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KRONOSPAN
CHIRK
DISPERSION MODELLING ASSESSMENT

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1 INTRODUCTION

Kronospan Limited (Kronospan) operates a panel board manufacturing facility at their site in Chirk, North Wales (the Facility). The panel board manufacturing process is operated in accordance with an Environmental Permit (EP) which was granted by Wrexham Borough Council (WCBC) (Ref: WCBC/IPPC/03/KR(V2)). In addition to the EP granted by WCBC, the Formalin plant and combustion processes which supply power and heat to support the manufacturing process is operated in accordance with an EP which is regulated by Natural Resources Wales (NRW) (Ref: EA/EPR/BW9999IG/V004).

The application is seeking to transfer all WCBC EP to be regulated by NRW. In addition to this it is proposed to apply for a new Chip Plant and Orientated Strand Board (OSB) line. A full detailed explanation of the agreed process of applying for the EP application is detailed within the Supporting Information report.

The modelling that has been undertaken to support this application demonstrates normal operating conditions (the Likely Case), and also with the plant operating at the worst-case emissions (the Worst Case. In terms of the latter scenario these are unlikely to be achievable given the integrated nature of the combustion and production processes. In the situation where there is no production, heat demand is minimal and electricity demand is reduced which would lead to a progressive shutdown of operations.

1.1 Structure of the report

This report has the following structure:

- A description of the emission points to atmosphere is provided in Section 2.
- A description of the operating and emissions scenarios to be considered in this dispersion modelling assessment is provided in Section 0.
- National and international air quality legislation and guidance, and local planning policies which relate to air quality, are considered in Sections 4 and 5.
- The current levels of ambient air quality are described in Section 6.
- Section 7 highlights residential properties and ecological receptors in the vicinity of the Facility sensitive to changes in air quality associated with the proposals.
- The inputs used for the dispersion model are contained within Section 8.
- Section 9 to Section 12 present and discuss the results of the dispersion modelling.
- The conclusions are presented in Section 0.
- All figure, model input data, and results tables are provided in the Appendices.

2 EMISSION POINTS TO ATMOSPHERE

Table 2.1 outlines the plant on site, along with the use of each plant and where the emissions vent to atmosphere. As shown, there are a number of combustion sources on site, under normal operations exhaust gases from the combustion plant are used within the driers and exit to atmosphere via the cyclones.

For the purpose of this analysis it is worth splitting the sources into two groups. Those related to the combustion processes on site and those related to the process. The combustion sources are set out in Table 2.1, the process plant in Table 2.2.

Table 2.1 - Combustion Plant					
Combustion Unit	**Fuel**	**Thermal Capacity**	**Status**	**Use**	**Vent to atmosphere via**
Natural Gas Heaters					
K1	Gas	2.25 MW	Primary heat source	Kronoplus single daylight press plus space heating.	Dedicated stack only
K5	Gas	14.1 MW	Standby for K7	Rawboard thermal oil to contiroll presses.	Dedicated stack only
K6	Gas	16.5 MW	Standby for K7 & K8	Rawboard thermal oil to contiroll presses.	Dedicated stack only
Biomass Boilers					
K7	Biomass Gas	38 MW	Primary heat source	Grate based combustion system producing steam and heating thermal oil for the Particle Board and MDF processes. Residual heat from the stack fed into MDF Drier 2.	MDF 1 or MDF 2 cyclone or dedicated stack
K8	Biomass	32 MW	Primary heat source	Grate based combustion system producing steam and heating thermal oil for the Particle Board and MDF processes. Residual heat from the stack fed into the MDF Drier 1.	MDF 1 or MDF 2 cyclone or dedicated stack
Gas Engines					
Engine 1	Gas	21.28 MW	Primary electricity, heat and steam source for the manufacturing process.	Electricity supplied to the Site. Steam production for MDF 1 & 2 process. Heat to the MDF Driers (MDF 1 and MDF 2).	MDF 1 or MDF 2 cyclone or dedicated stack
Engine 2	Gas	21.28 MW			MDF 1 or MDF 2 cyclone or dedicated stack
Engine 3	Gas	21.28 MW			MDF 1 or MDF 2 cyclone or dedicated stack
Engine 4	Gas	21.28 MW			MDF 1 or MDF 2 cyclone or dedicated stack
Engine 5	Gas	21.28 MW			MDF 1 or MDF 2 cyclone or dedicated stack
Gas Turbines					
GT1	Gas	20.5 MW	Standby in the event that a gas engine is offline.	Heat to MDF1 drier during gas engine maintenance. Back-up electricity supply to site.	MDF 1 cyclone or dedicated stack

Table 2.1 - Combustion Plant					
Combustion Unit	**Fuel**	**Thermal Capacity**	**Status**	**Use**	**Vent to atmosphere via**
GT2	Gas	20.5 MW	Standby in the event that a gas engine is offline.	Heat to MDF2 drier during gas engine maintenance. Back-up electricity supply to site.	MDF 2 cyclone or dedicated stack
Process Driers – combustion plant					
MDF1	Gas	15 MW	Standby for K8/GT1	MDF1 drier. Direct drier. Back-up.	MDF 1 cyclone only
MDF2	Gas	32 MW	Standby for K7/GT2	MDF2 drier. Direct drier. Back-up.	MDF 2 cyclone only
Bab 2 (to be reconditioned as OSB 1)	Wood Dust/Gas	35 MW	Primary heat source	Panelboard drier 2. Direct drier.	WESP or dedicated stack
Bab 3 (to be reconditioned as OSB 2)	Wood Dust/Gas	35 MW	Primary heat source	Panelboard drier 3. Direct drier.	WESP or dedicated stack
New Chip dryer	Wood Dust/Gas	45 MW	Primary heat source	Chip drier. Direct drier.	Chip WESP
OSB 1 (reconditioned Bab 2)	Wood Dust/Gas	35 MW	Primary heat source	OSB drier 1. Direct drier.	WESP
OSB 2 (reconditioned Bab 3)	Wood Dust/Gas	35 MW	Primary heat source	OSB drier 2. Direct drier.	WESP

Table 2.2 – Process Plant		
Unit	**Use**	**Vent to atmosphere via**
A1	Exhaust from the emissions control – formaldehyde plant	Dedicated stack only
A5	Exhaust from the NAIRB wet scrubber on the Rein VITS 2,3 and 5 paper impregnation lines	Dedicated stack only
A6	Exhaust from the NAIRB wet scrubber on the Rein VITS 4 paper impregnation line	Dedicated stack only
MDF1 cyclone	Abatement for emissions from the MDF 1 drier	MDF 1 Cyclone
MDF2 cyclone	Abatement for emissions from the MDF 1 drier	MDF 2 Cyclone
WESP	Abatement for emissions from the Bab 2 and 3 driers and the Press Abatement plant	WESP
Press abatement system (existing)	Press abatement system on the MDF 1, MDF 2 and particleboard Contiroll (3 lines)	WESP
Consented chip dryer (planning consented)	Chip dryer fuelled by gas and dust (within planning consent but not yet permitted, currently being constructed)	PB WESP
Abatement plant on OSB line (planning proposed)	Press abatement system on the proposed OSB line	WESP

3 Operating and Emissions Scenarios

The combustion sources on site are such that in the event that any plant is not available other sources can provide the heat and power needed. For all other sources it has been assumed that these are in continuous operation.

The following section details the operating scenarios for the sources considered as part of this dispersion modelling assessment. These are summarised in Table 3.1 and Table 3.2.

3.1 Existing Operations

3.1.1 Normal operations

Under normal operating conditions emissions to atmosphere from the Facility are from the K1 boiler, the MDF 1 and MDF 2 cyclones, the WESP (formally known as the SEKA), the emissions control system from the Formalin Plant (A1), and the NAIRB wet scrubbers on the paper impregnation plant (A5 and A6).

K1 is a 2.25MW gas heater providing heating. While the thermal capacity of the plant falls below the threshold in the IED the existing EP includes an ELV for NOx, K1 is included in the modelling to correctly define the impact of the installation.

MDF 1 cyclone is fed from the MDF 1 drier which is a direct heat drier. The existing WCBC EP includes ELVs from MDF 1 cyclone for PM, CVOC and HC20, but does not include an emission limit for NOx. A recent review of the BREF includes BAT AELs for direct heat driers of 250 mg/Nm^3 (dry air, 273K, 101.3kPA, no correction of oxygen). However, monitoring from the cyclone has shown that emissions are typically around 100 mg/Nm^3 (dry air, 273K, 101.3kPA). As part of this EP application it is proposed to include an ELV for NOx on the MDF 1 cyclone as set out in the BREF.

Under normal operations emissions from MDF 1 cyclone consist of exhaust gases from the K8 biomass plant and two gas engines. The existing WCBC permit includes an ELVs for the full suite of pollutants listed in Annex VI of the IED for co-incineration plants, and the existing NRW permit includes an ELV for NOx from the gas engines. This application is seeking to keep the ELVs set in the existing WCBC and NRW permit for the K8 biomass plant and gas engines. For modelling purposes when determining the impact of pollutants other than those for which an ELV has been set for the MDF 1 cyclone, it has been assumed that the release rate from the K8 biomass plant vents to atmosphere via the MDF 1 cyclone under normal operations.

MDF 2 cyclone is fed from the MDF 1 drier which is a direct heat drier. The existing WCBC permit includes ELVs for NOx, CO, PM, CVOCs, SO2, HCl and HF. These had been included in the WCBC permit to account for the emissions from the K7 biomass plant which feed the MDF 2 drier. As part of this EP application it is proposed to vary the ELVs from the MDF 2 cyclone to align with the BREF. This would mean there would be ELVs set at the MDF 2 cyclone for NOx, PM, CVOC and CH_2O.

Under normal operations emissions from the MDF 2 cyclone consists of exhaust gases from the K7 biomass plant and three gas engines. The existing permits do not include any ELVs for the K7 biomass plant, but the NRW permit does include ELVs for the gas engines. As part of this application it is proposed to introduce ELVs for the K7 biomass plant based on those set out in Process Guidance Note 1/02(12) Statutorily Guidance for Boilers and Furnaces 20-50MW thermal input. This will mean that there will be ELVs set for the K7 for NOx, CO, PM and SO2 prior to the MDF 2 drier. For modelling purposes it has been assumed that the release rate of CO and SO2 from the K7 biomass plant vents to atmosphere via the MDF 2 cyclone under normal operations.

In the existing configuration the WESP includes emissions from the Bab 2 and Bab 3 driers together with the emissions from the three existing presses (the MDF 1 and 2 presses and the Particleboard Press).

Bab 2 and Bab 3 driers are direct heat panel board driers. The existing WCBC includes ELVs for the Bab 2 and Bab 3 driers at the emission point to atmosphere which is the WESP. This only includes ELVs for PM, CVOCs, total Aldehydes, and CH_2O. A recent review of the BREF includes BAT AELs for NOx for these sources of 250mg/Nm^3 (dry air, 273K, 101.3kPA, 18% reference oxygen content). However, monitoring from the driers has shown that emissions are typically around 100 mg/Nm^3 (dry air, 273K, 101.3kPA, 18% reference oxygen content). The BREF does not include any limit for total Aldehydes. As part of this EP application it is proposed to set the ELVs at the point of the Bab 2 and Bab 3 driers entering the WESP and include an ELV for NOx to align with the BREF. This would mean there would be ELVs set at the Bab 2 and Bab 3 driers for NOx, PM, CVOCs, and CH_2O.

The existing WCBC permit includes ELVs to air for PM, CVOCs, total Aldehydes, and CH2O, for the three presses combined (referred to as the Contriroll combined in the existing WCBC permit). This monitored prior to release to atmosphere via the WESP. Historically these emissions vented to atmosphere via a separate stack but this was changed to vent via the WESP to aid dispersion in mid 2016. The BREF does not include any limit for total Aldehydes. Therefore it is proposed to remove the ELVs set for total Aldehydes as part of the EP application.

The Formalin Plant includes an emission control system, which vents to atmosphere via a dedicated stack (A1). The existing NRW permit includes an ELV for CH2O. It is not proposed to change this ELV as part of the EP application.

The paper impregnation plant includes two NAIRB wet scrubbers (A5 and A6). Both are covered under the existing NRW permit. The permit includes ELVs for CH2O and TVOCs. It is not proposed to change this ELV as part of the EP application.

3.1.2 WESP Offline

Condition 2.1.15 of the existing permit (ref: WCBC/IPPC/03/KR(v3)), states:

> *"any malfunction of the SEKA WESP unit and associated plant, or any other circumstance which results in the discharge of particleboard drier emissions from the drier stacks shall be treated as an emergency. The particleboard drier operations shall be terminated as soon as is reasonably practicable, but within a period not exceeding 1-hour, until such time as normal operations of the SEKA WESP unit can be restored."*

Therefore, emissions of exhaust gases from Bab 2 and 3 dedicated stacks are considered an emergency scenario if the WESP is offline. This has been considered in the dispersion modelling as an emergency case.

3.1.3 MDF 1 or 2 Cyclone Offline

The MDF 1 and 2 driers are fed by exhaust gases from a mixture of K7, K8, Gas Engines, and Gas Turbines (if gas engine is unavailable).

MDF 1 drier normally takes the exhaust gases from K8 biomass plant and two gas engines. However, if MDF 2 cyclone is offline MDF 1 drier can take the exhaust gases from K7, K8 and up to two gas engines. If the MDF 2 cyclone is offline the electricity demand for the site is reduced and only three gas engines are needed. In this instance the exhaust gases from two gas engines will be used in the MDF 1 drier, but one of the gas engines will need to exhaust via its own dedicated stack.

