:

Figure 5. Wind Roses - Bramham 2018 - 2022

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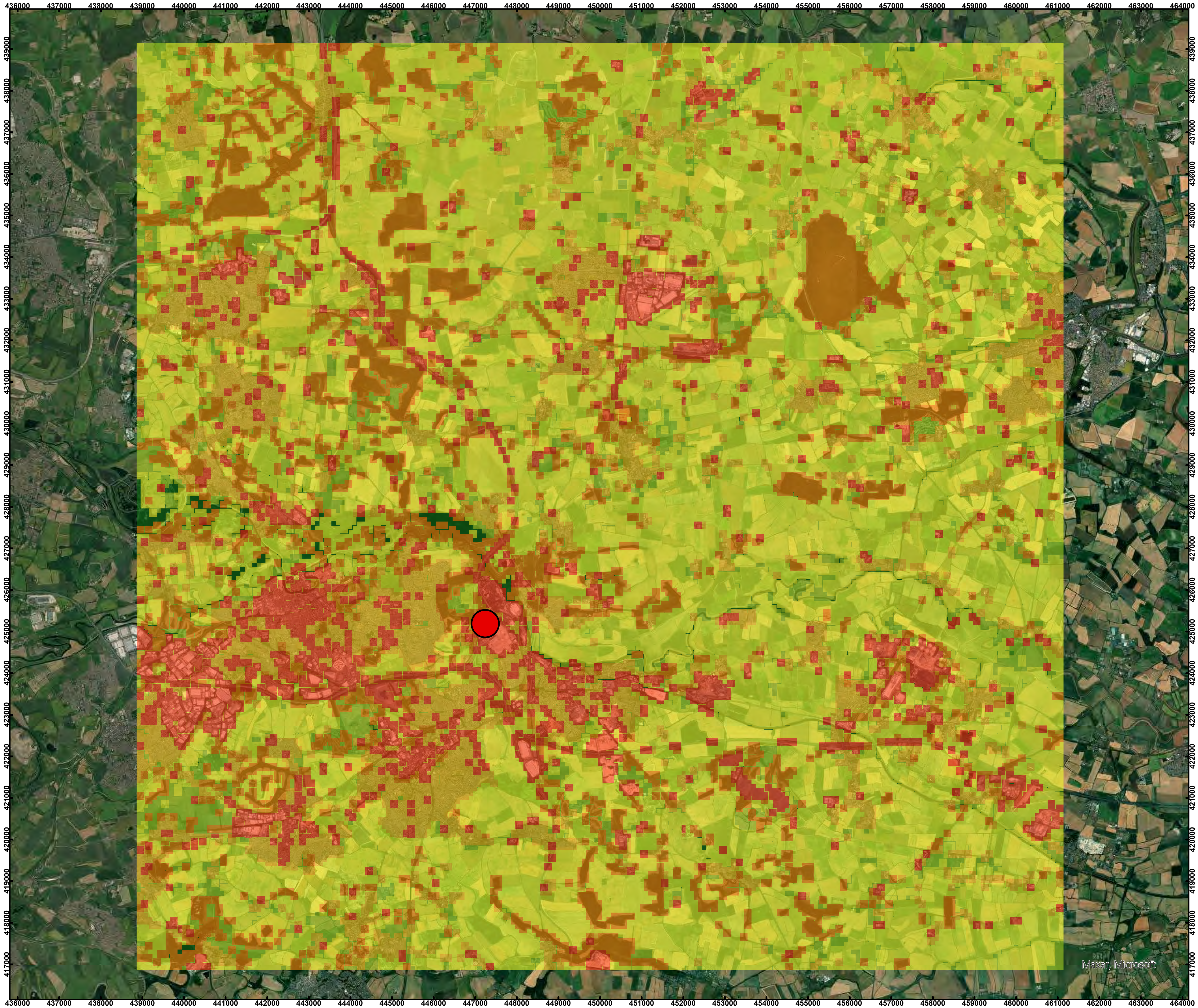

Legend

Site location

Roughness length (m)

- 0.0001
- 0.0005
- 0.03
- 0.05
- 0.5
- 0.75
- 1.2

Client:	enfinium
Site:	Ferrybridge 1
Project:	Line 3 Air Quality Assessment
Title:	Figure 6. Surface Roughness File
Drawn by: SMN	Date:

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0 0.75 1.5 3 km

N

Scale: 1:85,000

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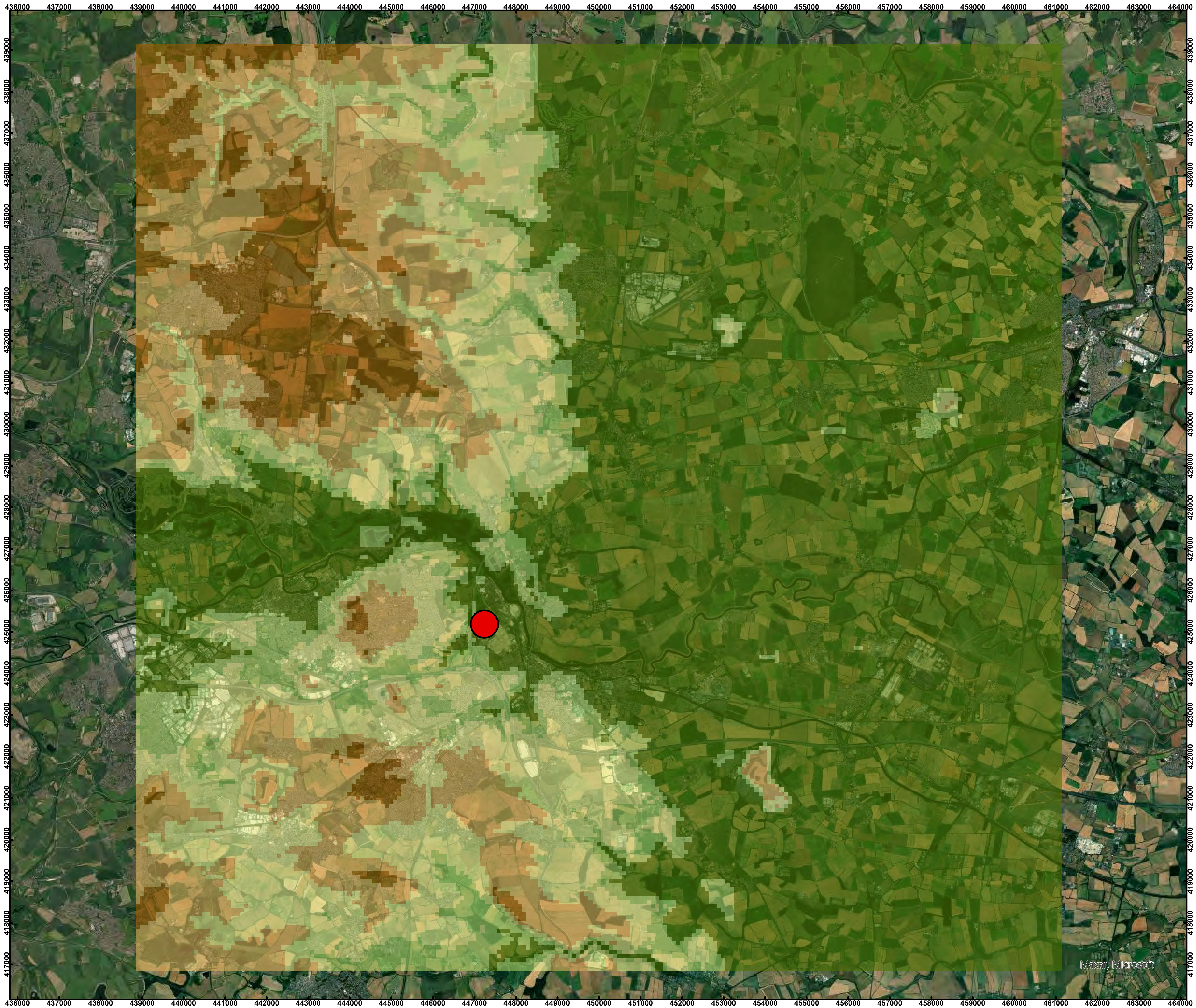

Legend

Site location

Elevation (m)

- <20
- 20 - 30
- 30 - 50
- 50 - 70
- >70

Client:	enfinium
Site:	Ferrybridge 1
Project:	Line 3 Air Quality Assessment
Title:	

Figure 7. Terrain File

Drawn by: SMN	Date:

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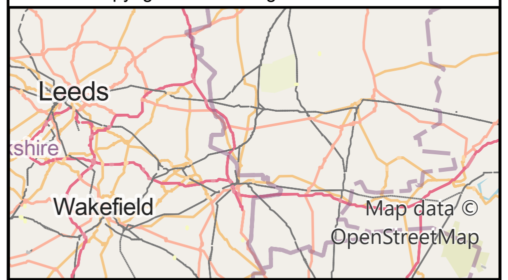

0 0.75 1.5 3 km

N

Scale: 1:85,000

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Legend

- L1 & L2 stack
- L3 stack
- Buildings modelled - Operational Facility
- Buildings modelled - Proposed Facility

Notes:
The modelled buildings and stacks align with the features at ground level. Due to the angle of the aerial mapping the top of the buildings and stacks appear misaligned with the modelled features.