MDF 2 drier is the larger drier and normally takes the exhaust gases from K7 biomass plant and three gas engines. However, if MDF 1 cyclone is offline MDF 2 drier can take the exhaust gases from K7, K8 and up to four gas engines. If the MDF 1 cyclone is offline the electricity demand for the site is reduced and only four gas engines are needed. In this instance the exhaust gases from all the operating gas engines can be used in the MDF 2 drier.

3.1.4 MDF 1 and 2 Cyclone Offline

If MDF 1 and 2 cyclones are offline for a short period, the sources feeding the drier will need to vent to atmosphere via their own dedicated stacks. This would only occur for extremely short and rare periods as the electricity and heat generated would not be able to be used on site. In this scenario emissions from K7 and K8 biomass plants together with up to five gas engines would vent to atmosphere via their dedicated stacks but there would be no emissions from the MDF 1 or MDF 2 cyclones.

3.1.5 K7 or K8 Biomass Plant Offline

K7 and K8 biomass plant are used to produce steam for the MDF process and heat thermal oil for the contiroll presses, with residual heat from the exhaust gases used in the MDF driers. If either of these are offline, the heat for the driers will be provided by the burners in the driers and gas heaters K5 and / or K6 will be used to heat the oil for the contiroll presses. In this instance the MDF 1 and MDF 2 cyclones would still be operating together with either K5 or K6, which will always vent to atmosphere via their dedicated stacks.

For the dispersion modelling if K7 and K8 are offline, it has been assumed that the MDF driers continue to operate but K5 and K6 will also operate to heat the thermal oil for the contiroll presses.

3.1.6 Gas Engine Unavailable

Gas Turbine 1 is linked to MDF 1 drier and Gas Turbine 2 to MDF 2 drier. These gas turbines will be used as a back-up to the gas engines. This would not change the emissions from the driers.

3.2 Proposed operations

The site benefits from planning permission for a new chip preparation plant and associated drier and WESP (referred to as the PB WESP). This process is not currently permitted. As part of this EP application it is proposed to include this process. It is proposed to apply for the ELVs for the PB WESP based on the BAT AELS set in the BREF. ELVs are proposed for NOx, PM, TVOC and CH_2O.

In addition the consented chip preparation plant, a planning application has been submitted to WCBC for a new Orientated Strand Board (OSB) line. This would involve the reconditioning of the existing Bab 2 and Bab 3 driers – to be referred to as the OSB drier 1 and OSB drier 2, in addition to the construction of an additional OSB line and associated press. In terms of emissions to air this proposal would mean that the OSB drier 1 and OSB drier 2 would vent to atmosphere via the WESP, and a 4^{th} press (OSB press) would vent to atmosphere via the WESP with the existing Contiroll presses on the MDF 1, MDF 2 and Particleboard lines. It is proposed to apply for the ELVs for the OSB driers and the OSB press based on the BAT AELS set in the BREF. ELVs are proposed for NOx, PM, TVOC and CH_2O.

The proposed introduction of the new chip preparation plant and OSB line does not change any of the described operating scenarios when certain items of plant are offline.

Table 3.1 – Operating Scenarios – Combustion Sources							
Source	**Normal Ops**	**MDF 1 Only Offline**	**MDF 2 Only Offline**	**SEKA Only Offline**	**MDF 1 and MDF 2 Offline(1)**	**MDF 1, MDF 2 and SEKA Offline(1)**	**K7 and K8 offline**
K1	K1	K1	K1	K1	K1	K1	K1
K5	-	-	-	-	-	-	K5
K6	-	-	-	-	-	-	K6
K7	MDF 2	MDF 2	MDF 1	MDF 2	K7	K7	-
K8	MDF 1	MDF 2	MDF 1	MDF 1	K8	K8	-
Gas Engine 1	MDF 1	-	MDF 1	MDF 1	Gas Engine Stack	Gas Engine Stack	MDF 1
Gas Engine 2	MDF 1	MDF 2	MDF 1	MDF 1	Gas Engine Stack	Gas Engine Stack	MDF 1
Gas Engine 3	MDF 2	MDF 2	Gas Engine Stack	MDF 2	Gas Engine Stack	Gas Engine Stack	MDF 2
Gas Engine 4	MDF 2	MDF 2	-	MDF 2	Gas Engine Stack	Gas Engine Stack	MDF 2
Gas Engine 5	MDF 2	MDF 2	-	MDF 2	Gas Engine Stack	Gas Engine Stack	MDF 2
Bab 2	WESP	WESP	WESP	Bab 2	WESP	Bab 2	WESP
Bab 3	WESP	WESP	WESP	Bab 3	WESP	Bab 3	WESP
MDF 1 burner	-	-	-	-	-	-	MDF 1
MDF 2 burner	-	-	-	-	-	-	MDF 2
Gas Turbine 1	Only if 1 or more Gas Engines are offline – a single Gas Turbine would replace the operation of a single Gas Engine.						
Gas Turbine 2							

NOTES:

(1) When the driers are offline the electricity demand for the site would be reduced and therefore not all gas engines would be needed. However, for a worst-case assessment it has been assumed that all gas engines could operate at the same time for short periods.

Table 3.2 – Operating Scenarios – Some Gas Engines Offline – Gas Turbines Used as Backup							
Source	**MDF 2 Only Offline**	**MDF 1 and MDF 2 Offline – 1 GE Offline(1)**	**MDF 1 and MDF 2 Offline – 2 GE Offline(1)**	**MDF 1, MDF 2 and SEKA Offline – 1 GE Offline(1)**	**MDF 1, MDF 2 and SEKA Offline – 2 GE Offline(1)**	**MDF 1, MDF 2 and SEKA Offline – 1 GE Offline(1)**	**MDF 1, MDF 2 and SEKA Offline – 2 GE Offline(1)**
K1	K1	K1	K1	K1	K1	K1	K1
K5	-	-	-	-	-	-	-
K6	-	-	-	-	-	-	-
K7	MDF 1	K7	K7	K7	K7	K7	K7
K8	MDF 1	K8	K8	K8	K8	K8	K8
Gas Engine 1	MDF 1	-	-	-	-	-	-
Gas Engine 2	MDF 1	Gas Engine Stack	-	Gas Engine Stack	-	Gas Engine Stack	-
Gas Engine 3		Gas Engine Stack	Gas Engine Stack	Gas Engine Stack	Gas Engine Stack	Gas Engine Stack	Gas Engine Stack
Gas Engine 4	-	Gas Engine Stack	Gas Engine Stack	Gas Engine Stack	Gas Engine Stack	Gas Engine Stack	Gas Engine Stack
Gas Engine 5	-	Gas Engine Stack	Gas Engine Stack	Gas Engine Stack	Gas Engine Stack	Gas Engine Stack	Gas Engine Stack
Bab 2	WESP	WESP	WESP	Bab 2	Bab 2	Bab 2	Bab 2
Bab 3	WESP	WESP	WESP	Bab 3	Bab 3	Bab 3	Bab 3
MDF 1 burner	-	-	-	-	-	-	-
MDF 2 burner	-	-	-	-	-	-	-
Gas Turbine 1	Gas Turbine Stack	Gas Turbine Stack	Gas Turbine Stack	Gas Turbine Stack	Gas Turbine Stack	Gas Turbine Stack	Gas Turbine Stack
Gas Turbine 2	-	-	Gas Turbine Stack	-	Gas Turbine Stack	-	Gas Turbine Stack

Note:

Only those scenarios where the Gas Turbine would vent via its own stack are listed above.

(1) When the driers are offline the electricity demand for the site would be reduced and therefore not all gas engines would be needed. However, for a worst-case assessment it has been assumed that all gas engines could operate at the same time for short periods.

3.3 Emissions scenarios

A recent review of the BREF includes BAT AELs for NOx for direct heat driers such as the MDF 1 and MDF 2 cyclones, the existing Bab 2 and 3 driers, the proposed chip drier and proposed OSB driers. This is 250mg/Nm^3 (dry air, 273K, 101.3kPA, 18% reference oxygen content). However, monitoring from the existing driers has shown that emissions are typically around 100mg/Nm^3 (dry air, 273K, 101.3kPA, 18% reference oxygen content)

The assumption that these direct heat driers operate at the BAT AEL is therefore considered very conservative.

To account for this the following emissions scenarios have been considered for each operating scenario:

(1) **Likely Case** – Driers emitting NOX calculated from typical emissions, all other sources emitting at the relevant ELVs.

(2) **Worst Case** - Driers emitting NOx calculated from BAT AEL, all other sources emitting at the relevant ELVs

4 LEGISLATION

4.1 European legislation

European air quality legislation is consolidated under Directive 2008/50/EC, which came into force on 11th June 2008. This Directive consolidates previous legislation which was designed to deal with specific pollutants in a consistent manner and provides new air targets and limits for fine particulates. The consolidated Directives include:

- Directive 99/30/EC – the First Air Quality "Daughter" Directive – which sets Ambient Air Directive (AAD) Limit Values for nitrogen dioxide and oxides of nitrogen, sulphur dioxide, lead and particulate matter;
- Directive 2000/69/EC – the Second Air Quality "Daughter" Directive – which sets AAD Limit Values for benzene and carbon monoxide; and
- Directive 2002/3/EC – the Third Air Quality "Daughter" Directive – which seeks to establish long-term Target Values, an alert threshold and an information threshold for concentrations of ozone in ambient air.

The fourth daughter Directive – 2004/107/EC - was not included within the consolidation. It sets health-based Target Values on polycyclic aromatic hydrocarbons (PAHs), cadmium, arsenic, nickel and mercury, for which there is a requirement to reduce exposure to as low as reasonably achievable.

4.2 UK legislation

The Air Quality Standards Regulations (2010) seek to transpose Directive 2008/50/EC and the Fourth Daughter Directive within the United Kingdom (UK. The regulations also extend powers, under Section 85(5) of the Environment Act (1995), for the Secretary of State to give directions to local authorities for the implementation of these Directives.

The UK Air Quality Strategy (2007)[1] is the method of implementation of the AAD Limit Values and Targets in England, Scotland, Wales and Northern Ireland. This document builds on the previous Strategy, published in 2000, and a 2003 Addendum.

The Air Quality Strategy defines "standards" and "objectives" in paragraph 17:

"For the purposes of the strategy:

- standards are the concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. The standards are based on assessment of the effects of each pollutant on human health including the effects on sensitive subgroups or on ecosystems; and
- objectives are policy targets often expressed as a maximum ambient concentration not to be exceeded, either without exception or with a permitted number of exceedances, within a specified timescale."

The status of the objectives is clarified in paragraph 22, which also emphasises the importance of European Directives:

> *"The air quality objectives in the Air Quality Strategy are a statement of policy intentions or policy targets. As such, there is no legal requirement to meet these objectives except in as far as these mirror any equivalent legally binding limit values in EU legislation. Where UK standards or objectives are the sole consideration, there is no legal obligation upon regulators, to set Emission Limit Values (ELVs) any more stringent than the emission levels associated with the use of Best Available Techniques (BAT) in issuing permits under the PPC Regulations. This aspect is dealt with fully in the PPC Practical Guides."*

[1] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, CM 7169 NIA 61/06-07, July 2007, DEFRA – para 17 of Volume 1

5 AIR QUALITY STANDARDS, OBJECTIVES AND GUIDELINES

In the UK, AAD Limit Values, Targets, and air quality standards and objectives (AQOs) for major pollutants are described in The Air Quality Strategy (AQS). In addition, the Environment Agency includes Environmental Assessment Levels (EALs) for other pollutants in the environmental management guidance document 'Air Emissions Risk Assessment for your Environmental Permit'[2] ("Air Emissions Guidance"). The long-term and short-term EALs from this document 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.

5.1 Nitrogen dioxide

All combustion processes produce nitric oxide (NO) and nitrogen dioxide (NO_2), known by the general term of nitrogen oxides (NOx). In general, most the NOx released is in the form of NO, which then reacts with ozone in the atmosphere to form NO_2. Of the two compounds, NO_2 is associated with adverse effects on human health, principally relating to respiratory illness. The World Health Organisation (WHO) has stated that "many chemical species of nitrogen oxides exist, but the air pollutant species of most interest from the point of view of human health is nitrogen dioxide".

The major sources of NOx in the UK are road transport and power stations. According to the most recent annual report from the National Atmospheric Emissions Inventory (NAEI), road transport accounted for 37% of UK emissions, with power stations accounting for a further 27%. High levels of NOx in urban areas are almost always associated with high traffic densities.

The AQS includes two objectives to be achieved by 31st December 2005. Both of these objectives are included in the Air Quality Directive, with an achievement date of 1st January 2010.

- A limit for the one-hour mean of 200µg/m^3, not to be exceeded more than 18 times a year (equivalent to the 99.79th percentile).
- A limit for the annual mean of 40µg/m^3.

In addition, the AQS includes objectives for the protection of sensitive vegetation and ecosystems of 30µg/m^3 for the annual mean, and 75µg/m^3 for the daily mean concentration of nitrogen oxides.

5.2 Particulate matter

Concerns over the health impact of solid matter suspended in the atmosphere tend to focus on particles with a diameter of less than 10µm, known as PM_{10}s. These particles have the ability to enter and remain in the lungs. Various epidemiological studies have shown increases in mortality associated with high levels of PM_{10}s, although the underlying mechanism for this effect is not yet understood. Significant sources of PM10s are road transport (22%), quarrying (16%) and stationary combustion (34%).

The AQS includes two objectives for PM_{10}s to be achieved by the end of 2004, both of which are included in the Air Quality Directive.

- A limit for the annual mean of 40µg/m^3, to be achieved by 2004.
- A daily limit of 50µg/m^3, not to be exceeded more than 35 times a year (the 90.4th percentile) to be achieved by 2004.

The previous AQS included some provisional objectives for 2010. These have been replaced by an exposure reduction objective for $PM_{2.5}$s in urban areas and a target value for $PM_{2.5}$s of 25µg/m^3 as an annual mean. This target value is included in the Air Quality Directive.

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

5.3 Formaldehyde

Formaldehyde (HC_2O) is permitted to be released from a number of sources on Site. Targets or objectives for the concentration in ambient air have not been set in legislation. However, the Air Emissions Guidance includes the following EALs for CH_2O:

- An annual limit of 5µg/m^3; and
- An hourly limit of – 100µg/m^3.

These values have been derived from the workplace exposure limits set out in EH40 (2005), which states that the long-term exposure limit (8-hour reference period) and the short-term exposure limit (15-minute reference period) is 2.5mg/m^3. Previous versions of the Air Emissions Guidance (H1 Annex F, and IPPC H1) set out the methodology for converting the workplace exposure limits into annual and max 1-hour limits. The values presented in the Guidance (and listed above) appear to have an additional safety factor applied than stated in the methodology.

5.4 Carbon monoxide

Carbon monoxide (CO) is produced by the incomplete combustion of fuels containing carbon. By far the most significant source is road transport, which produces 67% of the UK's emissions. CO can interfere with the processes that transport oxygen around the body, which can prove fatal at very high levels.

Concentrations in the UK are well below levels at which health effects can occur. The AQS includes the following objective for the control of CO, which is also included in the Air Quality Directive:

- A limit for the 8-hour running mean of 10mg/m^3, to be achieved by 1st January 2005.

5.5 Sulphur dioxide

Sulphur dioxide (SO_2) is predominantly released by the combustion of fuels containing sulphur. Around 68% of UK emissions in 2004 were associated with power stations, with much of the remainder associated with other combustion processes. Emissions of SO_2 have reduced by 87% since 1970, due to a reduction in the number of coal fired combustion plants, the installation of flue gas desulphurisation plants on a number of large coal-fired power stations and the reduction in sulphur content of liquid fuels.

The AQS contains three objectives for the control of SO_2:

- A limit for the 15-minute mean of 266µg/m^3, not to be exceeded more than 35 times a year (the 99.9th percentile) to be achieved by 31st December 2005.
- A limit for the one hour mean of 350µg/m^3, not to be exceeded more than 24 times a year (the 99.73rd percentile) to be achieved by 31st December 2004.
- A limit for the daily mean of 125µg/m^3, not to be exceeded more than 3 times a year (the 99.2nd percentile) to be achieved by 31st December 2004.

The hourly and daily objectives are included in the Air Quality Directive.

In addition, the AQS includes two objectives for the protection of vegetation and ecosystems. These are a concentration of 20µg/m^3 (reduced to 10µg/m^3 where lichens or bryophytes are present) as an annual mean and as a winter average.

5.6 Hydrogen chloride

There are no AQOs for hydrogen chloride contained within the AQS. However, the Air Emissions Guidance defines the short-term EAL as 750µg/m^3. There is no long-term EAL.

5.7 Hydrogen fluoride

There are no AQOs for hydrogen fluoride contained within the AQS. However, the Air Emissions Guidance defines the short-term EAL as 160µg/m^3 and the long-term EAL as 16µg/m^3.

The Air Emissions Guidance also provides Critical Levels for the protection of vegetation and ecosystems of 5µg/m^3 as a daily mean and 0.5µg/m^3 as a weekly mean concentration of hydrogen fluoride.

5.8 Metals

Lead is the only metal included in the AQS. Lead can have many health effects, including effects on the synthesis of haemoglobin, the nervous system and the kidneys. Emissions of lead in the UK have declined by 98% since 1970, due principally to the virtual elimination of leaded petrol.

The AQS includes objectives to limit the annual mean to 0.5µg/m^3 by the end of 2004 and to 0.25µg/m^3 by the end of 2008. Only the first objective is included in the Air Quality Directive.

The fourth Daughter Directive on air quality (Commission Decision 2004/107/EC) includes target values for arsenic, cadmium and nickel. However, the preamble to the Directive makes it clear that the use of these target values is relatively limited. Paragraph (5) states:

> *"The target values would not require any measures entailing disproportionate costs. Regarding industrial installations, they would not involve measures beyond the application of best available techniques (BAT) as required by Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control (5) and in particular would not lead to the closure of installations. However, they would require Member States to take all cost-effective abatement measures in the relevant sectors."*

And paragraph (6) states:

> *"In particular, the target values of this Directive are not to be considered as environmental quality standards as defined in Article 2(7) of Directive 96/61/EC and which, according to Article 10 of that Directive, require stricter conditions than those achievable by the use of BAT."*

Although these target values have been included in the assessment, it is important to note that the application of the target values would not have an effect on the design or operation of Facility. The Facility will be designed in accordance with BAT and will include cost effective methods for the abatement of arsenic, cadmium and nickel, including the injection of activated carbon and a fabric filter.

Emissions limits have been set in EPs for similar facilities for a number of heavy metals which do not have air quality standards associated with them. The EALs for these metals, and lead, are summarised in Table 5.1.

Table 5.1: Environmental Assessment Levels (EALs) for Metals			
Metal	**Daughter Directive Target Level (µg/m³)**	**EALs (µg/m³)**	
		Long-term	**Short-term**
Arsenic (As)	0.006	0.003	-
Antimony (Sb)	-	5	150
Cadmium (Cd)	0.005	0.005	-
Chromium (II & III) (Cr)	-	5	150
Chromium (VI) (Cr)	-	0.0002	-
Cobalt (Co)	-	-	-
Copper (Cu)	-	10	200
Lead (Pb)	-	0.25	-
Manganese (Mn)	-	0.15	1500
Mercury (Hg)	-	0.25	7.5
Nickel (Ni)	0.020	0.020	-
Thallium (Tl)	-	-	-
Vanadium (V)	-	5	1

5.9 Dioxins and furans

Dioxins and furans are a group of organic compounds with similar structures, which are formed as a result of combustion in the presence of chlorine. Principal sources include steel production, power generation, coal combustion and uncontrolled combustion, such as bonfires. The Municipal Waste Incineration Directive and UK legislation imposed strict limits on dioxin emissions in 1995, with the result that current emissions from incineration of municipal solid waste in the UK in 1999 were less than 1% of the emissions from waste incinerators in 1995. The Waste Incineration Directive, now included in the IED, imposed even lower limits, reducing the limit to one tenth of the previously permitted level.

One dioxin, 2,3,7,8-TCDD, is a definite carcinogen and a number of other dioxins and furans are considered to be possible carcinogens. A tolerable daily intake (TDI) for Dioxins, furans and dioxins like PCBs has been recommended by the Committee on the Toxicity of Chemicals in Food, Consumer Products and the Environment of 2pg I-TEQ per kg bodyweight per day.

Dioxins are not normally compared with set EALs, but the probable ingestion rates of dioxins by different groups of people is considered as part of the Human Health Risk Assessment contained as a separate document within the application.

5.10 Polychlorinated biphenyl (PCBs)

PCBs have high thermal, chemical and electrical stability and were manufactured in large quantities in the UK between the 1950s and mid 1970s. Commercial PCB mixtures, which contained a range of dioxin-like and non-dioxin like congeners, were sold under a variety of trade names, the most common in the UK being the Aroclor mixtures. UK legislative restrictions on the use of PCBs were first introduced in the early 1970s.

Although now banned from production current atmospheric levels of PCBs are due to the ongoing primary anthropogenic emissions (e.g. accidental release of products or materials containing PCBs), volatilisation from environmental reservoirs which have previously received PCBs (e.g. sea and soil) or incidental formation of some congeners during the combustion process.

There are no AQOs for PCBs contained within the AQS. However, the Air Emissions Guidance defines the short-term EAL as 6µg/m^3 and the long-term EAL as 0.2µg/m^3.

A number of PCBs are considered to possess dioxin like toxicity and are known as dioxin-like PCBs. The total intake from dioxins, furans and dioxins like PCBs is compared to the TDI for dioxins, furans and dioxin like PCBs as part of the Human Health Risk Assessment contained as a separate document within the application.

5.11 Summary

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 Air Quality Assessment Levels (AQALs). Table 5.2 summarises the air quality objectives and guidelines used in this assessment. The sources for each of the values can be found in the preceding sections.

Table 5.2: Air Quality Assessment Levels (AQALs)

Pollutant	Limit Value (µg/m^3)	Averaging Period	Frequency of Exceedances
Nitrogen dioxide (NO_2)	200	1 hour	18 times per year (99.79th percentile)
	40	Annual	-
Particulate matter (PM_{10})	50	24 hours	35 times per year (90.41th percentile)
	40	Annual	-
Particulate matter ($PM_{2.5}$)	25	Annual	-
Formaldehyde (CH_2O)	100	1-hour	-
	5	Annual	-
Carbon monoxide (CO)	10,000	8 hours, running	-
Sulphur dioxide (SO_2)	266	15 minutes	35 times per year (99.9th percentile)
	350	1 hour	24 times per year (99.73rd percentile)
	125	24 hours	3 times per year (99.18th percentile)
Hydrogen chloride (HCl)	750	1 hour	-
Hydrogen fluoride (HF)	160	1 hour	-
	16	Annual	-
Lead (Pb)	0.25	Annual	-
Polychlorinated biphenyl (PCBs)	6	1-hour	-
	0.2	Annual	-

Table 5.3 Critical Levels for the Protection of Vegetation and Ecosystems		
Pollutant	**Concentration ($\mu g/m^3$)**	**Measured as**
Nitrogen oxides (NO_x as NO_2)	75	Daily mean
	30	Annual mean
Sulphur dioxide (SO_2)	10	Annual mean for sensitive lichen communities and bryophytes and ecosystems where lichens and bryophytes are an important part of the ecosystems integrity
	20	Annual mean for all higher plants
Hydrogen fluoride (HF)	5	Daily mean
	0.5	Weekly mean

6 BASELINE AIR QUALITY

The Kronospan Facility is located on land adjacent to Holyhead Road, Chirk and covers a total area of approximately 40 hectares. The Kronospan site comprises a number of large industrial process buildings including air emissions stacks, storage areas for raw materials, warehouse buildings for manufactured products, offices and car parking. The main residential area of Chirk is located to the east of the site with residential properties lining the majority of the eastern side of Holyhead Road. Chirk town centre is located approximately 500m to the south east of the site. The wider area beyond the urban settlement of Chirk is dominated by agricultural fields and woodland. Chirk Castle and its grounds are located to the west of the site, beyond the Llangollen Canal. In this section, we have reviewed the baseline air quality and defined appropriate baseline concentrations to be used in this assessment.

6.1 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. In the latest Local Air Quality Management (LAQM) report, WCBC concluded that all the AQALs will be met, and there is no requirement to undertake a detailed assessment.

No Air Quality Management Areas (AQMAs) have been declared within 10km of the Facility.

6.2 Mapped background data

In order to assist local authorities with their responsibilities under LAQM, the Department for the Environment Food and Rural Affairs (DEFRA) provides modelled background concentrations of pollutants throughout the UK on a 1 km by 1 km grid. This model is based on known pollution sources and background measurements and is used by local authorities in lieu of suitable monitoring data. Mapped background concentrations have been downloaded for the grid square containing the Facility. A summary is presented within Table 6.1.

The mapped background data is calibrated against monitoring data. For instance, the 2015 mapped background concentrations are based on 2015 meteorological data and are calibrated against monitoring undertaken in 2015. As a conservative approach where mapped background data is used the concentration for the year against which the data was validated has been used, rather than the predicted future year concentration provided in the mapped background dataset. This eliminates any potential uncertainties over anticipated trends in future background concentrations.

It is noted that concentrations will vary over the modelling domain area. Therefore, the maximum mapped background concentration within the modelling domain has been calculated and is also presented in Table 6.1. This analysis has shown that the mapped background square containing the Kronospan Facility is slightly higher than the local area, but concentrations are very low. The fact that the mapped background square is greatest over the Kronospan Facility shows that the operations of the Facility are taken into account in the mapped background dataset.

Table 6.1: Mapped Background Concentration

Pollutant	Concentration (µg/m³)			Dataset
	At Facility	Max. Within Modelling Domain	Min. Within Modelling Domain	
Nitrogen dioxide (NO_2)	10.7	11.1	4.5	2015 dataset
Particulate matter (as PM_{10})	11.5	14.5	9.2	2015 dataset
Particulate matter (as $PM_{2.5}$)	7.7	10.1	6.2	2015 dataset

Table 6.1: Mapped Background Concentration				
Pollutant	Concentration (µg/m³)			Dataset
	At Facility	Max. Within Modelling Domain	Min. Within Modelling Domain	
Sulphur dioxide (SO_2)	3.4	3.4	2.7	2011 dataset
Carbon monoxide (CO)	210	223	209	2011 dataset

6.3 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 DEFRA.

Background monitoring sites are positioned so that they are not influenced significantly by any single source or street but rather by the integrate contribution from all sources upwind of the station. Therefore, background monitoring sites are considered broadly representative of concentrations over several square kilometres. Conversely, roadside, kerbside, and traffic monitoring sites are only representative of concentrations in the immediate vicinity of the analyser.