Client:	enfinium
Site:	Ferrybridge 1
Project:	Line 3 Air Quality Assessment
Title:	Figure 8. Buildings and Sources Modelled
Drawn by: SMN	Date:

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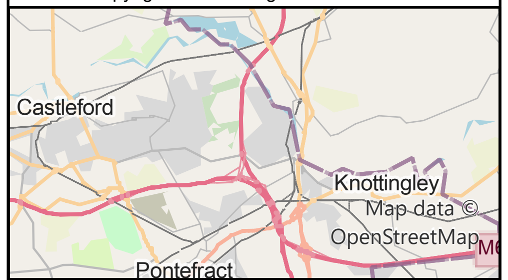

0 0.01 0.03 0.05 km

Scale: 1:1,441

N

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Legend

Stack

Human sensitive receptors

AQMAs

Annual mean nitrogen dioxide as % of AQAL - Operational Facility

Annual mean nitrogen dioxide as % of AQAL - Proposed Facility

Annual mean nitrogen dioxide as % of AQAL - Change

Note:
Assumes 70% NOx to NO2 conversion rate

Client:	enfinium
Site:	Ferrybridge 1
Project:	Line 3 Air Quality Assessment
Title:	

Figure 9. Annual Mean Nitrogen Dioxide

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0 0.4 0.8 1.6 km

Scale: 1:40,000

N

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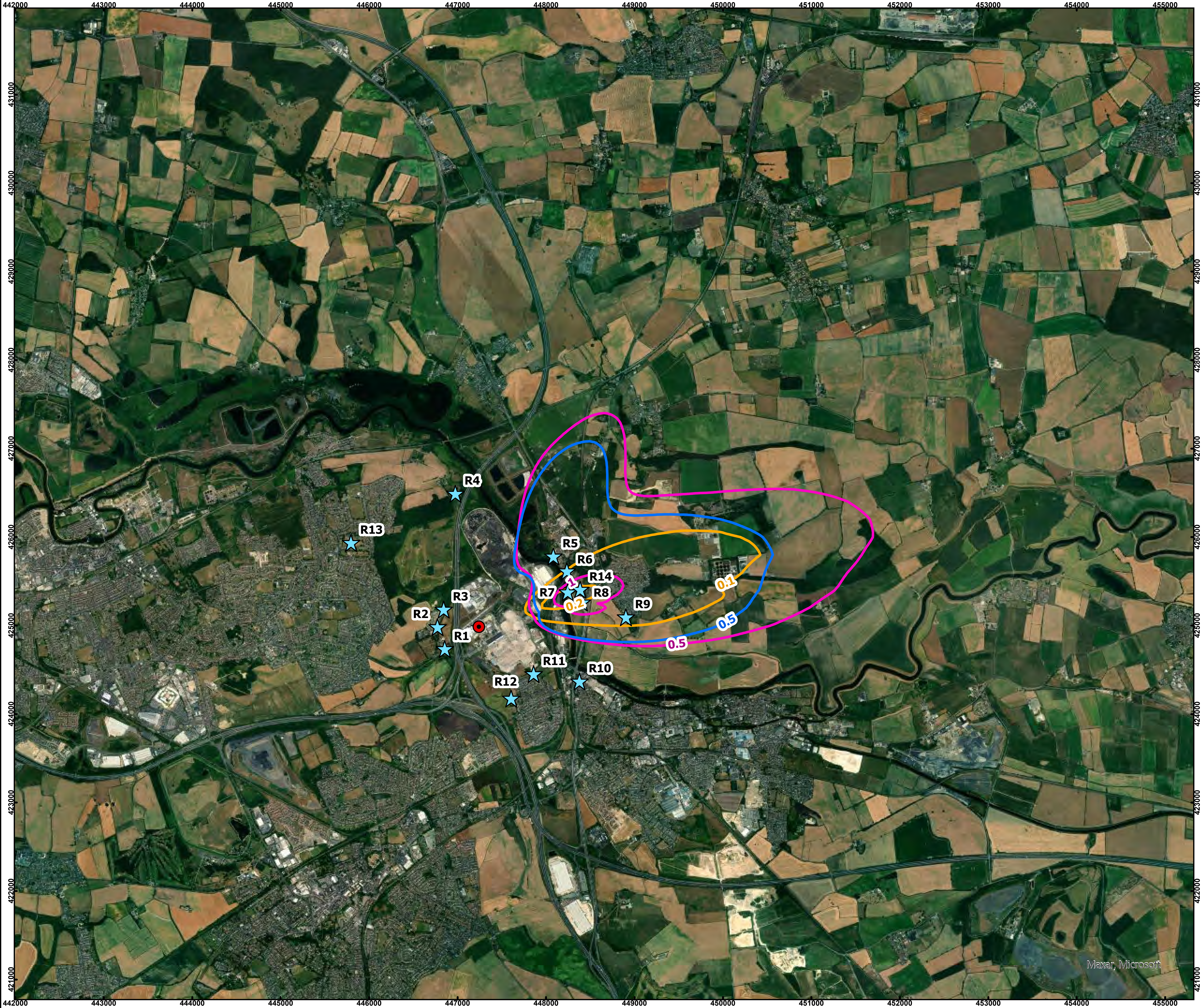

Legend

Stack

Human sensitive receptors

Annual mean benzene as % of AQAL - Operational Facility

Annual mean benzene as % of AQAL - Proposed Facility

Annual mean benzene as % of AQAL - Change

Note:
Assumes all VOCs emitted as benzene

Client:	enfinium
Site:	Ferrybridge 1
Project:	Line 3 Air Quality Assessment
Title:	

Figure 10. Annual Mean VOCs as Benzene

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0 0.4 0.8 1.6 km

N

Scale: 1:40,000

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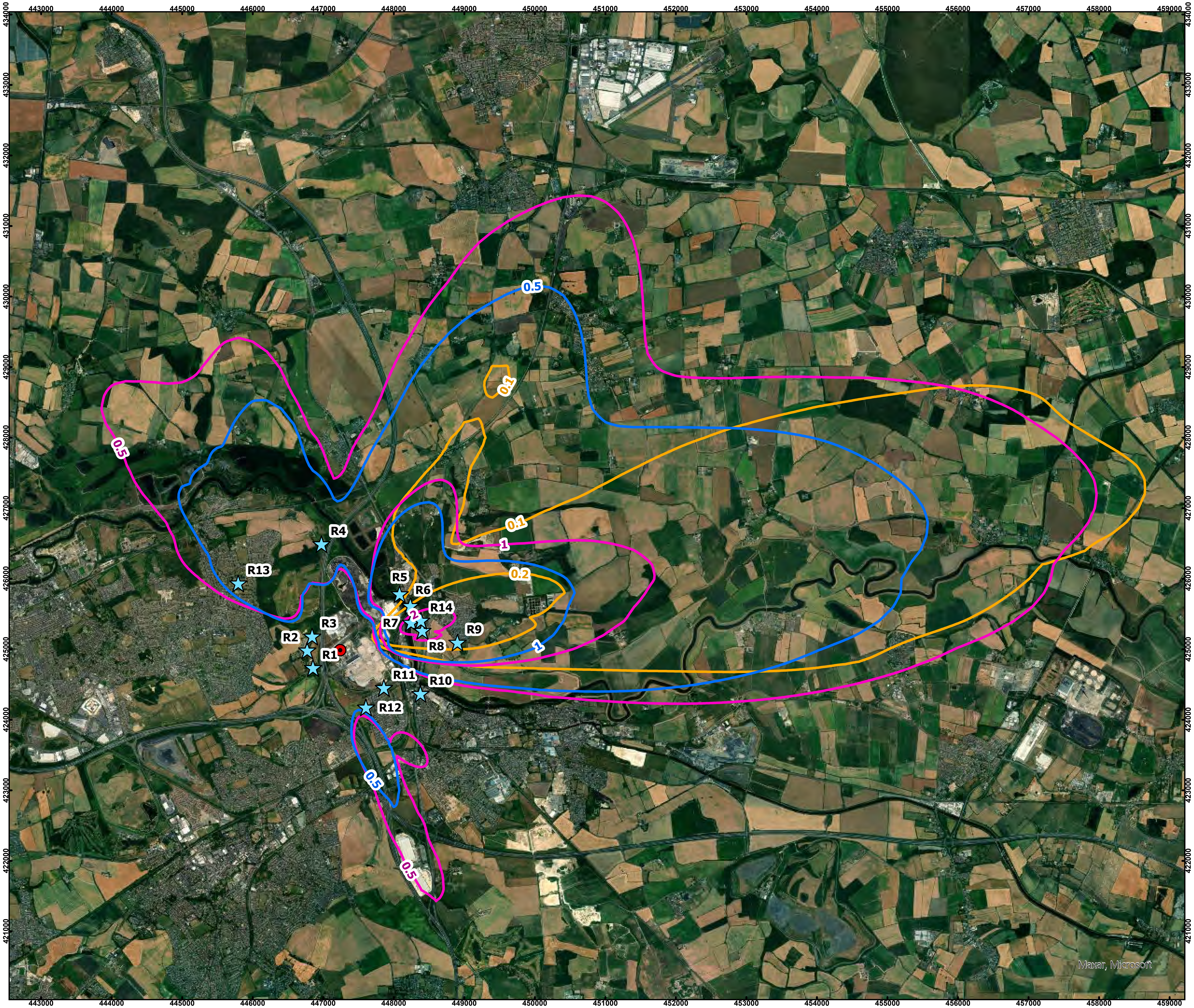

Legend

- Stack
- Human sensitive receptors
- Annual mean cadmium as % of AQAL - Operational Facility
- Annual mean cadmium as % of AQAL - Proposed Facility
- Annual mean cadmium as % of AQAL - Change

Note:
Assumes cadmium emitted at the combined cadmium and thallium emission limit

Client:	enfinium
Site:	Ferrybridge 1
Project:	Line 3 Air Quality Assessment
Title:	