The closest AURN monitoring station to the Facility is at a roadside location in Wrexham. As this is outside of the modelling domain and only representative of concentrations in the immediate vicinity of the analyser monitoring from this AURN has not been considered in detail for this assessment.

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 monitoring undertaken by WCBC as part of LAQM has shown that three NO_2 diffusion tubes are operated within the modelling domain. Reference should be made to Figure 2 of Appendix A which shows their location. A summary of the monitoring data from these diffusion tubes is provided in Table 6.2. This data has been extracted from the latest LAQM report. A review of the Welsh Air Quality Website has been undertaken to obtain data from 2016 and 2017.

Table 6.2: Diffusion Tube Results – Nitrogen Dioxide							
Site ID	Site Name	Type of Site	Annual Mean Concentration (µg/m³)				
			2013	2014	2015	2016 (1)	2017 (2)
010	Ceriog School	Suburban	13.6	13.1	12.2	11.9	14.1
022	Holyhead Road	Intermediate	16.8	17.3	16.4	15.8	17.9
-	Chapel Lane	Roadside	-	-	-	-	27.7

NOTES:

(1) Includes a national bias adjustment factor of 0.77 from ESG Didcot – 50% TEA in acetone

(2) Includes a Wrexham bias adjustment factor of 0.87.

As shown, concentrations are low in the area. The monitoring at these sites includes the contribution from the existing activities on the Kronospan site. The concentration monitored at Ceriog School was very similar to the mapped background grid square, as expected due to the suburban siting of the monitoring location. At the Holyhead Road site the maximum concentration has been between 41 and 45% of the AQAL over the last 5 years, which is around 10% above the mapped background concentration. At the Chapel Lane site the maximum concentration was 69%, which is around 43% above the mapped background concentration. However, this is located on the junction with Holyhead Road and not in an area of relevant public exposure where the annual mean AQAL applies.

6.4 Formaldehyde

CH_2O is not routinely monitored in the UK. In 2004 WCBC carried out two rounds of passive ambient monitoring for HC2O in Chirk. Following this in 2005 the Environment Agency's Air Quality Modelling Assessment Unit (AQMAU) undertook a modelling exercise to determine the contribution of the Kronospan Facility to the background levels. A summary of this exercise is set out in the WCBC 2005 Updating and Screening Assessment. This states that the background concentration 4 µg/m^3 and the contribution from the Kronospan Facility was 0.7µg/m^3. It appears that this background concentration was extracted from the WHO document "guidelines for indoor air quality"[3] which states that mean ambient air background concentrations range from 1 to 4µg/m^3. In 2016 some additional monitoring was undertaken by WCBC at a number of sites in Chirk and at the Wrexham AURN. This was only undertaken for a two week period but showed that concentrations at the AURN were 1µg/m^3, with concentrations in Chirk ranging from 0.6 to 1.2µg/m^3. The concentrations monitored in Chirk included a contribution from the point sources at the Facility which have been modelled as part of this assessment. Therefore, for the purpose of this assessment the monitored concentration at the AURN has been used - 1µg/m^3.

6.5 Hydrogen chloride

Hydrogen chloride is measured 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).

The closest monitoring station to the Facility is Plas Y Benin, located approximately 60km to the west. Therefore, the data available from this station is not representative of the overall air quality in the area. A summary of data from all UK monitoring sites is provided in the following table.

Table 6.3: UKEAP – Hydrogen Chloride Monitoring

Quantity	Annual Mean Concentration (µg/m^3)				
	2011	2012	2013	2014	2015
Minimum	0.12	0.11	0.15	0.10	0.12
Maximum	0.53	0.49	0.50	0.54	0.71
Average	0.29	0.27	0.31	0.26	0.24

In lieu of any local monitoring, the UK maximum from the national monitoring network has been used as the baseline concentration for this assessment as a conservative estimate (0.71µg/m^3 – 2015). The choice of baseline concentration will be considered further if the impact of the Facility cannot be screened out as 'insignificant'.

[3] World Health Organisation, WHO Guidelines for Indoor Air Quality

6.6 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 0.036µg/m^3 to 2.35µg/m^3.

In lieu of any local monitoring, the maximum measured baseline hydrogen fluoride concentration (2.35µg/m^3) has been used for this assessment as a conservative estimate. The choice of baseline concentration will be considered further if the impact of the Facility cannot be screened out as 'insignificant'.

6.7 Metals

Metals are measured as part of the Rural Metals and UK Urban/Industrial Networks (previously the Lead, Multi-Element and Industrial Metals Networks). The closest monitoring station is located at Runcorn Western Point approximately 48km north-east of the Facility. A summary of the monitoring at Rural Background and Urban Background sites is presented in the Table 6.4 on the following page.

As shown, the concentrations monitored between 2012 and 2016 were lower than the AQALs, with the exception of nickel at un 2016 at the maximum urban background site. This was recorded at Sheffield Tinsley, which is close to an industrialised area. The maximum monitored metal concentrations from UK rural background sites between 2012 and 2016 have been used as baseline concentrations within this assessment. The use of a rural background site is considered appropriate as there is very little industry in the local area and the contribution from the Facility is being explicitly modelled. The choice of baseline concentration will be considered further if the impact of the Facility cannot be screened out as 'insignificant'.

Table 6.4: Metals Monitoring							
Metal	**Annual Mean Concentration (ng/m³)**						**Maximum concentration as % of AQAL**
	AQAL	**2012**	**2013**	**2014**	**2015**	**2016**	
Maximum of all UK rural background sites							
Antimony	5,000	0.78	0.62	0.38	-	-	0.02%
Arsenic	3	0.47	0.43	0.43	0.39	0.48	16.1%
Cadmium	5	0.09	0.09	0.07	0.07	0.08	1.8%
Chromium	5,000	0.85	1.38	2.62	3.43	3.77	0.1%
Cobalt	-	0.08	0.08	0.05	0.05	0.04	-
Copper	10,000	1.92	1.92	1.59	1.72	1.92	0.02%
Manganese	150	1.53	1.83	1.16	1.67	1.81	1.2%
Mercury	250	1.05	1.27	1.26	-	-	0.5%
Nickel	20	0.55	0.72	0.59	1.37	1.17	6.8%
Lead	250	4.40	3.40	2.88	2.83	3.39	1.8%
Vanadium	5,000	0.76	0.85	0.64	0.46	0.52	0.02%
Maximum of all UK urban background sites							
Antimony	5,000	-	-	-	-	-	-
Arsenic	3	0.84	0.92	1.04	0.97	1.04	34.8%
Cadmium	5	0.36	0.41	0.58	0.45	0.40	11.7%
Chromium	5,000	7.30	28.61	34.48	28.38	38.67	0.8%
Cobalt	-	0.54	0.73	0.69	0.59	0.56	-
Copper	10,000	15.04	17.86	21.69	19.28	21.43	0.22%
Manganese	150	17.44	30.52	36.08	27.73	27.40	24.1%
Mercury	250	3.67	3.26	3.69	2.54	2.47	1.5%
Nickel	20	8.53	14.44	19.92	17.55	20.35	101.8%
Lead	250	13.13	19.89	18.82	15.24	14.44	8.0%
Vanadium	5,000	2.65	2.54	2.56	1.42	1.38	0.1%

Notes:
"-" data was not available at the time of writing this report.
Mercury is based on the monitored mercury in particulate and vapour phase.

6.8 Dioxins, furans and polychlorinated biphenyl (PCBs)

Dioxins, furans and PBCs are monitored on a quarterly basis at a number of urban and rural stations in the UK as part of the Toxic Organic Micro Pollutants (TOMPs) network.

Manchester Law Courts is the closest monitoring site to the Facility, located approximately 81km to the north-west. A summary of dioxin and furan and PCB concentrations from all monitoring sites across the UK is presented in the following table. Unfortunately, data is only available up until the end of 2012 from the UK-air website.

Table 6.5: TOMPS – Dioxins and Furan and PCB Monitoring

Site	Annual Mean Dioxin and Furans Concentration (fgTEQ/m^3)		Annual Mean PCBs Concentration (pg/m^3)	
	2011	2012	2011	2012
Auchencorth Moss	0.07	0.13	15.17	10.46
Hazelrigg	2.03	8.75	31.13	28.78
High Muffles	0.98	4.33	24.60	13.74
London Nobel House	3.70	15.45	93.85	83.20
Manchester Law Courts	12.53	33.00	119.45	101.72
Weybourne	2.50	9.25	19.19	19.54

As shown, the concentrations vary significantly between sites and years. As no site is located in close proximity to the Facility, the maximum monitored concentration has been used as the baseline concentration within this assessment (33.00fg/TEQ/m^3 for dioxins and furans, and 119.45pg/m^3 for PCBs).

6.9 Background concentration to be used

The above analysis has shown that there are several local monitoring sites in the area. However, each of these contain a contribution from the existing activities on site. The existing permitted operations have been modelled as part of this application. Therefore, it is most appropriate to use the mapped background concentration as the source of background data in this assessment.

Table 6.6: Summary of Background Concentrations

Pollutant	Annual Mean Concentration	Units	Justification
Nitrogen dioxide (NO_2)	11.1	µg/m^3	2015 DEFRA mapped background concentration maximum within the modelling domain, but assessment also considers local monitoring data
Particulate matter (as PM_{10})	14.5	µg/m^3	2015 DEFRA mapped background concentration maximum within the modelling domain.
Particulate matter (as $PM_{2.5}$)	10.1	µg/m^3	
Formaldehyde (CH_2O)	1	µg/m^3	Monitored concentration from Wrexham AURN in 2016
Carbon monoxide (CO)	223	µg/m^3	2001 mapped background dataset - maximum grid square within the modelling domain

Table 6.6: Summary of Background Concentrations			
Pollutant	**Annual Mean Concentration**	**Units**	**Justification**
Sulphur dioxide (SO_2)	3.4	µg/m^3	2001 mapped background dataset - maximum grid square within the modelling domain
Hydrogen chloride (HCl)	0.71	µg/m^3	Maximum concentration from UK monitoring (2011 – 2015)
Hydrogen fluoride (HF)	2.35	µg/m^3	Maximum measured baseline concentration as presented in the EPAQS report
Antimony (Sb)	0.78	ng/m^3	Maximum annual average monitored concentration from a UK rural background site (2012 – 2016)
Arsenic (As)	0.48	ng/m^3	
Cadmium (Cd)	0.09	ng/m^3	
Chromium (Cr)	3.77	ng/m^3	
Cobalt (Co)	0.08	ng/m^3	
Copper (Cu)	1.92	ng/m^3	
Manganese (Mn)	1.83	ng/m^3	
Mercury (Hg)	1.27	ng/m^3	
Nickel (Ni)	1.37	ng/m^3	
Lead (Pb)	4.40	ng/m^3	
Vanadium (V)	0.85	ng/m^3	
Dioxins and furans	33.00	fg/m^3	Maximum monitored concentration from a UK site (2011 – 2012)
Polychlorinated biphenyl (PCBs)	119.45	pg/m^3	Maximum monitored concentration from a UK site (2011 – 2012)

7 SENSITIVE RECEPTORS

The general approach of this assessment is to evaluate the highest predicted process contribution to ground level concentrations, known as the point of maximum impact. In addition, the predicted process contribution across the modelling domain has been analysed to determine the impact at all areas of relevant exposure. As such individual receptor locations have not been identified.

7.1 Sensitive ecological receptors

A study was undertaken 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 10km of the Facility;
- Sites of Special Scientific Interest (SSSIs) within 2km of the Facility; and
- National Nature Reserves (NNR), Local Nature Reserves (LNRs), Local Wildlife Sites (LWS) and ancient woodlands within 2km of the Facility.

The sensitive ecological receptors identified are displayed in Figure 3 of Appendix A and listed in Table 7.1.

Table 7.1: Sensitive Ecological Receptors

Site	Designation
River Dee and Bala Lake	SAC, SSSI
Johnstown Newt Sites	SAC
Berwyn and South Clwyd Mountains	SAC, IBA
Berwyn	SPA
Chirk Castle	SSSI
Nant-y-Belan and Prynela Woods	Ancient Woodland
Pentri Wood	Ancient Woodland
Barracks Field	LWS
Ceod-Y-Canal Wood	LWS
Various Ancient Woodlands	LWS

The impact of emissions from the Facility has been assessed at the sites identified. The results of this assessment are presented in Section 12.

8 DISPERSION MODELLING METHODOLOGY

8.1 Selection of model

Detailed dispersion modelling was undertaken using the model ADMS 5.2.2, 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 Environmental Permitting purposes to the satisfaction of local authorities, the Environment Agency and NRW.

8.2 Model inputs

8.2.1 Source and emissions data

The principal inputs to the model with respect to the emissions to air from the Facility are presented in 10. When determining the release rate of pollutants in the first instance the maximum volumetric flow rate recorded from each item of plant has been multiplied by the existing or proposed ELV. As detailed in 10, this is conservative as the monitoring data has shown that emissions are typically well below the ELVs and the volumetric flow has varied over the last 2 years.

8.2.2 Meteorological data and surface characteristics

The impact of meteorological data was taken into account by using weather data in the model for the years 2013 – 2017. The nearest meteorological station representative of conditions at the Chirk site is at RAF Shawbury, located approximately 30 km south east of the Facility. Wind roses from RAF Shawbury for each year can be found in Figure 4 of Appendix A. Using 5 years of weather data allows for inter-annual variability to be taken into account and the assessment is based on the worst-case year. This approach prevents a particularly 'bad' year being excluded from the analysis.

8.2.2.1 Surface roughness

The surface roughness length can be selected in ADMS for both the dispersion and meteorological site. The wider area around the Facility is mostly agricultural land, with small areas of woodland and the small residential area of Chirk. A surface roughness length of 0.5m has been used in the model as this is representative of parkland and open suburbia and considered appropriate given the nature of the surrounding area. The complex nature of the site has been considered by included the most significant buildings on site in the modelling as detailed in Section 8.2.5.

The area around the meteorological site is mostly agricultural land. As such, a surface roughness length of 0.2m has been used in the model for the meteorological site.

8.2.2.2 Monin-Obukov length

The Monin-Obukov length for the site and meteorological site can be specified in ADMS. This provides a measure of the stability of the atmosphere and indicates the height above which convective turbulence (i.e. thermal) is more important than mechanical (i.e. friction). This allows for the effect of the urban heat island, to prevent the atmosphere from ever becoming very stable, to be simulated within the model.

For the purpose of this assessment the Monin-Obukov lengths used for the modelling domain and the meteorological site were kept equal. This value was taken to be the model default which is considered appropriate for rural areas.

8.2.3 Modelling domain

Modelling has been undertaken over a 3.3km x 3.3km grid with a spatial resolution of 33m. The maximum grid spacing in each is less than 1.5 times the stack height in accordance with the Environment Agency modelling rule of thumb.

Table 8.1: Modelling Domain

Grid	Domain
Grid Spacing (m)	33
Grid Points	101
Grid Start X	326850
Grid Finish X	330150
Grid Start Y	336750
Grid Finish Y	340050

8.2.4 Terrain

It is recommended that, where gradients within 500m of the modelling domain are greater than 1 in 10, complex terrain data should be used within ADMS. A review of the local area has deemed that the effect of terrain should be considered when setting up the model. To account for this the initial modelling has been undertaken excluding the effects of terrain and a comparison has been undertaken including the effects of terrain. The initial results showed that the effect of terrain was minimal the greatest driver to the dispersion of pollutants in this instance is the building wake effects. The detailed modelling therefore excludes the effects of terrain.

8.2.5 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[4] 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.

[4] AQTAG06 – Technical guidance on detailed modelling approach for an appropriate assessment for emissions to air – January 2013.

A review of the site layout has been undertaken and the details of the applicable buildings are presented in Table 8.2. Only those which are greater than 40% of the stack height have been included. A site plan showing which buildings have been contained in the model is presented in Figure 6 of Appendix A. As shown for the Proposed Scenario a few additional buildings have been included to account for the chip and OSB processes.

Table 8.2: Building Details

Buildings	Centre Point		Height (m)	Length (m)	Width (m)	Angle (°)
	X (m)	Y (m)				
Dry CHP Silos	328422.40	338354.50	26.0	43.16	8.22	91.29
K7 Boiler	328428.20	338318.10	31.0	22.10	35.59	1.94
MDF Refiner B	328451.80	338409.40	27.0	12.20	14.10	82.50
MDF Refiner C	328465.30	338411.10	36.6	14.60	14.10	82.50
MDF Fibre Cyclones	328471.80	338230.90	46.0	11.70	6.16	81.61
Chip Silos	328464.50	338337.80	26.0	18.00	7.00	82.50
Main Factory C	328499.30	338287.10	11.5	65.00	96.00	82.00
Gas Engines	328506.00	338434.10	18.2	26.00	27.60	82.50
WESP	328404.20	338343.50	65.5	5.00	-	-
Main Factory A	328745.70	338373.10	11.5	426.72	197.63	82.00
Main Factory B	328533.00	338321.40	11.5	11.65	154.70	82.00
Ducting structure	328468.90	338296.30	16.5	7.45	68.40	82.00
Structure B	328428.80	338416.70	20.0	24.21	72.04	98.40
Structure A	328440.50	338336.70	20.0	6.53	8.07	180.00
Biomass A	328499.90	338362.40	30.0	5.70	13.17	81.87
Biomass B	328505.60	338363.30	35.0	3.35	9.10	82.23
Biomass Silos	328512.30	338365.90	30.0	5.11	11.39	81.51
Biomass C	328482.40	338359.10	25.0	17.02	9.40	81.08
Proposed Scenario additional buildings						
New Chip Preparation	328401.60	338432.30	36.0	29.00	120.00	98.40
New OSB	328498.2	338306.9	28.0	54.00	31.00	82.00
New OSB 2	328434.8	338292.1	30.0	26.00	16.00	82.00

8.3 Chemistry

The plant will release nitric oxide (NO) and NO_2 which are collectively referred to as NOx. In the atmosphere, a proportion of nitric oxide will be converted to NO_2 in a reaction with ozone which is influenced by solar radiation. Since the AQAL 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 in the Environment Agency's methodology. Given the short travel time to the areas of maximum concentrations, this approach is considered conservative.

8.4 Background concentrations

Background concentrations for the assessment have been derived from the DEFRA background maps as presented previously in Section 6.9. For short-term averaging periods (of less than 24-hours) the background concentration has been assumed to be twice the long-term ambient concentration following the Environment Agency's Air Emissions Guidance methodology.

9 IMPACT ON HUMAN HEALTH – ASSESSMENT CRITERIA

The general approach of this assessment is to evaluate the highest predicted process contribution to ground level concentrations, known as the point of maximum impact. In addition, the predicted process contribution has been evaluated across the modelling domain.

9.1 Screening

The Environment Agency's Air Emissions Guidance states that to screen out 'insignificant' process contributions (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.*

As part of this assessment, predicted process contributions have been compared to the AQALs provided in Section 5.

Consultation with the Environment Agency has confirmed that if the above criteria are achieved, it can be concluded that "it is not likely that emissions would lead to significant environmental impacts" and the process contributions can be screened out.

The long-term 1% process contribution threshold is based on the judgement that:

- it is unlikely that an emission at this level will make a significant contribution to air quality; and
- the threshold provides a substantial safety margin to protect health and the environment.

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

- spatial and temporal conditions mean that short-term process contributions are transient and limited in comparison with long-term process contributions; and
- the threshold provides a substantial safety margin to protect health and the environment.

If process contributions cannot be screened out as 'insignificant', analysis will be undertaken of the PEC (defined as the process contribution plus the background concentration) at the point of maximum impact and at areas of public exposure.

Consultation with the Environment Agency has revealed that if the long-term PEC is below 70% of the AQAL, or the short-term process contribution is less than 20% of the headroom[5] it can be concluded that "there is little risk of the PEC exceeding the AQAL", and the impact can be considered to be "not significant".

For the purpose of this analysis the long term background concentration is assumed to be 13.1 µg/m^3, as justified in Section 6.9. When determining if a short term impact can be described as "not significant" the process contribution should be less than 34.76 µg/m^3 (or 17.4% of the AQAL) – calculated as 20% of the AQAL of 200 µg/m^3 minus 2 x 13.1 µg/m^3.

[5] Calculated as the AQAL minus twice the long-term background concentration

10 IMPACT ON HUMAN HEALTH RESULTS – NORMAL OPERATIONS

10.1 Overview

The detailed results tables presented in Table AC.1 of Appendix C presents the maximum impact using the 5-years of weather data for the proposed normal operations. The results are presented for the maximum anywhere within the modelling domain, and the maximum outside the site boundary. This analysis assumes each item of plant operates at peak capacity.

As shown for the proposed operations the PEC is predicted to be less than 70% of the AQAL for all pollutants and averaging periods, with the exception of daily mean PM_{10}s. For daily mean PM_{10s} the screening assumption is that double the background should be added to determine the short term PEC. However, the approach set out in LAQM.TG(16) is that when determining the daily mean PEC the annual mean background should be added. Using the LAQM.TG(16) approach the PEC is less than 40% of the AQAL. This is not a significant impact.

A detailed analysis for each pollutant is provided in the following sections.

10.1.1 Nitrogen dioxide

As explained in Section 3.1.1, under normal operations the only sources of NOx from the site will be the K1 boiler, MDF 1 and 2 cyclones and the WESP for the existing scenario, but as part of this application it is proposed to include an additional source – the PB WESP.

The following figures have been produced which show the maximum PC of NO_2 for the proposed normal operations:

- Figure 7: Annual Mean Nitrogen Dioxide PC – Normal Operations – Likely Emissions
- Figure 8: Annual Mean Nitrogen Dioxide PC – Normal Operations – Worst-Case Emissions
- Figure 9: 99.79%ile of 1-hour Nitrogen Dioxide PC – Normal Operations –Likely Emissions
- Figure 10: 99.79%ile of 1-hour Nitrogen Dioxide PC – Normal Operations – Worst-Case Emissions

This analysis shows that no exceedences of the long or short term AQAL are predicted during normal operations.

10.1.1.1 Likely emissions scenario

The maximum predicted annual mean NO_2 process contribution from the Proposed Facility during normal operations, based on the likely emissions scenario, outside the site boundary is 8% of the AQAL, and the PEC is predicted to be 36% of the AQAL. The peak impact is close to the eastern boundary of the site. Although the process contribution cannot be screened out as 'insignificant', there is little risk of the PEC exceeding the AQAL and the annual mean impact is "not significant".

The maximum predicted 99.79%ile of 1-hour NO_2 process contribution from the Proposed Facility during normal operations, based on the likely emissions scenario, outside the site boundary is 14% of the AQAL. At all area of relevant public exposure where members of the public are expected to spend periods of 1-hour or more (including residential properties, schools, gardens of residential properties, and any other outdoor locations where members of the public might reasonably be expected to spend one hour or longer) the impact is less than 10% of the AQAL and can be screened out as 'insignificant'.

10.1.1.2 Worst-case emissions scenario

The maximum predicted annual mean NO_2 process contribution from the Proposed Facility during normal operations, based on the worst-case emissions scenario, outside the site boundary is 20% of the AQAL, and the PEC is predicted to be 48% of the AQAL. The peak impact is close to the eastern boundary of the site. Although the process contribution cannot be screened out as 'insignificant', there is little risk of the PEC exceeding the AQAL and the annual mean impact is "not significant".

The maximum predicted 99.79%ile of 1-hour NO_2 process contribution from the Proposed Facility during normal operations, based on the worst-case emissions scenario, outside the site boundary is 35% of the AQAL. At all area of relevant public exposure where members of the public are expected to spend periods of 1-hour or more (including residential properties, schools, gardens of residential properties, and any other outdoor locations where members of the public might reasonably be expected to spend one hour or longer) the impact is less than 25% of the AQAL. This cannot be screened out as 'insignificant', however, the total concentration including background is less than 50% of the AQAL and therefore there is little risk of the PEC exceeding the AQAL.

This scenario is worst-case as it assumes each drier operates at maximum capacity and emissions of NOx are at the BAT AELs. Monitoring of emissions from the driers has shown that emissions are typically 100mg/Nm^3, and therefore anticipated impacts are likely to be similar to those set out in Section 10.1.1.1.

10.1.2 Particulate matter

As explained in Section 3.1.1, under normal operations the only sources of PM from the site will be the MDF 1 and 2 cyclones and the WESP for the existing scenario, but as part of this application it is proposed to include an additional source – the PB WESP.

The following figures have been produced which show the maximum PC of PM for the proposed normal operations:

- Figure 11: Annual Mean PM10 Process Contribution – Normal Operations
- Figure 12: Annual Mean PM2.5 Process Contribution – Normal Operations
- Figure 13: 90.41 %ile 24-hour PM10 Process Contribution – Normal Operations

This analysis shows that no exceedences of the long or short term AQAL are predicted during normal operations.

10.1.2.1 PM10s

The maximum predicted annual mean PM_{10} process contribution from the Proposed Facility during normal operations outside the site boundary is 8% of the AQAL, and the PEC is predicted to be 44% of the AQAL. The peak impact is close to the eastern boundary of the site. Although the process contribution cannot be screened out as 'insignificant', there is little risk of the PEC exceeding the AQAL and the annual mean impact is "not significant".

The maximum predicted 90.41%ile daily mean PM_{10} process contribution from the Proposed Facility during normal operations outside the site boundary is 18% of the AQAL, and the PEC is predicted to be 76% of the AQAL. However, this assumes that the background is twice the annual mean background concentration in accordance with the Environment Agency guidance. The LAQM.TG(16) guidance recommends that when calculating the daily mean PEC the annual mean is used (not twice the annual mean). Using the LAQM.TG(16) guidance the maximum PEC is 47% of the AQAL.

The peak impact is close to the eastern boundary of the site. Although the process contribution cannot be screened out as 'insignificant' at areas of relevant public exposure, there is little risk of the PEC exceeding the AQAL and the annual mean impact is "not significant".

10.1.2.2 PM2.5s

The maximum predicted annual mean $PM_{2.5}$ process contribution from the Proposed Facility during normal operations outside the site boundary is 13% of the AQAL, and the PEC is predicted to be 53% of the AQAL. The peak impact is close to the eastern boundary of the site. Although the process contribution cannot be screened out as 'insignificant', there is little risk of the PEC exceeding the AQAL and the annual mean impact is "not significant".

10.1.3 Formaldehyde

As explained in Section 3.1.1, under normal operations the only sources of CH_2O from the site will be the MDF 1 and 2 cyclones, the WESP, the formaldehyde plant (A1) and the exhausts from the NAIRB wet scrubbers on the paper impregnation lines (A5 and A6) for the existing scenario, but as part of this application it is proposed to include an additional source – the PB WESP.