Figure 11. Annual Mean Cadmium

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0 0.5 1 2 km

Scale: 1:50,000

N

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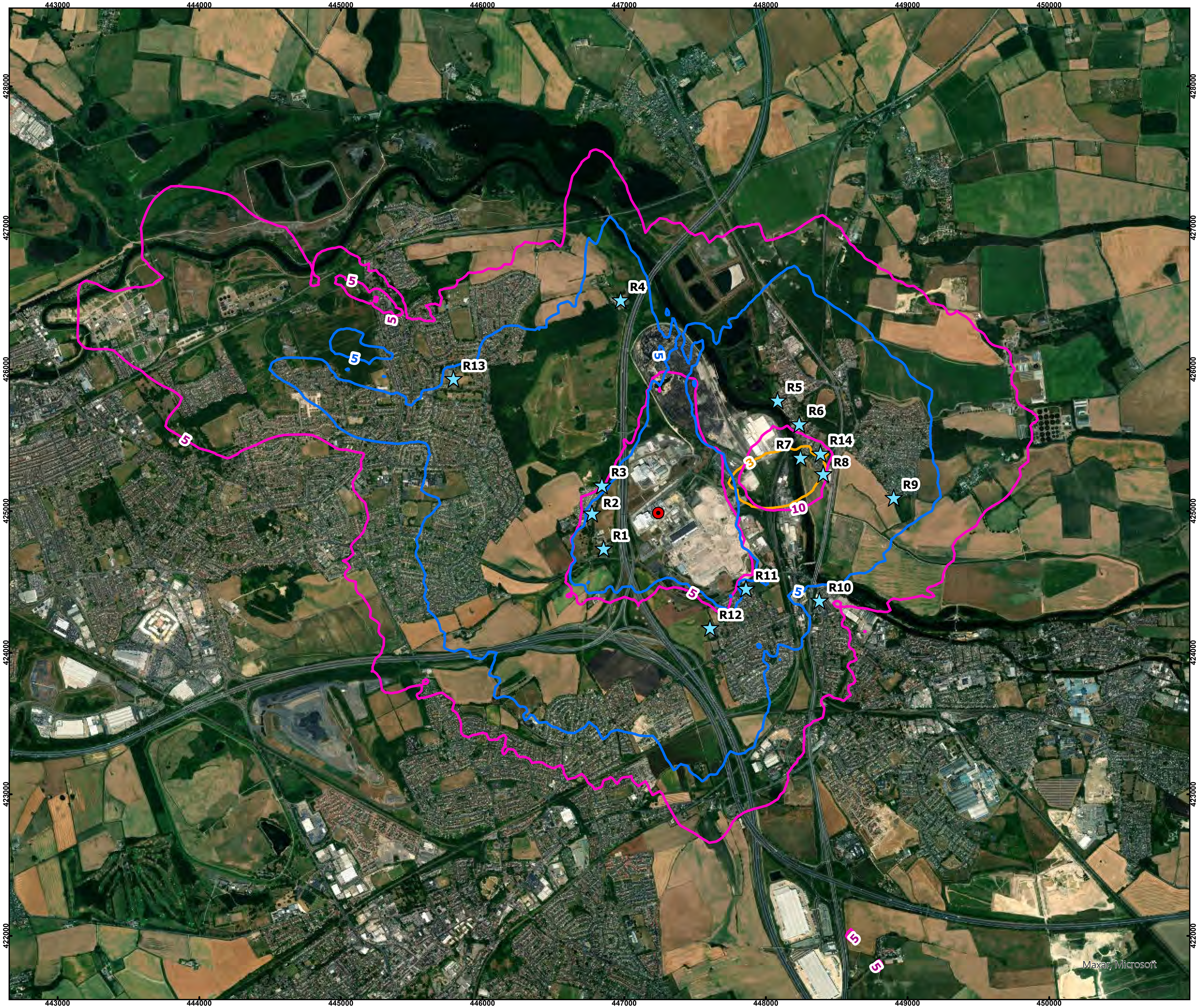

Legend

- Stack
- Human sensitive receptors
- 99.79th percentile of hourly mean nitrogen dioxide as % of AQAL - Operational Facility
- 99.79th percentile of hourly mean nitrogen dioxide as % of AQAL - Proposed Facility
- 99.79th percentile of hourly mean nitrogen dioxide as % of AQAL - Change

Note:
Assumes 35% NOx to NO2 conversion rate

Client:	enfinium
Site:	Ferrybridge 1
Project:	Line 3 Air Quality Assessment
Title:	

Figure 12. Hourly Mean Nitrogen Dioxide

Drawn by: SMN	Date:

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Scale: 1:25,000

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Legend

Stack

Human sensitive receptors

99.9th percentile of 15-minute mean sulphur dioxide as % of AQAL - Operational Facility

99.9th percentile of 15-minute mean sulphur dioxide as % of AQAL - Proposed Facility

99.9th percentile of 15-minute mean sulphur dioxide as % of AQAL - Change

Client:	enfinium
Site:	Ferrybridge 1
Project:	Line 3 Air Quality Assessment
Title:	

Figure 13. 15-Minute Mean Sulphur Dioxide

Drawn by: SMN	Date:

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0 0.15 0.3 0.6 km

N

Scale: 1:15,000

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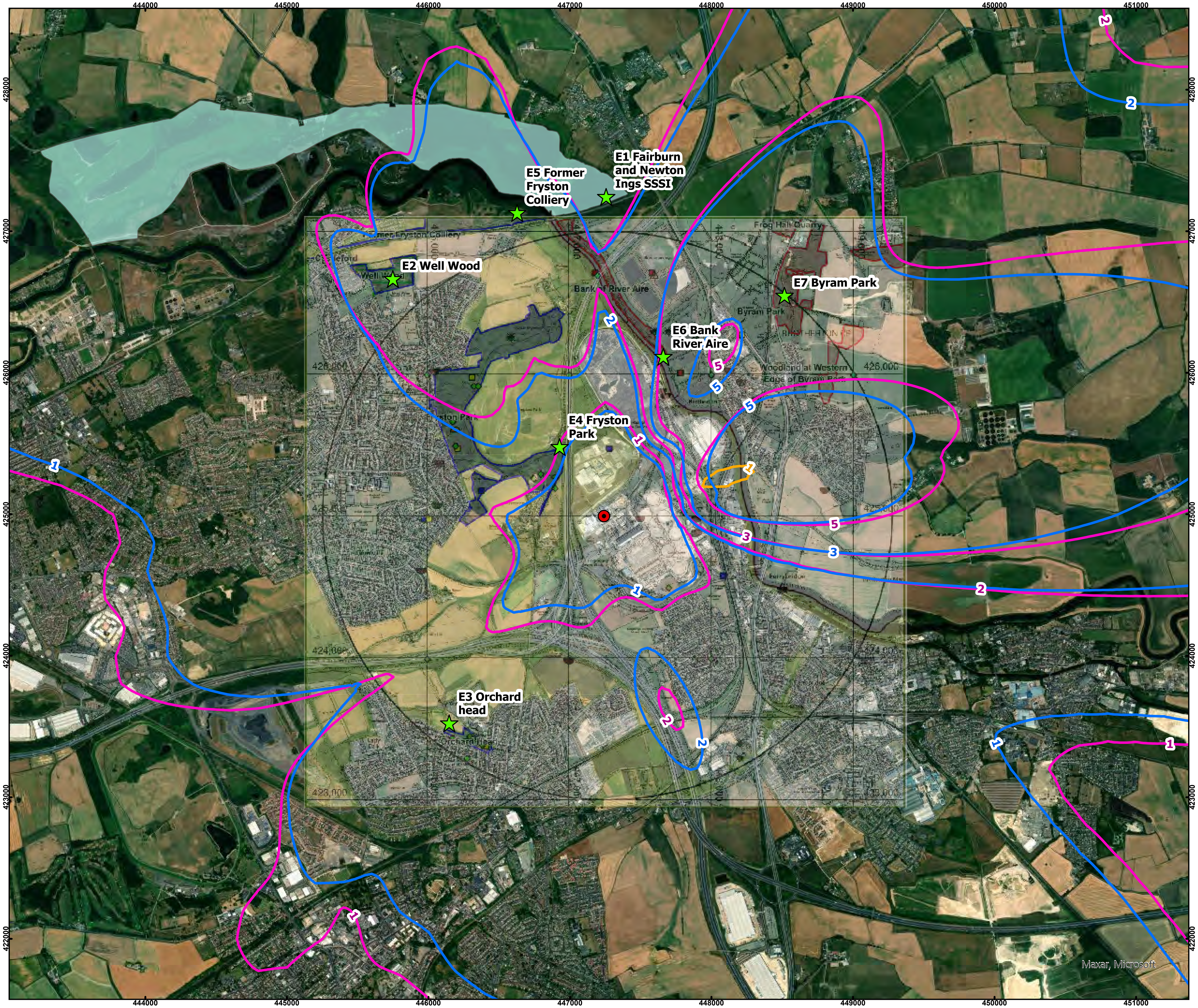
Kingsgate, Wellington Road North,
Stockport, Cheshire, SK4 1LW
Tel: 0161 476 0032
Fax: 0161 474 0618



Legend

- Stack
- Fairburn and Newton Ings SSSI
- Ecological sensitive receptors
- Annual mean ammonia as % of Critical Level - Operational Facility
- Annual mean ammonia as % of Critical Level - Proposed Facility
- Annual mean ammonia as % of Critical Level - Change

Client:	enfinium
Site:	Ferrybridge 1
Project:	Line 3 Air Quality Assessment
Title:	

Figure 14. Annual Mean Ammonia

Drawn by: SMN	Date:

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0 0.25 0.5 1 km

N

Scale: 1:25,000

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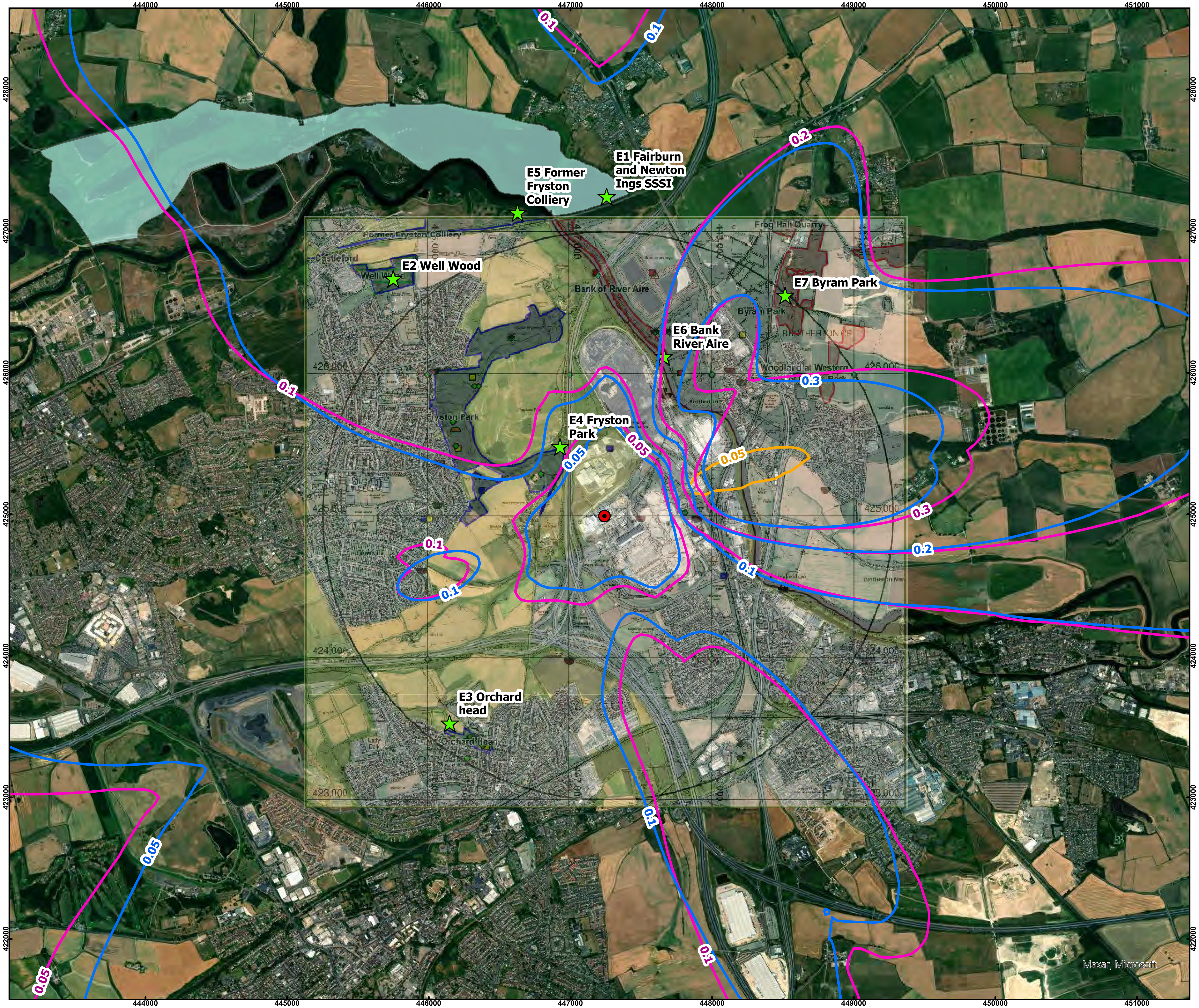
Tel: 0161 476 0032
Fax: 0161 474 0618