The following figures have been produced which show the maximum PC of CH_2O for the proposed normal operations:

- Figure 14: Annual Mean Formaldehyde Process Contribution – Normal Operations
- Figure 15: Maximum 1-hour Mean Formaldehyde Process Contribution – Normal Operations

This analysis shows that no exceedences of the long or short term AQAL are predicted during normal operations.

The maximum predicted annual mean CH_2O process contribution from the Proposed Facility during normal operations outside the site boundary is 21% of the AQAL, and the PEC is predicted to be 41% of the AQAL. The peak impact is close to the eastern boundary of the site. Although the process contribution cannot be screened out as 'insignificant', there is little risk of the PEC exceeding the AQAL and the annual mean impact is "not significant".

The maximum predicted 1-hour mean CH_2O process contribution from the Proposed Facility during normal operations outside the site boundary is 16% of the AQAL, and the PEC is predicted to be 18% of the AQAL. At all area of relevant public exposure where members of the public are expected to spend periods of 1-hour or more (including residential properties, schools, gardens of residential properties, and any other outdoor locations where members of the public might reasonably be expected to spend one hour or longer) the impact is less than 10% of the AQAL. This impact can be screened out as 'insignificant'.

10.1.4 Other VOCs

The permit will include an emission limit for TVOCs. This consists of a wide range of VOCs. The Production of Wood-base Panels BREF states that:

> *"The main constitutes of the volatile organic fraction in wood are generally not considered in literature as possessing toxic properties. An exception is formaldehyde."*

In addition to CH_2O (which is considered in Section 10.1.3) there are two AQALs set for two other VOCs; benzene and 1,3-butadiene. If either of these species were to be released from the Facility it would be expected that the BREF and the existing EP would also consider these species. The ELVs are set for TVOC and CH_2O but no other speciation is required. Assuming that the entire TVOC emissions consist on either benzene or 1,3-butadiene is extremely unlikely as if these VOCs were of concern limits would be set in a similar approach to HC_2O.

When considering the effect of TVOC emissions, the concentration has been considered rather than the change as a percentage of an AQAL.

The following figures have been produced:

- Figure 16: Annual Mean TVOC Process Contribution – Normal Operations
- Figure 17: Maximum 1-hour Mean TVOC Process Contribution – Normal Operations

10.1.5 Carbon monoxide

As explained in Section 3.1.1, under normal operations the only sources of CO from the site will be the MDF 1 and 2 cyclones. The CO from MDF 1 cyclone is from the K8 biomass plant and the CO from the MDF 2 cyclone is from the K7 biomass plant. The existing WCBC EP has an emission limit for CO on the MDF 2 cyclone. However, as part of this application it is proposed to remove this ELV and instead set an ELV on the emissions from the K7 biomass plant into the MDF 2 drier.

As shown in Appendix C, the maximum predicted 8-hour rolling mean CO process contribution from the Proposed Facility during normal operations outside the site boundary is less than 10% of the AQAL which can be screened out as 'insignificant'.

10.1.6 Sulphur dioxide

As explained in Section 3.1.1, under normal operations the only sources of SO_2 from the site will be the MDF 1 and 2 cyclones. The SO_2 from MDF 1 cyclone is from the K8 biomass plant and the SO_2 from the MDF 2 cyclone is from the K7 biomass plant.

As shown in Appendix C, the maximum predicted short term SO_2 process contribution from the Proposed Facility during normal operations outside the site boundary is less than 10% of the AQAL which can be screened out as 'insignificant'.

10.1.7 Other pollutants

The K8 biomass plant is a co-incinerator and includes ELVs on emissions to air for the full suite of IED pollutants. Emissions of NOx, PM, VOCs, CO and SO_2 have been considered in the preceding sections as these are also released from other sources on site. Under normal operations the emissions from the K8 biomass plant are used in the MDF 1 drier and vent to atmosphere via the MDF 1 cyclone stack. The detailed results table provided in Appendix C shows that at the point of maximum impact the peak concentration is less than 1% of the long term and less than 10% of the short term standard for all other pollutants with the exception of annual mean cadmium impacts. The peak annual mean cadmium impact is 4% of the AQAL. However, this assumes that emissions from the K8 biomass plant are at the combined ELV for cadmium and thallium, and these only consist of cadmium. Monitoring from the site has shown that cadmium emissions are typically well below the ELV. Although the process contribution cannot be screened out as 'insignificant', there is little risk of the PEC exceeding the AQAL and the annual mean impact of cadmium is "not significant".

10.1.8 Metals

The K8 biomass plant will be regulated as a co-incinerator and as such the EP will include an ELV for total metals. However, there are specific AQALs set for individual metals. The Environment Agency guidance document 'Guidance on assessing group 3 metals stack emissions from incinerators – V.4 June 2016' ('Environment Agency metals guidance') has been developed to assist in determine the impact of individual metals and is applicable for use for this application to NRW. The guidance states that where the PC for any metal exceeds 1% of the long term or 10% of the short term environmental standard (in this case the AQAL), this is considered to have potential for significant pollution. Where the PC exceeds these criteria the PEC should be compared to the environmental standard. The PEC can be screened out where the PEC is less than the environmental standard. Where the impact is within these parameters it can be concluded that there is no risk of exceeding the AQAL and as such the magnitude of change and significance of effect is considered 'negligible'.

Table 10.1 and Table 10.2 detail the PC and PEC assuming that each metal is released at the combined long and short term metal ELVs set out in the IED respectively. If the PC is greater than 1% of the AQAL when it is assumed that each metal is emitted at the total metal ELV, further analysis has been undertaken assuming the release is no greater than the maximum monitored at an existing waste facility. The Environment Agency 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 group ELV. We have used the maximum monitored emission presented in the Environment Agency's analysis as a conservative assumption.

As shown, if it is assumed that the entire emissions of metals consist of only one metal, the impact is generally less than 1% of the long term and less than 10% of the short term AQAL, with the exception of annual mean impacts of arsenic, chromium (VI), manganese and nickel. The PEC is only predicted to exceed the long term AQAL for chromium (VI) using this worst-case screening assumption. If it is assumed that the K8 biomass plant would perform no worse than a currently operating co-incinerator, the process contribution is below 1% of the long term and 10% of the short term AQAL for all pollutants with the exception of nickel. However, the PECs for nickel is well below the AQALs and therefore it can be concluded that there is no risk of exceeding the AQAL for metals.

Table 10.1: Metals Impact – Point of Maximum Impact – Annual Mean							
Metal	AQAL (ng/m³)	Background Concentration (ng/m³)	Assuming each metal emitted at 100% of the group ELV		Maximum monitored emissions (as % of ELV)	Assuming operation no worse than a currently operating Facility	
			PC as % of AQAL	PEC as % of AQAL		PC as % of AQAL	PEC as % of AQAL
Arsenic	3	0.48	58.73%	74.73%	5.00%	0.95%	16.95%
Antimony	5,000	0.78	0.04%	0.05%	2.30%	0.0003%	0.02%
Chromium	5,000	3.77	0.04%	0.11%	18.40%	0.002%	0.08%
Chromium (VI)	0.2	0.75	880.94%	1257.94%	0.03%	0.07%	377.07%
Cobalt	-	0.08	-	-	1.12%	-	-
Copper	10,000	1.92	0.02%	0.04%	5.80%	0.0003%	0.02%
Lead	250	4.40	0.70%	2.46%	10.06%	0.02%	1.78%
Manganese	150	1.83	1.17%	2.39%	12.00%	0.05%	1.27%
Nickel	20	1.37	8.81%	15.66%	44.00%	1.25%	8.10%
Vanadium	5,000	0.85	0.04%	0.05%	1.20%	0.0001%	0.02%

Table 10.2: Metals Impact – Point of Maximum Impact – Maximum 1-hour							
Metal	AQAL (ng/m³)	Background Concentration (ng/m³)	Assuming each metal emitted at 100% of the group ELV		Maximum monitored emissions (as % of ELV)	Assuming operation no worse than a currently operating Facility	
			PC as % of AQAL	PEC as % of AQAL		PC as % of AQAL	PEC as % of AQAL
Arsenic	-	0.96	-	-	5.00%	-	-
Antimony	150,000	1.56	0.04%	0.04%	2.30%	0.0000003%	0.00%
Chromium	150,000	7.54	0.04%	0.04%	18.40%	0.000002%	0.01%
Chromium (VI)	-	1.51	-	-	0.03%	-	-
Cobalt	-	0.16	-	-	1.12%	-	-
Copper	200,000	3.84	0.03%	0.03%	5.80%	0.0000005%	0.00%
Lead	-	8.80	-	-	10.06%	-	-
Manganese	1,500,000	3.66	0.00%	0.004%	12.00%	0.0000001%	0.00%
Nickel	-	2.74	-	-	44.00%	-	-
Vanadium	1000	1.70	5.96%	6.13%	1.20%	0.00002%	0.17%

11 Impact on Human Health Results – Non Standard Operations

11.1 Non-Standard Operations

Section 10 has detailed the impact of the Facility under normal operations. However, as detailed in Section 3, the plant may operate under non-standard conditions if for instance if a drier is offline. A summary of the non-standard operating scenarios is provided below:

(1) MDF 1 offline – MDF 2 drier can use the exhaust gases from the K7 and K8 biomass plants and four gas engines, the electricity needed on site would be reduced so only four gas engines would be needed. Exhaust gases from all four gas engines can be accommodated within the MDF 2 drier. Therefore, there would be no change from normal operations.

(2) MDF 2 offline – MDF 1 drier can use the exhaust gases from the K7 and K8 biomass plants and three gas engines, the electricity needed on site would be reduced so only three gas engines would be needed; two of which would be used in MDF 1 drier, and one would need to vent to atmosphere via its own dedicated stack. Therefore, this would result in an additional emission point to atmosphere from the gas engine. The impact of this operating scenario has been considered further below.

(3) WESP offline – the exhaust gases from the Bab 2 and Bab 3 driers and continuous press abatement system would need to vent to atmosphere via their own dedicated stack. This is considered an emergency release in the existing permit. The WCBC EP ensures that this is limited to periods of less than 1-hour and any occurrences are reported. It is proposed to keep this condition with the new EP. Therefore this scenario has not been considered further.

(4) MDF 1 and 2 offline – If both MDF driers are offline, the exhaust gases from the biomass plants and gas engines would need to vent to atmosphere via their dedicated stacks. If the MDF driers were not online, the power and heat needed for the site would be reduced and these combustion plants would not be needed and would be shut down. Therefore, this operating scenario would only occur for short periods. In this instance there would not be emissions from the MDF cyclones but there would be emissions from the K7, K8 biomass plants, and up to 5 gas engines and the WESP, and the proposed PB WESP as a worst-case. The impact of this operating scenario has been considered further below.

(5) All driers offline – If both MDF driers and the WESP are offline, the emissions would be as scenario (4) above, but emissions would also be released from the Bab 2 and Bab 3 stacks, (or OSB stacks when reconditioned). This is considered an emergency release in the existing permit and the permit ensures that this is limited to periods of less than 1-hour and any occurrences are reported. It is proposed to keep this condition with the new permit. Therefore this scenario has not been considered further.

(6) K7 and K8 biomass plants are offline – the drying process would still be able to operate but the K5 and K6 gas heaters will be used to heat the thermal oil for the presses. In this case emissions from site would also be from the K5 and K6 gas heaters. The impact of this operating scenario has been considered further below.

In all instances the Gas Turbines would be used as back-up to the Gas Engines. The impact of all scenarios where the one or more Gas Engines are not operating and either one or two Gas Turbines are needed has been analysed. For the worst-case emissions scenario, if a Gas Engine or Gas Turbine exhaust gases are used the mass release of emissions from the cyclones calculated will not change, as this is based on the BAT AEL for the driers. Therefore, the impact of the back-up Gas Turbines has not been considered further in this analysis as effectively these would replace emissions from the Gas Engines and impact of both scenarios is similar.

11.2 MDF 2 Offline – Scenario 2

If the MDF 2 drier is offline, the MDF 1 drier can use the exhaust gases from the K7 and K8 biomass plants and two gas engines, the electricity needed on site would be reduced so only 3 gas engines would be needed; the exhaust gases of two engines would be used in MDF 1 drier, and one would need to vent to atmosphere via its own dedicated stack. Therefore, this would result in an additional emission point to atmosphere from the gas engine. The gas engine only includes an ELV for NOx.

Under normal operations exhaust gases from K7 would vent to atmosphere via the MDF 2 drier. However, if this is offline these will vent to atmosphere via the MDF 1 drier. The MDF 1 drier will include an emission limit for NOx, PM and HC_2O and the emissions of other pollutants are based on the release rate from the biomass plants into the drier. The K7 biomass plant will have an emission limit for NOx, CO, PM and SO_2. Emission of NOx and PM are limited at the exit from the MDF drier. For NOx and PM we have assumed that the MDF 1 drier operates at the ELV, and the MDF 1 drier will continue to need to comply with the ELV even if the K7 biomass plant also vented to atmosphere via the MDF 1 drier.

The only potential change to the overall impact of emissions from the facility would be for NOx (due to the gas engine), and CO and SO_2 (as a result of the potential change in dispersion as the release from the K7 biomass plant is vented to atmosphere via the MDF 1 drier). The detailed results tables presented in Table AC.2 of Appendix C presents the maximum impact using the 5-years of weather data when the MDF 2 drier is offline. The results are presented for the maximum anywhere within the modelling domain, and the maximum outside the site boundary. This analysis assumes each item of plant operates at peak capacity.

As shown when the MDF 2 drier is offline the PEC is predicted to be less than 70% of the AQAL for all pollutants and averaging periods. A detailed analysis for each pollutant is provided in the following sections.

11.2.1 Nitrogen dioxide

The following figures have been produced which show the maximum PC of NO_2 for the when the MDF 2 drier is offline:

- Figure 18: Annual Mean Nitrogen Dioxide Process Contribution – MDF 2 Offline
- Figure 19: Annual Mean Nitrogen Dioxide Process Contribution – MDF 2 Offline – Worst-Case Emissions
- Figure 20: 99.79%ile 1-hour Mean Nitrogen Dioxide Process Contribution – MDF 2 Offline – Likely Emissions
- Figure 21: 99.79%ile 1-hour Mean Nitrogen Dioxide Process Contribution – MDF 2 Offline – Worst-Case Emissions

This analysis shows that no exceedences of the long or short term AQAL are predicted when the MDF 2 drier is offline. The impact is also lower than normal operations.

11.2.1.1 Likely emissions scenario

The maximum predicted annual mean NO_2process contribution from the Proposed Facility when the MDF 2 drier is offline, based on the likely emissions scenario, outside the site boundary is 9% of the AQAL, and the PEC is predicted to be 37% of the AQAL. The peak impact is close to the eastern boundary of the site. Although the process contribution cannot be screened out as 'insignificant', there is little risk of the PEC exceeding the AQAL and the annual mean impact is "not significant".

The maximum predicted 99.79%ile of 1-hour NO_2 process contribution from the Proposed Facility when the MDF 2 drier is offline, based on the likely emissions scenario, outside the site boundary is 11% of the AQAL. At all area of relevant public exposure where members of the public are expected to spend periods of 1-hour or more (including residential properties, schools, gardens of residential properties, and any other outdoor locations where members of the public might reasonably be expected to spend one hour or longer) the impact is less than 10% of the AQAL and can be screened out as 'insignificant'.

11.2.1.2 Worst-case emissions scenario

The maximum predicted annual mean NO_2 process contribution from the Proposed Facility when the MDF 2 drier is offline, based on the worst-case emissions scenario, outside the site boundary is 19% of the AQAL, and the PEC is predicted to be 46% of the AQAL. The peak impact is close to the eastern boundary of the site. Although the process contribution cannot be screened out as 'insignificant', there is little risk of the PEC exceeding the AQAL and the annual mean impact is "not significant".

The maximum predicted 99.79%ile of 1-hour NO_2 process contribution from the Proposed Facility when the MDF 2 drier is offline, based on the worst-case emissions scenario, outside the site boundary is 27% of the AQAL. At all area of relevant public exposure where members of the public are expected to spend periods of 1-hour or more (including residential properties, schools, gardens of residential properties, and any other outdoor locations where members of the public might reasonably be expected to spend one hour or longer) the impact is less than 17% of the AQAL. This cannot be screened out as 'insignificant', however, the total concentration including background is less than 50% of the AQAL and therefore there is little risk of the PEC exceeding the AQAL.

This scenario is worst-case as it assumes each drier operates at maximum capacity and emissions of NOx are at the BAT AELs. Monitoring of emissions from the driers has shown that emissions are typically 100mg/Nm^3, and therefore anticipated impacts are likely to be similar to those set out in Section 11.2.1.1.

11.2.2 Carbon monoxide

As shown in Table AC.2 of Appendix C, the maximum predicted 8-hour rolling mean CO process contribution from the Proposed Facility when the MDF 2 drier is offline outside the site boundary is less than 10% of the AQAL which can be screened out as 'insignificant'.

11.2.3 Sulphur dioxide

As shown in Table AC.2 of Appendix C, the maximum predicted short term SO_2 process contribution from the Proposed Facility when the MDF 2 drier is offline outside the site boundary is greater than 10% of the AQAL and cannot be screened out as 'insignificant'.

The following figures have been produced which show the maximum PC of SO_2 for the when the MDF 2 drier is offline:

- Figure 22: 99.18%ile 24-hour Mean Sulphur Dioxide Process Contribution – MDF 2 Offline
- Figure 23: 99.73%ile 1-hour Mean Sulphur Dioxide Process Contribution – MDF 2 Offline
- Figure 24: 99.9%ile 15-min Mean Sulphur Dioxide Process Contribution – MDF 2 Offline

This is based on the K7 biomass plant operating at the ELV of 200 mg/Nm^3 (6% reference oxygen content) as taken from Process Guidance Note 1/02/(12), and the K8 operating at the ELV of 50 mg/Nm^3 (6% reference oxygen content) as taken from the IED. The greatest contributor to the predicted SO_2 impact is the K7 biomass plant. The impact from the K8 biomass plant is less than 2% of the AQAL for all averaging periods. Monitoring from the K7 biomass plant has shown that emissions of SO_2 are significantly lower than the proposed ELV of 200 mg/Nm^3.

The maximum predicted 99.18%ile of 24-hour SO_2 process contribution from the Proposed Facility when the MDF 2 drier is offline outside the site boundary is 11% of the AQAL. At all area of relevant public exposure where members of the public are expected to spend periods of 24-hours or more (including residential properties, schools, gardens of residential properties, and any other outdoor locations where members of the public might reasonably be expected to spend 24 hours or longer) the impact is less than 10% of the AQAL. This impact can be screened out as 'insignificant'.

The maximum predicted 99.73%ile of 1-hour SO_2 process contribution from the Proposed Facility when the MDF 2 drier is offline outside the site boundary is 10% of the AQAL. This impact can be screened out as 'insignificant'.

The maximum predicted 99.90%ile of 15-minute SO_2 process contribution from the Proposed Facility when the MDF 2 drier is offline outside the site boundary is 16% of the AQAL. At a small area of the public footpath to the west of the Facility where members of the public could be expected to spend periods of 15-minutes or more the impact cannot be screened out as 'insignificant'. However, at all residential properties the impact can be screened out as 'insignificant'. The total concentration including background is less than 20% of the AQAL and therefore there is little risk of the PEC exceeding the AQAL.

This analysis is highly conservative as it assumes that emissions of SO_2 from the K7 and K8 biomass plant are at the ELVs. As such the results presented are considered worst-case and actual impacts are likely to be lower.

11.3 MDF 1 and 2 Offline – Scenario 4

If both MDF driers are offline, the exhaust gases from the biomass plant and gas engines would vent to atmosphere via their dedicated stacks. If the MDF driers were not online, the power and heat needed for the site would be reduced and these combustion plants would not be needed and would be shut down. It would also not be beneficial Kronospan to operate the combustion plant in power only generation mode for prolonged periods. Therefore, this operating scenario would only occur for short periods. The detailed results tables presented in Table AC.3 of Appendix C presents the maximum impact using the 5-years of weather data when the MDF 1 and 2 driers are offline and all combustion plant needs to vent to atmosphere via their dedicated stacks. The results are presented for the maximum anywhere within the modelling domain, and the maximum outside the site boundary. This analysis assumes each item of plant operates at peak capacity. It should be noted that CH_2O and TVOCs is not released from any of the combustion plants and therefore when the combustion plant emit to atmosphere via their dedicated stacks there would be no increase in CH_2O and TVOC emissions from the site, and these would actually reduce as the MDF driers which are a source are no longer operating.

As shown the PEC is predicted to be less than 70% of the AQAL for all pollutants and averaging periods outside the site boundary, with the exception of daily mean PM10s. For daily mean PM10s the screening assumption is that double the background should be added to determine the short term PEC. However, the approach set out in LAQM.TG(16) is that when determining the daily mean PEC the annual mean background should be added. Using the LAQM.TG(16) approach the PEC is less than 50% of the AQAL. This is not a significant impact.

A detailed analysis for each pollutant is provided in the following sections. Although results are presented in the Table AC.3 of Appendix C for all averaging periods this analysis has only focussed on impact of a period of 1-hours or less. As explained, if the MDF driers are offline for any period the power demand for the site would be reduced and not all the combustion plant would be needed. Therefore this detailed analysis has only focused on NO_2, CO, SO_2, and the other pollutants released from the K8 biomass plant.

11.3.1 Nitrogen dioxide

The following figure has been produced which show the maximum predicted impact from the Facility when the MDF 1 and 2 driers are offline and the combustion plant normally venting to atmosphere via these driers vents to atmosphere via their dedicated stacks. This assumes that the emissions from WESPs are based on the monitored typical emissions from the driers and emissions from the combustion plant is calculated based on operating at the ELV:

- Figure 25: 99.79%ile 1-hour Mean Nitrogen Dioxide Process Contribution – MDF 1 and 2 Offline – Likely Emissions

The following figure has been produced which show the maximum predicted impact from the facility when the MDF 1 and 2 driers are offline and the combustion plant normally venting to atmosphere via these driers vents to atmosphere via their dedicated stacks. This assumes that the emissions from WESPs are based on the BAT AELS for the driers and emissions from the combustion plant is calculated based on operating at the ELV:

- Figure 26: 99.79%ile 1-hour Mean Nitrogen Dioxide Process Contribution – MDF 1 and 2 Offline – Worst-Case Emissions

The maximum predicted 99.79%ile of 1-hour NO_2 process contribution from the Proposed Facility when the MDF 1 and 2 driers are offline and the combustion plant normally venting to atmosphere via these driers vents to atmosphere via their dedicated stacks, based on the likely emissions scenario, outside the site boundary is 34% of the AQAL. At all area of relevant public exposure where members of the public are expected to spend periods of 1-hour or more (including residential properties, schools, gardens of residential properties, and any other outdoor locations where members of the public might reasonably be expected to spend one hour or longer) the impact is less than 20% of the AQAL. This cannot be screened out as 'insignificant', however, the total concentration including background is less than 50% of the AQAL and therefore there is little risk of the PEC exceeding the AQAL.

The maximum predicted 99.79%ile of 1-hour NO_2 process contribution from the Proposed Facility when the MDF 1 and 2 driers are offline and the combustion plant normally venting to atmosphere via these driers vents to atmosphere via their dedicated stacks, based on the worst-case emissions scenario, outside the site boundary is 37% of the AQAL. At all area of relevant public exposure where members of the public are expected to spend periods of 1-hour or more (including residential properties, schools, gardens of residential properties, and any other outdoor locations where members of the public might reasonably be expected to spend one hour or longer) the impact is less than 25% of the AQAL. This cannot be screened out as 'insignificant', however, the total concentration including background is less than 50% of the AQAL and therefore there is little risk of the PEC exceeding the AQAL.

This scenario is worst-case as it assumes that the remaining driers operate at maximum capacity and emissions of NOx are at the BAT AELs. Monitoring of emissions from the driers has shown that emissions are typically 100mg/Nm^3, and therefore anticipated impacts are likely to be similar to those set out for the likely emissions case.

11.3.2 Carbon monoxide

As shown in Appendix C, the maximum predicted 8-hour rolling mean CO process contribution from the Proposed Facility when the MDF 1 and 2 driers are offline outside the site boundary is less than 10% of the AQAL which can be screened out as 'insignificant'.

11.3.3 Sulphur dioxide

As shown in Table AC.3 of Appendix C, the maximum predicted short term SO_2 process contribution from the Proposed Facility when the MDF 1 and 2 driers are offline and the combustion plant normally venting to atmosphere via these driers vents to atmosphere via their dedicated stacks, outside the site boundary is greater than 10% of the AQAL and cannot be screened out as 'insignificant'.

The following figures have been produced which show the maximum PC of SO_2 for the when the MDF 2 drier is offline:

- Figure 27: 99.18%ile 24-hour Mean Sulphur Dioxide Process Contribution – MDF 1 and 2 Offline
- Figure 28: 99.73%ile 1-hour Mean Sulphur Dioxide Process Contribution – MDF 1 and 2 Offline
- Figure 29: 99.9%ile 15-min Mean Sulphur Dioxide Process Contribution – MDF 1 and 2 Offline

As explained previously, this is based on the K7 biomass plant operating at the ELV of 200 mg/Nm^3 (6% reference oxygen content) as taken from Process Guidance Note 1/02/(12), and the K8 operating at the ELV of 50 mg/Nm^3 (6% reference oxygen content) as taken from the IED. The greatest contributor to the predicted SO_2 impact is the K7 biomass plant. The impact from the K8 biomass plant is less than 2% of the AQAL for all averaging periods. Monitoring from the K7 biomass plant has shown that emissions of SO_2 are lower than the proposed ELV of 200 mg/Nm^3.

The maximum predicted 99.18%ile of 24-hour SO_2 process contribution from the Proposed Facility when the MDF 1 and 2 driers are offline outside the site boundary is 32% of the AQAL. At all area of relevant public exposure where members of the public are expected to spend periods of 24-hours or more (including residential properties, schools, gardens of residential properties, and any other outdoor locations where members of the public might reasonably be expected to spend 24 hours or longer) the impact is less than 10% of the AQAL. This impact can be screened out as 'insignificant'.

The maximum predicted 99.73%ile of 1-hour SO_2 process contribution from the Proposed Facility when the MDF 1 and 2 driers are offline outside the site boundary is 22% of the AQAL. At all area of relevant public exposure where members of the public are expected to spend periods of 1-hour or more (including residential properties, schools, gardens of residential properties, and any other outdoor locations where members of the public might reasonably be expected to spend 1 hour or longer) the impact is less than 10% of the AQAL. This impact can be screened out as 'insignificant'.