Legend

Stack

Fairburn and Newton Ings SSSI

Ecological sensitive receptors

Nitrogen deposition as kgN/ha/yr - Operational Facility

Nitrogen deposition as kgN/ha/yr - Proposed Facility

Nitrogen deposition as kgN/ha/yr - Change

Client:	enfinium
Site:	Ferrybridge 1
Project:	Line 3 Air Quality Assessment
Title:	

Figure 15. Nitrogen Deposition

Drawn by: SMN	Date:

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0 0.25 0.5 1 km

Scale: 1:25,000

N

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B Ferrybridge 2 Model Inputs

The source and emissions input data utilised within the modelling F2 are presented in Table 39 to Table 40. These are based on operational data obtained from the CEMS. These inputs have been used to determine the existing contribution from F2 to baseline pollutant concentrations.

Table 38: Stack Data – F2

Item	Unit	Value
Height	m	119
Number of lines	-	2
Effective internal diameter (both lines combined)	m	3.11
Stack location	m, m	447250, 425345
Notes: *(1) Stack location is the centre point of the two flues.*		

Table 39: Flue Gas Conditions – F2

Item	Unit	Both lines combined
Temperature	°C	140
Exit moisture content	% v/v	18.9%
Exit oxygen content	% v/v dry	6.3%
Reference oxygen content	% v/v dry	11.00%
Volume at reference conditions (273.15K, dry, ref O_2)	Nm^3/h	619,123
	Nm^3/s	172.0
Volume at actual conditions	Am^3/h	783,626
	Am^3/s	217.7
Flue gas exit velocity	m/s	28.65

Table 40: Stack Emissions Data –F2, Both Lines Combined

Pollutant	Daily or periodic		Half-hourly	
	ELV (mg/Nm^3, unless stated)	Release rate (g/s, unless stated)	ELV (mg/Nm^3, unless stated)	Release rate (g/s, unless stated)
Oxides of nitrogen (as NO_2)	180	30.96	400	54.91
Sulphur dioxide	40	6.879	200	27.46
Carbon monoxide	50	8.599	150(1)	20.59
Total dust (PM)(2)	5	0.860	30	4.119
Hydrogen chloride	8	1.376	60	8.237
Volatile organic compounds (as TOC)	10	1.720	20	2.746
Hydrogen fluoride	1	0.172	-	-

Ammonia	15	2.580	-	-
Cadmium and thallium	0.02	3.440 mg/s	-	-
Mercury	0.02	3.440 mg/s	-	-
Other metals[(3)]	0.3	51.59 mg/s	-	-
Benzo(a)pyrene (PAHs)[(4)]	0.2 µg/Nm³	34.40 µg/s	-	-
Dioxins and furans[(5)]	0.06 ng/Nm³	10.32 ng/s	-	-
PCBs[(6)]	5 µg/Nm³	0.860 mg/s	-	-

Notes:

All emissions are expressed at reference conditions of dry gas, 11% oxygen, 273.15K.

[(1)] Averaging period for carbon monoxide is 95% of all 10-minute averages in any 24-hour period.

[(2)] As a worst-case it has been assumed that the entire dust emissions consist of either PM_{10} or $PM_{2.5}$ for comparison with the relevant AQALs.

[(3)] Other metals consist of antimony (Sb), arsenic (As), lead (Pb), chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni) and vanadium (V).

[(4)] 0.2 µg/m³ is the maximum recorded at a UK plant (2019 Waste Incineration BREF, Figure 8.121). This is assumed to be the emission concentration from F2.

[(5)] The EPs include a limit of 0.06 ng I-TEQ/Nm³ as an average over a minimum of 6 hours, and a limit of 0.08 ng I-TEQ/Nm³ as a long-term average over a minimum of 2 weeks. The long-term average sampling is only required if it cannot be demonstrated that emissions are low and stable. It has been assumed that the long-term average monitoring will not be required and an emission limit of 0.06 ng I-TEQ/Nm³ is representative of the maximum annual mean emission concentration from F2.

[(6)] Table 3.8 of the 2006 Waste Incineration BREF states that the annual average total PCBs is less than 0.005 mg/Nm³ (dry, 11% oxygen, 273K). In lieu of other available operational data, this has been assumed to be the emission concentration from F2.

Table 41: Building Details – F2

Buildings	Centre Point		Height (m)	Length (m)	Width (m)	Angle (°)
	X (m)	Y (m)				
F2 Boiler[(1)]	447155	425285	53	50	50	328
F2 Bunker	447115	425260	42	87	45	328
F2 FGT	447220	425325	34	40	35	328

Note:

[(1)] Selected as the main building

C APIS Critical Loads

Table 42: Nitrogen Deposition Critical Loads

ID	Site	Species/Habitat Type	NCL Class	Lower Critical Load (kgN/ha/yr)	Upper Critical Load (kgN/ha/yr)	Maximum Background (kgN/ha/yr)
European and UK Statutory Designated Sites						
E1	Fairburn and Newton Ings SSSI	Agrostis stolonifera - Alopecurus geniculatus Grassland	Low and medium altitude hay meadows	10	20	14.1
		Juncus Effusus / Acutiflorus - Galium Palustre Rush Pasture	Moist or wet mesotrophic to eutrophic hay meadow and rich fens	15	25	14.1
		Salix Cinerea - Galium Palustre Woodland	Broadleaved deciduous woodland	10	15	26.6
Local nature sites						
E2	Well Wood	Grassland	Calcareous grassland	10	20	13.7
		Woodland	Broadleaved deciduous woodland	10	15	25.8
E3	Orchard Head	Grassland	Calcareous grassland	10	20	13.8
		Woodland	Broadleaved deciduous woodland	10	15	26.0
E4	Fryston Park	Grassland	Calcareous grassland	10	20	13.8
		Woodland	Broadleaved deciduous woodland	10	15	26.1
E5	Former Fryston Colliery	Agrostis stolonifera - Alopecurus geniculatus Grassland	Low and medium altitude hay meadows	10	20	13.9
		Juncus Effusus / Acutiflorus - Galium Palustre Rush Pasture	Moist or wet mesotrophic to eutrophic hay meadow and rich fens	15	25	13.9
		Salix Cinerea - Galium Palustre Woodland	Broadleaved deciduous woodland	10	15	26.2
E6	Bank River Aire	Woodland	Broadleaved deciduous woodland	10	15	26.5
E7	Byram Park	Woodland	Broadleaved deciduous woodland	10	15	26.5

Table 43: Acid Deposition Critical Loads

ID	Site	Species/Habitat Type	Acidity Class	Critical Load Function (keq/ha/yr)			Maximum Background (keq/ha/yr)	
				CLminN	CLmaxN	CLmaxS	N	S
European and UK Statutory Designated Sites								
E1	Fairburn and Newton Ings SSSI	Agrostis stolonifera - Alopecurus geniculatus Grassland	Calcareous grassland	0.856	4.856	4.000	1.00	0.17
		Juncus Effusus / Acutiflorus - Galium Palustre Rush Pasture	Calcareous grassland	0.856	4.856	4.000	1.00	0.17
		Salix Cinerea - Galium Palustre Woodland	Unmanaged Broadleafed/ Coniferous Woodland	0.142	1.659	1.517	1.90	0.22
Local nature sites								
E2	Well Wood	Grassland	Calcareous grassland	0.856	4.856	4.000	1.00	0.18
		Woodland	Unmanaged Broadleafed/ Coniferous Woodland	0.142	10.851	10.709	1.80	0.23
E3	Orchard Head	Grassland	Calcareous grassland	0.856	4.856	4.000	1.00	0.16
		Woodland	Unmanaged Broadleafed/ Coniferous Woodland	0.142	10.897	10.755	1.90	0.21
E4	Fryston Park	Grassland	Calcareous grassland	0.856	4.856	4.000	1.00	0.17
		Woodland	Unmanaged Broadleafed/ Coniferous Woodland	0.142	10.867	10.725	1.90	0.22
E5	Former Fryston Colliery	Agrostis stolonifera - Alopecurus geniculatus Grassland	Calcareous grassland	0.856	4.856	4.000	1.00	0.18
		Juncus Effusus / Acutiflorus - Galium Palustre Rush Pasture	Calcareous grassland	0.856	4.856	4.000	1.00	0.18

ID	Site	Species/Habitat Type	Acidity Class	Critical Load Function (keq/ha/yr)			Maximum Background (keq/ha/yr)	
				CLminN	CLmaxN	CLmaxS	N	S
		Salix Cinerea - Galium Palustre Woodland	Unmanaged Broadleafed/ Coniferous Woodland	0.142	1.659	1.517	1.90	0.23
E6	Bank River Aire	Woodland	Unmanaged Broadleafed/ Coniferous Woodland	0.357	2.883	2.526	1.90	0.21
E7	Byram Park	Woodland	Unmanaged Broadleafed/ Coniferous Woodland	0.142	10.863	10.721	1.90	0.21

D Deposition Analysis at Ecological Sites

Table 44: Annual Mean PC for Deposition Analysis – Operational Facility

ID	Site	Annual mean PC (ng/m³)			
		Nitrogen dioxide	Sulphur dioxide	Hydrogen chloride	Ammonia
E1	Fairburn and Newton Ings SSSI	187.2	59.4	11.9	22.3
E2	Well Wood	185.4	58.9	11.8	22.1
E3	Orchard Head	104.6	33.2	6.6	12.5
E4	Fryston Park	218.6	69.4	13.9	26.0
E5	Former Fryston Colliery	198.8	63.1	12.6	23.7
E6	Bank River Aire	244.9	77.7	15.5	29.2
E7	Byram Park	252.5	80.2	16.0	30.1

Table 45: Annual Mean PC for Deposition Analysis – Proposed Facility

ID	Site	Annual mean PC (ng/m³)			
		Nitrogen dioxide	Sulphur dioxide	Hydrogen chloride	Ammonia
E1	Fairburn and Newton Ings SSSI	179.9	60.6	12.1	22.2
E2	Well Wood	180.6	60.8	12.2	22.2
E3	Orchard Head	98.6	33.2	6.6	12.1
E4	Fryston Park	200.2	67.4	13.5	24.7
E5	Former Fryston Colliery	190.2	64.0	12.8	23.4
E6	Bank River Aire	227.0	76.4	15.3	28.0
E7	Byram Park	251.9	84.8	17.0	31.0

Table 46: Deposition Calculation – Operational Facility

ID	Site	Deposition (kg/ha/yr)				Total N Deposition (kgN/ha/yr)	Acid Deposition (keq/ha/yr)	
		Nitrogen dioxide	Sulphur dioxide	Hydrogen chloride	Ammonia		N	S
Grassland deposition velocity								
E1	Fairburn and Newton Ings SSSI	0.027	0.112	0.182	0.116	0.143	0.010	0.012
E2	Well Wood	0.027	0.111	0.181	0.115	0.141	0.010	0.012
E3	Orchard Head	0.015	0.063	0.102	0.065	0.080	0.006	0.007
E4	Fryston Park	0.031	0.131	0.213	0.135	0.167	0.012	0.014
E5	Former Fryston Colliery	0.029	0.119	0.194	0.123	0.152	0.011	0.013
E6	Bank River Aire	0.035	0.147	0.238	0.151	0.187	0.013	0.016
E7	Byram Park	0.036	0.152	0.246	0.156	0.193	0.014	0.016
Woodland deposition velocity								
E1	Fairburn and Newton Ings SSSI	0.054	0.225	0.437	0.174	0.228	0.016	0.026
E2	Well Wood	0.053	0.223	0.433	0.172	0.225	0.016	0.026
E3	Orchard Head	0.030	0.126	0.244	0.097	0.127	0.009	0.015
E4	Fryston Park	0.063	0.263	0.511	0.203	0.266	0.019	0.031
E5	Former Fryston Colliery	0.057	0.239	0.464	0.184	0.242	0.017	0.028
E6	Bank River Aire	0.071	0.294	0.572	0.227	0.298	0.021	0.035
E7	Byram Park	0.073	0.303	0.590	0.234	0.307	0.022	0.036

Table 47: Deposition Calculation – Proposed Facility

ID	Site	Deposition (kg/ha/yr)				Total N Deposition (kgN/ha/yr)	Acid Deposition (keq/ha/yr)	
		Nitrogen dioxide	Sulphur dioxide	Hydrogen chloride	Ammonia		N	S
Grassland deposition velocity								
E1	Fairburn and Newton Ings SSSI	0.026	0.115	0.186	0.115	0.141	0.010	0.012
E2	Well Wood	0.026	0.115	0.186	0.116	0.142	0.010	0.012
E3	Orchard Head	0.014	0.063	0.102	0.063	0.077	0.006	0.007
E4	Fryston Park	0.029	0.128	0.207	0.128	0.157	0.011	0.014
E5	Former Fryston Colliery	0.027	0.121	0.196	0.122	0.149	0.011	0.013
E6	Bank River Aire	0.033	0.145	0.234	0.145	0.178	0.013	0.016
E7	Byram Park	0.036	0.160	0.260	0.161	0.197	0.014	0.017
Woodland deposition velocity								
E1	Fairburn and Newton Ings SSSI	0.052	0.229	0.446	0.173	0.224	0.016	0.027
E2	Well Wood	0.052	0.230	0.447	0.173	0.225	0.016	0.027
E3	Orchard Head	0.028	0.126	0.244	0.095	0.123	0.009	0.015
E4	Fryston Park	0.058	0.255	0.496	0.192	0.250	0.018	0.030
E5	Former Fryston Colliery	0.055	0.242	0.471	0.182	0.237	0.017	0.028
E6	Bank River Aire	0.065	0.289	0.562	0.218	0.283	0.020	0.034
E7	Byram Park	0.073	0.321	0.624	0.242	0.314	0.022	0.038

Table 48: Detailed Results – Nitrogen Deposition – Operational Facility

ID	Site	NCL Class	Deposition Velocity	PC			PEC		
				PC N dep kgN/ha/yr	% of Lower CL	% of Upper CL	PEC N dep kgN/ha/yr	% of Lower CL	% of Upper CL
European and UK Statutory Designated Sites									
E1	Fairburn and Newton Ings SSSI	Low and medium altitude hay meadows	Grassland	0.14	**1.43%**	0.71%	14.24	**142.4%**	71.2%
		Moist or wet mesotrophic to eutrophic hay meadow and rich fens	Grassland	0.14	0.95%	0.57%	14.24	95.0%	57.0%
		Broadleaved deciduous woodland	Woodland	0.23	**2.28%**	**1.52%**	26.83	**268.3%**	**178.9%**
Local nature sites									
E2	Well Wood	Calcareous grassland	Grassland	0.14	1.41%	0.71%	13.84	138.4%	69.2%
		Broadleaved deciduous woodland	Woodland	0.23	2.25%	1.50%	26.03	260.3%	173.5%
E3	Orchard Head	Calcareous grassland	Grassland	0.08	0.80%	0.40%	13.88	138.8%	69.4%
		Broadleaved deciduous woodland	Woodland	0.13	1.27%	0.85%	26.13	261.3%	174.2%
E4	Fryston Park	Calcareous grassland	Grassland	0.17	1.67%	0.83%	13.97	139.7%	69.8%
		Broadleaved deciduous woodland	Woodland	0.27	2.66%	1.77%	26.37	263.7%	175.8%
E5	Former Fryston Colliery	Low and medium altitude hay meadows	Grassland	0.15	1.52%	0.76%	14.05	140.5%	70.3%
		Moist or wet mesotrophic to eutrophic hay meadow and rich fens	Grassland	0.15	1.01%	0.61%	14.05	93.7%	56.2%
		Broadleaved deciduous woodland	Woodland	0.24	2.42%	1.61%	26.44	264.4%	176.3%
E6	Bank River Aire	Broadleaved deciduous woodland	Woodland	0.30	2.98%	1.98%	26.80	268.0%	178.7%
E7	Byram Park	Broadleaved deciduous woodland	Woodland	0.31	3.07%	2.05%	26.81	268.1%	178.7%

Table 49: Detailed Results – Nitrogen Deposition – Proposed Facility

ID	Site	NCL Class	Deposition Velocity	PC			PEC		
				PC N dep kgN/ha/yr	% of Lower CL	% of Upper CL	PEC N dep kgN/ha/yr	% of Lower CL	% of Upper CL
European and UK Statutory Designated Sites									
E1	Fairburn and Newton Ings SSSI	Low and medium altitude hay meadows	Grassland	0.14	**1.41%**	0.70%	14.24	**142.4%**	71.2%
		Moist or wet mesotrophic to eutrophic hay meadow and rich fens	Grassland	0.14	0.94%	0.56%	14.24	94.9%	57.0%
		Broadleaved deciduous woodland	Woodland	0.22	**2.24%**	**1.50%**	26.82	**268.2%**	**178.8%**
Local nature sites									
E2	Well Wood	Calcareous grassland	Grassland	0.14	1.42%	0.71%	13.84	138.4%	69.2%
		Broadleaved deciduous woodland	Woodland	0.23	2.25%	1.50%	26.03	260.3%	173.5%
E3	Orchard Head	Calcareous grassland	Grassland	0.08	0.77%	0.39%	13.88	138.8%	69.4%
		Broadleaved deciduous woodland	Woodland	0.12	1.23%	0.82%	26.12	261.2%	174.2%
E4	Fryston Park	Calcareous grassland	Grassland	0.16	1.57%	0.78%	13.96	139.6%	69.8%
		Broadleaved deciduous woodland	Woodland	0.25	2.50%	1.66%	26.35	263.5%	175.7%
E5	Former Fryston Colliery	Low and medium altitude hay meadows	Grassland	0.15	1.49%	0.75%	14.05	140.5%	70.2%
		Moist or wet mesotrophic to eutrophic hay meadow and rich fens	Grassland	0.15	0.99%	0.60%	14.05	93.7%	56.2%
		Broadleaved deciduous woodland	Woodland	0.24	2.37%	1.58%	26.44	264.4%	176.2%
E6	Bank River Aire	Broadleaved deciduous woodland	Woodland	0.28	2.83%	1.89%	26.78	267.8%	178.6%
E7	Byram Park	Broadleaved deciduous woodland	Woodland	0.31	3.14%	2.09%	26.81	268.1%	178.8%

Table 50: Detailed Results – Nitrogen Deposition – Change in Impact

ID	Site	NCL Class	Deposition Velocity	PC			PEC		
				PC N dep kgN/ha/yr	% of Lower CL	% of Upper CL	PEC N dep kgN/ha/yr	% of Lower CL	% of Upper CL
European and UK Statutory Designated Sites									
E1	Fairburn and Newton Ings SSSI	Low and medium altitude hay meadows	Grassland	-0.002	-0.02%	-0.01%	14.24	**142.4%**	71.2%
		Moist or wet mesotrophic to eutrophic hay meadow and rich fens	Grassland	-0.002	-0.01%	-0.01%	14.24	94.9%	57.0%
		Broadleaved deciduous woodland	Woodland	-0.003	-0.03%	-0.02%	26.82	**268.2%**	178.8%
Local nature sites									
E2	Well Wood	Calcareous grassland	Grassland	0.000	0.00%	0.00%	13.84	**138.4%**	**69.2%**
		Broadleaved deciduous woodland	Woodland	0.000	0.00%	0.00%	26.03	**260.3%**	**173.5%**
E3	Orchard Head	Calcareous grassland	Grassland	-0.003	-0.03%	-0.01%	13.88	**138.8%**	**69.4%**
		Broadleaved deciduous woodland	Woodland	-0.004	-0.04%	-0.03%	26.12	**261.2%**	**174.2%**
E4	Fryston Park	Calcareous grassland	Grassland	-0.010	-0.10%	-0.05%	13.96	**139.6%**	**69.8%**
		Broadleaved deciduous woodland	Woodland	-0.016	-0.16%	-0.11%	26.35	**263.5%**	**175.7%**
E5	Former Fryston Colliery	Low and medium altitude hay meadows	Grassland	-0.002	-0.02%	-0.01%	14.05	**140.5%**	**70.2%**
		Moist or wet mesotrophic to eutrophic hay meadow and rich fens	Grassland	-0.002	-0.02%	-0.01%	14.05	**93.7%**	**56.2%**
		Broadleaved deciduous woodland	Woodland	-0.004	-0.04%	-0.03%	26.44	**264.4%**	**176.2%**
E6	Bank River Aire	Broadleaved deciduous woodland	Woodland	-0.015	-0.15%	-0.10%	26.78	**267.8%**	**178.6%**
E7	Byram Park	Broadleaved deciduous woodland	Woodland	0.007	0.07%	0.05%	26.81	**268.1%**	**178.8%**

Table 51: Detailed Results – Acid Deposition – Operational Facility

ID	Site	Acidity Class	Deposition Velocity	PC			PEC		
				N keq/ha/yr	S keq/ha/yr	% of CL	N keq/ha/yr	S keq/ha/yr	% of CL
European and UK Statutory Designated Sites									
E1	Fairburn and Newton Ings SSSI	Calcareous grassland (using base cation)	Grassland	0.010	0.012	0.46%	1.01	0.18	24.6%
		Unmanaged Broadleafed/Coniferous Woodland	Woodland	0.016	0.026	**2.57%**	1.92	0.25	**130.4%**
Local nature sites									
E2	Well Wood	Calcareous grassland (using base cation)	Grassland	0.010	0.012	0.46%	1.01	0.19	24.8%
		Unmanaged Broadleafed/Coniferous Woodland	Woodland	0.016	0.026	0.39%	1.82	0.26	19.1%
E3	Orchard Head	Calcareous grassland (using base cation)	Grassland	0.006	0.007	0.26%	1.01	0.17	24.1%
		Unmanaged Broadleafed/Coniferous Woodland	Woodland	0.009	0.015	0.22%	1.91	0.22	19.6%
E4	Fryston Park	Calcareous grassland (using base cation)	Grassland	0.012	0.014	0.54%	1.01	0.18	24.6%
		Unmanaged Broadleafed/Coniferous Woodland	Woodland	0.019	0.031	0.46%	1.92	0.25	20.0%
E5	Former Fryston Colliery	Calcareous grassland (using base cation)	Grassland	0.011	0.013	0.49%	1.01	0.19	24.8%
		Unmanaged Broadleafed/Coniferous Woodland	Woodland	0.017	0.028	2.73%	1.92	0.26	131.1%
E6	Bank River Aire	Unmanaged Broadleafed/Coniferous Woodland	Woodland	0.021	0.035	1.93%	1.92	0.24	75.1%
E7	Byram Park	Unmanaged Broadleafed/Coniferous Woodland	Woodland	0.022	0.036	0.53%	1.92	0.25	20.0%

Table 52: Detailed Results – Acid Deposition – Proposed Facility

ID	Site	Acidity Class	Depo-sition Velocity	PC			PEC		
				N keq/ha/yr	S keq/ha/yr	% of CL	N keq/ha/yr	S keq/ha/yr	% of CL
European and UK Statutory Designated Sites									
E1	Fairburn and Newton Ings SSSI	Calcareous grassland (using base cation)	Grassland	0.010	0.012	0.46%	1.01	0.18	24.6%
		Unmanaged Broadleafed/Coniferous Woodland	Woodland	0.016	0.027	**2.59%**	1.92	0.25	**130.4%**
Local nature sites									
E2	Well Wood	Calcareous grassland (using base cation)	Grassland	0.010	0.012	0.46%	1.01	0.19	24.8%
		Unmanaged Broadleafed/Coniferous Woodland	Woodland	0.016	0.027	0.40%	1.82	0.26	19.1%
E3	Orchard Head	Calcareous grassland (using base cation)	Grassland	0.006	0.007	0.25%	1.01	0.17	24.1%
		Unmanaged Broadleafed/Coniferous Woodland	Woodland	0.009	0.015	0.22%	1.91	0.22	19.6%
E4	Fryston Park	Calcareous grassland (using base cation)	Grassland	0.011	0.014	0.51%	1.01	0.18	24.6%
		Unmanaged Broadleafed/Coniferous Woodland	Woodland	0.018	0.030	0.44%	1.92	0.25	19.9%
E5	Former Fryston Colliery	Calcareous grassland (using base cation)	Grassland	0.011	0.013	0.49%	1.01	0.19	24.8%
		Unmanaged Broadleafed/Coniferous Woodland	Woodland	0.017	0.028	2.73%	1.92	0.26	131.1%
E6	Bank River Aire	Unmanaged Broadleafed/Coniferous Woodland	Woodland	0.020	0.034	1.88%	1.92	0.24	75.1%
E7	Byram Park	Unmanaged Broadleafed/Coniferous Woodland	Woodland	0.022	0.038	0.55%	1.92	0.25	20.0%

Table 53: Detailed Results – Acid Deposition – Change in Impact

ID	Site	Acidity Class	Deposition Velocity	PC			PEC		
				N keq/ha/yr	S keq/ha/yr	% of CL	N keq/ha/yr	S keq/ha/yr	% of CL
European and UK Statutory Designated Sites									
E1	Fairburn and Newton Ings SSSI	Calcareous grassland (using base cation)	Grassland	-0.0001	0.0002	0.00%	1.01	0.18	24.6%
		Unmanaged Broadleafed/Coniferous Woodland	Woodland	-0.0002	0.0005	0.02%	1.92	0.25	**130.4%**
Local nature sites									
E2	Well Wood	Calcareous grassland (using base cation)	Grassland	0.0000	0.0004	0.01%	1.01	0.19	24.8%
		Unmanaged Broadleafed/Coniferous Woodland	Woodland	0.0000	0.0009	0.01%	1.82	0.26	19.1%
E3	Orchard Head	Calcareous grassland (using base cation)	Grassland	-0.0002	0.0000	0.00%	1.01	0.17	24.1%
		Unmanaged Broadleafed/Coniferous Woodland	Woodland	-0.0003	0.0000	0.00%	1.91	0.22	19.6%
E4	Fryston Park	Calcareous grassland (using base cation)	Grassland	-0.0007	-0.0004	-0.02%	1.01	0.18	24.6%
		Unmanaged Broadleafed/Coniferous Woodland	Woodland	-0.0011	-0.0009	-0.02%	1.92	0.25	19.9%
E5	Former Fryston Colliery	Calcareous grassland (using base cation)	Grassland	-0.0002	0.0002	0.00%	1.01	0.19	24.8%
		Unmanaged Broadleafed/Coniferous Woodland	Woodland	-0.0003	0.0004	0.01%	1.92	0.26	131.1%
E6	Bank River Aire	Unmanaged Broadleafed/Coniferous Woodland	Woodland	-0.0010	-0.0006	-0.06%	1.92	0.24	75.1%
E7	Byram Park	Unmanaged Broadleafed/Coniferous Woodland	Woodland	0.0005	0.0020	0.02%	1.92	0.25	20.0%

E Detailed Results Tables

Table 54: Dispersion Modelling Results – PC at Point of Maximum Impact - Daily ELVs – Operational Facility

Pollutant	Quantity	Units	AQAL	Bg Conc.	2018	2019	2020	2021	2022	Max	Max as % of AQAL	PEC	PEC as % of AQAL
Nitrogen dioxide	Annual mean	µg/m³	40	0.46	0.46	0.54	0.56	0.36	0.51	0.56	**1.40%**	15.57	38.92%
	99.79th %ile of hourly means	µg/m³	200	7.00	7.00	7.03	7.32	7.29	7.08	7.32	3.66%	37.34	18.67%
Sulphur dioxide	99.18th %ile of daily means	µg/m³	125	1.92	1.92	1.75	2.24	1.59	1.75	2.24	1.79%	8.10	6.48%
	99.73rd %ile of hourly means	µg/m³	350	4.39	4.39	4.41	4.58	4.24	4.43	4.58	1.31%	10.45	2.98%
	99.9th %ile of 15 min. means	µg/m³	266	5.24	5.24	5.19	5.19	5.55	5.13	5.55	2.09%	11.42	4.29%
Particulates (PM_{10})	Annual mean	µg/m³	40	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.06%	17.15	42.87%
	90.41st %ile of daily means	µg/m³	50	0.07	0.07	0.09	0.09	0.06	0.09	0.09	0.18%	34.34	68.68%
Particulates ($PM_{2.5}$)	Annual mean	µg/m³	10	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.22%	7.87	78.66%
Carbon monoxide	8 hour running mean	µg/m³	10,000	5.05	5.05	5.83	5.29	5.25	4.87	5.83	0.06%	466.11	4.66%
	Hourly mean	µg/m³	30,000	10.45	10.45	9.66	7.96	10.38	8.38	10.45	0.03%	470.74	1.57%
Hydrogen chloride	Hourly mean	µg/m³	750	1.67	1.67	1.55	1.27	1.66	1.34	1.67	0.22%	3.24	0.43%
Hydrogen fluoride	Annual mean	µg/m³	16	0.00	0.00	0.00	0.00	0.00	0.00	0.004	0.03%	2.36	14.73%
	Hourly mean	µg/m³	160	0.21	0.21	0.19	0.16	0.21	0.17	0.21	0.13%	4.91	3.07%
Ammonia	Annual mean	µg/m³	180	0.05	0.05	0.06	0.07	0.04	0.06	0.07	0.04%	2.01	1.12%
	Hourly mean	µg/m³	2,500	3.14	3.14	2.90	2.39	3.11	2.51	3.14	0.13%	7.02	0.28%

Pollutant	Quantity	Units	AQAL	Bg Conc.	2018	2019	2020	2021	2022	Max	Max as % of AQAL	PEC	PEC as % of AQAL
VOCs (as benzene)	Annual mean	µg/m³	5	0.04	0.04	0.04	0.04	0.03	0.04	0.04	0.89%	0.52	10.46%
	Daily mean	µg/m³	30	0.76	0.76	0.56	0.79	0.47	0.57	0.79	2.65%	1.75	5.84%
Mercury	Daily mean	ng/m³	60	1.53	1.53	1.12	1.59	0.95	1.14	1.59	2.65%	7.30	12.17%
	Hourly mean	ng/m³	600	4.18	4.18	3.86	3.19	4.15	3.35	4.18	0.70%	9.89	1.65%
Cadmium	Annual mean	ng/m³	5	0.07	0.07	0.09	0.09	0.06	0.08	0.09	**1.77%**	0.57	11.32%
	Daily mean	ng/m³	30	1.53	1.53	1.12	1.59	0.95	1.14	1.59	5.30%	2.54	8.48%
PaHs	Annual mean	pg/m³	250	0.72	0.72	0.86	0.89	0.56	0.81	0.89	0.35%	191.46	76.58%
Dioxins and Furans	Annual mean	fg/m³	-	0.22	0.22	0.26	0.27	0.17	0.24	0.27	-	33.43	-
PCBs	Annual mean	ng/m³	200	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.01%	0.17	0.08%
	Hourly mean	ng/m³	6,000	1.05	1.05	0.97	0.80	1.04	0.84	1.05	0.02%	1.33	0.02%

Table 55: Dispersion Modelling Results – PC at Point of Maximum Impact - Short-Term ELVs – Operational Facility

Pollutant	Quantity	Units	AQAL	Bg Conc.	2018	2019	2020	2021	2022	Max	Max as % of AQAL	PEC	PEC as % of AQAL
Nitrogen dioxide	99.79th %ile of hourly means	µg/m³	200	30.02	15.55	15.62	16.27	16.19	15.73	16.27	8.13%	46.29	23.14%
Sulphur dioxide	99.73rd %ile of hourly means	µg/m³	350	5.87	21.94	22.06	22.89	21.20	22.16	22.89	6.54%	28.76	8.22%
	99.9th %ile of 15 min. means	µg/m³	266	5.87	26.22	25.96	25.96	27.76	25.63	27.76	**10.44%**	33.63	12.64%
Carbon monoxide	8 hour running mean	µg/m³	10,000	460.3	15.15	17.49	15.86	15.76	14.62	17.49	0.17%	477.77	4.78%
	Hourly mean	µg/m³	30,000	460.3	31.36	28.99	23.89	31.13	25.13	31.36	0.10%	491.64	1.64%
Hydrogen chloride	Hourly mean	µg/m³	750	1.57	12.54	11.59	9.56	12.45	10.05	12.54	1.67%	14.11	1.88%
Note: Assumes operation of both lines at the short term ELVs during the worst-case weather conditions for dispersion.													

Table 56: Dispersion Modelling Results – PC at Point of Maximum Impact - Daily ELVs – Proposed Facility

Pollutant	Quantity	Units	AQAL	Bg Conc.	2018	2019	2020	2021	2022	Max	Max as % of AQAL	PEC	PEC as % of AQAL
Nitrogen dioxide	Annual mean	µg/m³	40	15.01	0.49	0.57	0.61	0.37	0.54	0.61	**1.53%**	15.62	39.06%
	99.79th %ile of hourly means	µg/m³	200	30.02	9.49	9.34	9.98	8.31	9.61	9.98	4.99%	40.00	20.00%
Sulphur dioxide	99.18th %ile of daily means	µg/m³	125	5.87	2.74	2.24	3.05	1.70	2.40	3.05	2.44%	8.92	7.13%
	99.73rd %ile of hourly means	µg/m³	350	5.87	6.22	6.10	6.63	5.35	6.40	6.63	1.89%	12.50	3.57%
	99.9th %ile of 15 min. means	µg/m³	266	5.87	7.19	6.97	7.53	6.69	7.31	7.53	2.83%	13.40	5.04%
Particulates (PM_{10})	Annual mean	µg/m³	40	17.12	0.02	0.03	0.03	0.02	0.02	0.03	0.07%	17.15	42.88%
	90.41st %ile of daily means	µg/m³	50	34.25	0.08	0.10	0.11	0.06	0.10	0.11	0.22%	34.36	68.71%
Particulates ($PM_{2.5}$)	Annual mean	µg/m³	10	7.84	0.02	0.03	0.03	0.02	0.02	0.03	0.28%	7.87	78.72%
Carbon monoxide	8 hour running mean	µg/m³	10,000	460.29	7.57	7.55	8.14	7.57	7.83	8.14	0.08%	468.43	4.68%
	Hourly mean	µg/m³	30,000	460.29	13.32	12.61	10.12	10.04	10.99	13.32	0.04%	473.61	1.58%
Hydrogen chloride	Hourly mean	µg/m³	750	1.57	1.98	1.88	1.51	1.50	1.64	1.98	0.26%	3.55	0.47%
Hydrogen fluoride	Annual mean	µg/m³	16	2.35	0.00	0.01	0.01	0.00	0.00	0.01	0.03%	2.36	14.74%
	Hourly mean	µg/m³	160	4.71	0.27	0.25	0.20	0.20	0.22	0.27	0.17%	4.97	3.11%
Ammonia	Annual mean	µg/m³	180	1.94	0.06	0.07	0.08	0.05	0.07	0.08	0.04%	2.02	1.12%
	Hourly mean	µg/m³	2,500	3.89	3.63	3.44	2.76	2.74	2.99	3.63	0.15%	7.52	0.30%
VOCs (as benzene)	Annual mean	µg/m³	5	0.48	0.04	0.05	0.06	0.03	0.05	0.06	**1.11%**	0.53	10.68%
	Daily mean	µg/m³	30	0.96	0.95	0.85	1.08	0.62	0.86	1.08	3.61%	2.04	6.80%

Pollutant	Quantity	Units	AQAL	Bg Conc.	2018	2019	2020	2021	2022	Max	Max as % of AQAL	PEC	PEC as % of AQAL
Mercury	Daily mean	ng/m³	60	5.71	1.91	1.70	2.16	1.23	1.72	2.16	3.61%	7.88	13.13%
	Hourly mean	ng/m³	600	5.71	5.33	5.05	4.05	4.02	4.39	5.33	0.89%	11.04	1.84%
Cadmium	Annual mean	ng/m³	5	0.48	0.09	0.10	0.11	0.07	0.10	0.11	**2.22%**	0.59	11.76%
	Daily mean	ng/m³	30	0.95	1.91	1.70	2.16	1.23	1.72	2.16	7.21%	3.12	10.40%
PaHs	Annual mean	pg/m³	250	190.57	0.88	1.03	1.11	0.67	0.98	1.11	0.44%	191.68	76.67%
Dioxins and Furans	Annual mean	fg/m³	-	33.16	0.24	0.28	0.30	0.18	0.27	0.30	-	33.46	-
PCBs	Annual mean	ng/m³	200	0.14	0.02	0.03	0.03	0.02	0.02	0.03	0.01%	0.17	0.09%
	Hourly mean	ng/m³	6,000	0.29	1.33	1.26	1.01	1.00	1.10	1.33	0.02%	1.62	0.03%

Table 57: Dispersion Modelling Results – PC at Point of Maximum Impact - Short-Term ELVs – Proposed Facility

Pollutant	Quantity	Units	AQAL	Bg Conc.	2018	2019	2020	2021	2022	Max	Max as % of AQAL	PEC	PEC as % of AQAL
Nitrogen dioxide	99.79th %ile of hourly means	µg/m³	200	55.54	23.99	23.62	25.24	21.02	24.30	25.24	**12.62%**	55.26	27.63%
Sulphur dioxide	99.73rd %ile of hourly means	µg/m³	350	12.06	33.40	32.75	35.58	28.73	34.35	35.58	**10.17%**	41.45	11.84%
	99.9th %ile of 15 min. means	µg/m³	266	12.06	38.60	37.42	40.43	35.91	39.22	40.43	**15.20%**	46.29	17.40%
Carbon monoxide	8 hour running mean	µg/m³	10,000	426	22.72	22.64	24.42	22.70	23.50	24.42	0.24%	484.71	4.85%
	Hourly mean	µg/m³	30,000	426	39.96	37.84	30.37	30.13	32.96	39.96	0.13%	500.25	1.67%
Hydrogen chloride	Hourly mean	µg/m³	750	1.42	15.99	15.14	12.15	12.05	13.18	15.99	2.13%	17.55	2.34%

Note:
Assumes operation of all three lines at the short term ELVs during the worst-case weather conditions for dispersion.

Table 58: Long-Term Metals Results at Point of Maximum Impact – Operational Facility

Metal	AQAL	Baseline conc.	Metals emitted at combined metal limit				Metal as % of ELV (1)	Each metal emitted at the maximum concentration from the EA metals guidance document			
			PC		PEC			PC		PEC	
	ng/m³	ng/m³	ng/m³	as % AQAL	ng/m³	as % AQAL		ng/m³	as % AQAL	ng/m³	as % AQAL
Arsenic	6	1.07	1.33	**22.19%**	2.40	40.04%	8.3%	0.11	**1.85%**	1.18	19.70%
Antimony	5,000	1.33	1.33	0.03%	2.66	0.05%	3.8%	0.05	0.001%	1.38	0.03%
Chromium	-	5.06	1.33	-	6.39	-	30.7%	0.41	-	5.47	-
Chromium (VI)	0.25	1.01	1.33	**532.5%**	2.34	**937.5%**	0.043%	0.001	0.23%	1.01	**405.23%**
Cobalt	-	1.52	1.33	-	2.85	-	1.9%	0.02	-	1.54	-
Copper	-	18.08	1.33	-	19.41	-	9.7%	0.13	-	18.21	-
Lead	250	15.14	1.33	0.53%	16.47	6.59%	16.8%	0.22	0.09%	15.37	6.15%
Manganese	150	10.17	1.33	0.89%	11.50	7.67%	20.0%	0.27	0.18%	10.44	6.96%
Nickel	20	3.13	1.33	**6.66%**	4.46	22.29%	73.3%	0.98	**4.88%**	4.10	20.52%
Vanadium	-	3.02	1.33	-	4.35	-	2.0%	0.03	-	3.04	-

Notes:

(1) Metal as maximum percentage of the group 3 ELV of 0.3 mg/Nm³, recalculated from the data presented in Environment Agency's metals guidance document (V.4) Table A1.

Table 59: Short-Term Metals Results at Point of Maximum Impact – Operational Facility

Metal	AQAL	Baseline conc.	Metals emitted at combined metal limit				Metal as % of ELV [(1)]	Each metal emitted at the maximum concentration from the EA metals guidance document			
			PC		PEC			PC		PEC	
	ng/m³	ng/m³	ng/m³	as % AQAL	ng/m³	as % AQAL		ng/m³	as % AQAL	ng/m³	as % AQAL
Arsenic	-	2.14	62.71	-	64.85	-	8.3%	5.23	-	7.37	-
Antimony	150,000	2.67	62.71	0.04%	65.38	0.04%	3.8%	2.40	0.002%	5.07	0.003%
Chromium (daily mean)	2,000	10.12	23.83	1.19%	33.96	1.70%	30.7%	7.31	0.37%	17.43	0.87%
Chromium (VI)	-	2.02	62.71	-	64.74	-	0.043%	0.03	-	2.05	-
Cobalt	-	3.03	62.71	-	65.74	-	1.9%	1.17	-	4.20	-
Copper (daily mean)	50	36.17	23.83	**47.67%**	60.00	**120.00%**	9.7%	2.30	4.61%	38.47	76.94%
Lead	-	30.29	62.71	-	93.00	-	16.8%	10.51	-	40.80	-
Manganese	1,500,000	20.34	62.71	0.00%	83.05	0.01%	20.0%	12.54	0.001%	32.88	0.002%
Nickel	700	6.26	62.71	8.96%	68.97	9.85%	73.3%	45.99	6.57%	52.24	7.46%
Vanadium (daily mean)	1,000	6.03	23.83	2.38%	29.87	2.99%	2.0%	0.48	0.048%	6.51	0.65%

Notes:

[(1)] Metal as maximum percentage of the group 3 ELV of 0.3 mg/Nm³, recalculated from the data as presented in Environment Agency's metals guidance document (V.4) Table A1.

Table 60: Long-Term Metals Results at Point of Maximum Impact – Proposed Facility

Metal	AQAL	Baseline conc.	Metals emitted at combined metal limit				Metal as % of ELV (1)	Each metal emitted at the maximum concentration from the EA metals guidance document			
			PC		PEC			PC		PEC	
	ng/m³	ng/m³	ng/m³	as % AQAL	ng/m³	as % AQAL		ng/m³	as % AQAL	ng/m³	as % AQAL
Arsenic	6	1.07	1.66	**27.72%**	2.73	45.57%	8.3%	0.14	**2.31%**	1.21	20.17%
Antimony	5,000	1.33	1.66	0.03%	3.00	0.06%	3.8%	0.06	0.001%	1.40	0.03%
Chromium	-	5.06	1.66	-	6.73	-	30.7%	0.51	-	5.57	-
Chromium (VI)	0.25	1.01	1.66	**665.3%**	2.68	**1070.3%**	0.043%	0.001	0.29%	1.01	**405.29%**
Cobalt	-	1.52	1.66	-	3.18	-	1.9%	0.03	-	1.55	-
Copper	-	18.08	1.66	-	19.75	-	9.7%	0.16	-	18.24	-
Lead	250	15.14	1.66	0.67%	16.81	6.72%	16.8%	0.28	0.11%	15.42	6.17%
Manganese	150	10.17	1.66	**1.11%**	11.83	7.89%	20.0%	0.33	0.22%	10.50	7.00%
Nickel	20	3.13	1.66	**8.32%**	4.79	23.95%	73.3%	1.22	**6.10%**	4.35	21.74%
Vanadium	-	3.02	1.66	-	4.68	-	2.0%	0.03	-	3.05	-

Notes:

(1) Metal as maximum percentage of the group 3 ELV of 0.3 mg/Nm³, recalculated from the data presented in Environment Agency's metals guidance document (V.4) Table A1.

Table 61: Short-Term Metals Results at Point of Maximum Impact – Proposed Facility

Metal	AQAL	Baseline conc.	Metals emitted at combined metal limit				Metal as % of ELV (1)	Each metal emitted at the maximum concentration from the EA metals guidance document			
			PC		PEC			PC		PEC	
	ng/m³	ng/m³	ng/m³	as % AQAL	ng/m³	as % AQAL		ng/m³	as % AQAL	ng/m³	as % AQAL
Arsenic	-	2.14	79.92	-	82.07	-	8.3%	6.66	-	8.80	-
Antimony	150,000	2.67	79.92	0.05%	82.59	0.06%	3.8%	3.06	0.002%	5.73	0.004%
Chromium (daily mean)	2,000	10.12	32.47	1.62%	42.59	2.13%	30.7%	9.96	0.50%	20.08	1.00%
Chromium (VI)	-	2.02	79.92	-	81.95	-	0.043%	0.03	-	2.06	-
Cobalt	-	3.03	79.92	-	82.95	-	1.9%	1.49	-	4.52	-
Copper (daily mean)	50	36.17	32.47	**64.93%**	68.63	**137.26%**	9.7%	3.14	6.28%	39.30	78.61%
Lead	-	30.29	79.92	-	110.21	-	16.8%	13.40	-	43.69	-
Manganese	1,500,000	20.34	79.92	0.01%	100.27	0.01%	20.0%	15.98	0.001%	36.33	0.002%
Nickel	700	6.26	79.92	**11.42%**	86.18	12.31%	73.3%	58.61	8.37%	64.87	9.27%
Vanadium (daily mean)	1,000	6.03	32.47	3.25%	38.50	3.85%	2.0%	0.65	0.065%	6.68	0.67%

Notes:

(1) Metal as maximum percentage of the group 3 ELV of 0.3 mg/Nm³, recalculated from the data as presented in Environment Agency's metals guidance document (V.4) Table A1.

Table 62: Long-Term Metals Results at Point of Maximum Impact – Change in Impact

Metal	AQAL	Baseline conc.	Metals emitted at combined metal limit				Metal as % of ELV (1)	Each metal emitted at the maximum concentration from the EA metals guidance document			
			PC		PEC(2)			PC		PEC(2)	
	ng/m³	ng/m³	ng/m³	as % AQAL	ng/m³	as % AQAL		ng/m³	as % AQAL	ng/m³	as % AQAL
Arsenic	6	1.07	0.33	**5.53%**	1.40	23.39%	8.3%	0.03	0.46%	1.10	18.32%
Antimony	5,000	1.33	0.33	0.01%	1.66	0.03%	3.8%	0.01	0.0003%	1.35	0.03%
Chromium	-	5.06	0.33	-	5.39	-	30.7%	0.10	-	5.16	-
Chromium (VI)	0.25	1.01	0.33	**132.8%**	1.34	**537.8%**	0.043%	0.0001	0.06%	1.01	**405.06%**
Cobalt	-	1.52	0.33	-	1.85	-	1.9%	0.01	-	1.52	-
Copper	-	18.08	0.33	-	18.41	-	9.7%	0.03	-	18.11	-
Lead	250	15.14	0.33	0.13%	15.48	6.19%	16.8%	0.06	0.02%	15.20	6.08%
Manganese	150	10.17	0.33	0.22%	10.50	7.00%	20.0%	0.07	0.04%	10.24	6.83%
Nickel	20	3.13	0.33	**1.66%**	3.46	17.30%	73.3%	0.24	**1.22%**	3.37	16.86%
Vanadium	-	3.02	0.33	-	3.35	-	2.0%	0.01	-	3.02	-

Notes:

(1) Metal as maximum percentage of the group 3 ELV of 0.3 mg/Nm³, recalculated from the data presented in EA's metals guidance document (V.4) Table A1.

(2) PEC presented is for the Proposed Development.

Table 63: Short-Term Metals Results at Point of Maximum Impact – Change in Impact

Metal	AQAL	Baseline conc.	Metals emitted at combined metal limit				Metal as % of ELV (1)	Each metal emitted at the maximum concentration from the EA metals guidance document			
			PC		PEC			PC		PEC	
	ng/m³	ng/m³	ng/m³	as % AQAL	ng/m³	as % AQAL		ng/m³	as % AQAL	ng/m³	as % AQAL
Arsenic	-	2.14	17.21	-	19.35	-	8.3%	1.43	-	3.58	-
Antimony	150,000	2.67	17.21	0.01%	19.88	0.01%	3.8%	0.66	0.0004%	3.33	0.00%
Chromium (daily mean)	2,000	10.12	8.63	0.43%	18.76	0.94%	30.7%	2.65	0.13%	12.77	0.64%
Chromium (VI)	-	2.02	17.21	-	19.24	-	0.043%	0.01	-	2.03	-
Cobalt	-	3.03	17.21	-	20.24	-	1.9%	0.32	-	3.35	-
Copper (daily mean)	50	36.17	8.63	**17.27%**	44.80	89.60%	9.7%	0.83	1.67%	37.00	74.00%
Lead	-	30.29	17.21	-	47.50	-	16.8%	2.89	-	33.17	-
Manganese	1,500,000	20.34	17.21	0.001%	37.55	0.003%	20.0%	3.44	0.0002%	23.78	0.002%
Nickel	700	6.26	17.21	2.46%	23.47	3.35%	73.3%	12.62	1.80%	18.88	2.70%
Vanadium (daily mean)	1,000	6.03	8.63	0.86%	14.67	1.47%	2.0%	0.17	0.017%	6.21	0.62%

Notes:

(1) Metal as maximum percentage of the group 3 ELV of 0.3 mg/Nm³, recalculated from the data as presented in Environment Agency's metals guidance document (V.4) Table A1.

(2) PEC presented is for the Proposed Development

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