The maximum predicted 99.90%ile of 15-minute SO_2 process contribution from the Proposed Facility when the MDF 1 and 2 driers are offline outside the site boundary is 31% of the AQAL. At a small area of the public footpath to the west of the Facility where members of the public could be expected to spend periods of 15-minutes or more the impact cannot be screened out as 'insignificant'. However, at all residential properties the impact can be screened out as 'insignificant'. The total concentration including background is less than 35% of the AQAL and therefore there is little risk of the PEC exceeding the AQAL.

This analysis is highly conservative as it assumes that emissions of SO_2 from the K7 and K8 biomass plant are at the ELVs. As such the results presented are considered worst-case and actual impacts are likely to be lower.

11.3.4 Other pollutants

The K8 biomass plant is a co-incinerator and includes ELVs on emissions to air for the full suite of IED pollutants. Emissions of NOx, PM, CO and SO2 have been considered in the preceding sections as these are also released from other sources on site. However, the K8 biomass plant includes emissions limits for the full suite of IED pollutants. The detailed results table provided in Appendix C shows that at the point of maximum impact the peak concentration is less than 10% of the short term standard for all other pollutants and therefore the impact can be screened out as 'insignificant'.

11.4 K7 and K8 biomass plants offline – Scenario 6

If either K7 or K8 biomass plant are offline, the MDF driers would still be able to operate but the K5 or K6 gas heaters will be used to heat the thermal oil for the presses. In this case NOx emissions from site would be from the K1 boiler, MDF 1 cyclone, MDF 2 cyclone, SEKA, K5 or K6. The worst-case scenario is that both the K7 and K8 biomass plants are offline, as in this instance both the K5 and K6 gas heaters would be needed to heat the thermal oil for the presses. The K5 and K6 gas heaters only includes an ELV for NOx. Therefore, this analysis has only focused on NO_2 impacts. The detailed results tables presented in Table AC.4 of Appendix C presents the maximum impact using the 5-years of weather data when the K7 and K8 biomass plant are offline and K5 and K6 gas heaters are needed to heat the thermal oil.

11.4.1 Nitrogen dioxide

The following figure has been produced which show the maximum predicted impact from the Facility when the K7 and K8 biomass plants are offline but the Facility is still operating at peak capacity, based on the likely emissions scenario. This assumes that the emissions from driers and WESPs are based on the monitored typical emissions and emissions from the combustion plant is calculated based on operating at the ELV:

- Figure 30: 99.79%ile 1-hour Mean Nitrogen Dioxide Process Contribution – K7 and K8 Offline – Likely Emissions

The following figure has been produced which show the maximum predicted impact from the Facility when the K7 and K8 biomass plants are offline but the Facility is still operating at peak capacity, based on the worst-case emissions scenario. This assumes that the emissions from driers and WESPs are based on the BAT AELS emissions from the driers and emissions from the combustion plant is calculated based on operating at the ELV:

- Figure 31: 99.79%ile 1-hour Mean Nitrogen Dioxide Process Contribution – K7 and K8 Offline – Worst-Case Emissions

The maximum predicted 99.79%ile of 1-hour NO_2 process contribution from the Proposed Facility when the K7 and K8 biomass plants are offline, but the Facility is still operating at peak capacity based on the likely emissions scenario outside the site boundary is 40% of the AQAL. At all area of relevant public exposure where members of the public are expected to spend periods of 1-hour or more (including residential properties, schools, gardens of residential properties, and any other outdoor locations where members of the public might reasonably be expected to spend one hour or longer) the impact is less than 20% of the AQAL. Although this cannot be screened out as 'insignificant', the total concentration including background is less than 40% of the AQAL and therefore there is little risk of the PEC exceeding the AQAL.

The maximum predicted 99.79%ile of 1-hour NO_2 process contribution from the Proposed Facility when the K7 and K8 biomass plants are offline, but the Facility is still operating at peak capacity based on the worst-case emissions scenario outside the site boundary is 47% of the AQAL. At all area of relevant public exposure where members of the public are expected to spend periods of 1-hour or more (including residential properties, schools, gardens of residential properties, and any other outdoor locations where members of the public might reasonably be expected to spend one hour or longer) the impact is less than 30% of the AQAL. Although this cannot be screened out as 'insignificant', the total concentration including background is less than 60% of the AQAL and therefore there is little risk of the PEC exceeding the AQAL.

This scenario is worst-case as it assumes that the remaining driers operate at maximum capacity and emissions of NOx are at the BAT AELs. Monitoring of emissions from the driers has shown that emissions are typically 100mg/Nm^3, and therefore anticipated impacts are likely to be similar to those set out for the likely emissions case.

12 IMPACT AT ECOLOGICAL RECEPTORS

12.1 Operating Scenarios

The Critical Levels for protection of ecosystems are set for NOx, SO2, and HF and are expressed as a daily, weekly and annual mean, and acid and nitrogen deposition are expressed as an annual deposition rate. The operating scenarios which occur for periods of 1-hour or less are therefore not considered in this assessment. Of the scenarios identified in Section 3, only the following are expected to occur for periods of more than 1-hour:

(1) Normal operations – MDF1 and MDF2 driers operating and emissions from the Bab 2 and Bab 3 driers (or OSB driers) emit to atmosphere via the WESP. The only relevant emissions from site are from the K1 boiler, MDF 1 cyclone, MDF 2 cyclone, the WESP and the proposed PB WESP. The impact of this operating scenario has been considered further.

(2) MDF 1 offline – MDF 2 drier can use the exhaust gases from the K7 and K8 biomass plants and four gas engines, the electricity needed on site would be reduced so only four gas engines would be needed. Exhaust gases from all four gas engines can be accommodated within the MDF 2 drier. Therefore, the only relevant emissions from site would be from the K1 boiler, MDF 2 cyclone, the WESP and the proposed PB WESP – i.e. no change from normal operations.

(3) MDF 2 offline – MDF 1 drier can use the exhaust gases from the K7 and K8 biomass plants and three gas engines, the electricity needed on site would be reduced so only three gas engines would be needed; two of which would be used in MDF 1 drier, and one would need to vent to atmosphere via its own dedicated stack. Therefore, the only relevant emissions from site would be from the K1 boiler, MDF 1, a single gas engine, the WESP and the proposed PB WESP. The impact of this operating scenario has been considered further below.

(4) K7 and K8 biomass plants are offline – the drying process would still be able to operate but the K5 and K6 heaters will be used to heat the thermal oil for the presses. In this case relevant emissions from site would be from the K1 boiler, MDF 1 cyclone, MDF 2 cyclone, WESP, K5 and K6. This scenario is not expected to occur for extended periods and not for a continuous 24 hour period.

The only scenario in which all the combustion plant on site would be operating concurrently would be if the MDF 1 and MDF 2 driers are unavailable. However, if MDF 1 and MDF 2 driers are unavailable the electricity demand on site would be reduced and not all items of combustion plant would be required. This scenario would only occur for periods of 1 hour or less. Therefore, this scenario has not been considered in relation to the impact on ecological receptors.

12.2 Emissions Scenarios

The assessment of the impact of the Facility in relation to the AQALs for the protection of human health considered a range of emissions scenarios for NOx and concluded that even the likely emissions scenario had a great deal of conservatism applied in modelling. The impact of the emissions on ecological receptors has just considered the likely emissions scenario noting that the results are based on the following worst-case assumptions:

(1) All items of plant run at peak capacity when operating.

In reality, each item of plant is not continually operated at peak capacity as operations are dependent upon production.

(2) Emissions from all combustion plant are at the ELVs.

Monitoring of the emissions from the existing combustion plant on-site show that these normally operate below the ELVs.

(3) Operation of all items of plant occur during the worst-case weather conditions for dispersion.

It is unlikely that the non-standard operations would occur at the same time as the adverse conditions for dispersion of emissions occur.

(4) The predicted impacts are based on the maximum predicted concentration using 5 years of weather data.

12.3 Screening

The EA have produced Operational Instruction documents which explain how to assess aerial emissions from new or expanding Integrated Pollution Prevention and Control (IPPC) regulated industry applications, issued under the Environmental Permitting Regulations. The process to follow to satisfy the requirements of the Conservation of Habitats and Species Regulations 2010, Countryside and Rights of Way (CRoW) Act 2000, and the EA's wider duties under the Environment Act 1995 and the Natural Environment and Rural Communities Act 2006 (NERC06) are outlined.

Operational Instruction 67_12 "Detailed assessment of the impact of aerial emissions from new or expanding IPPC regulated industry for impacts on nature conservation"[6] provides the following risk based screening criteria for nature conservation sites.

Table 12.1: Screening Criteria

Threshold	European Sites	SSSIs	NNR, LNR, LWS, ancient woodland
Y (% threshold long-term)	1	1	100
Y (% threshold short-term)	10	10	100
Z (% threshold)	70	70	100
Note: short-term considers both daily and weekly timescales.			

Where:

- Y is the long-term process contribution calculated as a percentage of the relevant Critical Level or Load; and
- Z is the long-term predicted environmental concentration (PEC) calculated as a percentage of the relevant Critical Level or Load.

Operational Instruction 66-12 states:

- If PC < Y% Critical Level and Load then emissions from the application are 'not significant', and
- If PEC < Z% Critical Level and Load it can be concluded 'no likely significant effect' (alone and in-combination).

AQTAG 17 – "Guidance on in combination assessments for aerial emissions from EPR permits" states that:

> *"Where the maximum process contribution (PC) at the European site(s) is less than the Stage 2 de-minimis threshold of the relevant critical level or load, the PC is considered to be inconsequential and there is no potential for an alone or in-combination effects with other plans and projects."*

[6] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010039/EN010039-000589-Environment%20Agency%20-%20Document%202.pdf

Consultation with the EA has confirmed that the "Stage 2 de-minimis threshold" is the criteria outlined in Operational Instruction 67_12 outlined above.

It is important to note that the existing site has been operating for a number of years and the normal operations scenario will continue to be permitted by WCBC.

12.4 Aerial emissions – Critical Levels

12.4.1 Results – long term

When determining the impact of the operations in relation to the long term Critical Level is it appropriate to consider the normal operating scenarios, noting that this is conservative as it assumes all plant continually operates and does not consider periods of reduced operations on site or shutdowns.

Detailed results tables for each operating scenario are provided in Appendix D. This is supported by the following figures:

- Figure 32: Annual Mean NOx Process Contribution – Normal Operations – Proposed Operations – Likely Emissions
- Figure 33: Annual Mean SO2 Process Contribution – Normal Operations – Proposed Operations
- Figure 34: Annual Mean NOx Process Contribution – MDF 2 Offline – Proposed Operations – Likely Emissions
- Figure 35: Annual Mean SO2 Process Contribution – MDF 2 Offline – Proposed Operations

As shown for NOx the impact of normal operations is greater than when the MDF 2 drier is offline. This is as when the MDF 2 drier is offline this is no longer a source of NOx. However, for SO_2 the impact is greater when MDF 2 is offline. This is as the SO_2 released from MDF 1 consists of that from the K7 and K8 biomass plants, the increase is attributed to the lower rate of dispersion from the MDF 1 drier than MDF 2 drier.

12.4.1.1 NOx - Likely Emissions Scenario

As shown, for the likely emissions scenario the process contribution is less than 1% of the Critical Level, for both normal operations and when the MDF 2 drier is offline, at all European designated sites with the exception of River Dee and Bala Lake SAC. Therefore it can be concluded that emissions from the Facility are not significant at these sites and there is no likely significant effect, alone and in-combination with other sources.

The maximum impact at the River Dee and Bala SAC is 5.1% of the Critical Level during normal operations, which is reduced to 4.1% when the MDF 2 dryer is offline. However, the PEC remains below 70% of the Critical Level. Therefore emissions from the Facility are deemed to be 'not significant'.

The maximum impact at Chirk Castle SSSI is 7.6% of the Critical Level during normal operations and when the MDF 2 dryer is offline. However, the PEC remains below 70% of the Critical Level. Therefore emissions from the Facility are deemed to be 'not significant'.

The maximum impact at the two specifically identified ancient woodlands is 2.8% of the Critical Level during normal operations, which is reduced to 2.3% when the MDF 2 dryer is offline. As the process contribution is less than the Critical Level the contribution from the Facility is not significant. A review of the plot files has been undertaken to determine the impact at all other non-designated sites not specifically identified in Table 7.1 this has shown that at all sites the process contribution is less than the Critical Level the contribution from the Facility is not significant.

12.4.1.2 Sulphur dioxide

As shown, process contribution is less than 1% of the Critical Level, for both normal operations and when the MDF 2 drier is offline, at all European designated sites with the exception of River Dee and Bala Lake SAC. Therefore it can be concluded that emissions from the Facility are not significant at these sites and there is no likely significant effect, alone and in-combination with other sources.

The maximum impact at the River Dee and Bala SAC is 2.0% of the Critical Level during normal operations, which is increased to 2.8% when the MDF 2 dryer is offline. However, the PEC remains well below 70% of the Critical Level. Therefore emissions from the Facility are deemed to be 'not significant'.

The maximum impact at Chirk Castle SSSI is 2.1% of the Critical Level during normal operations and 4.4% when the MDF 2 dryer is offline. However, the PEC remains below 70% of the Critical Level. Therefore emissions from the Facility are deemed to be 'not significant'.

The maximum impact at the two specifically identified ancient woodlands is 0.9% of the Critical Level during normal operations, which is increased to 1.2% when the MDF 2 dryer is offline. As the process contribution is less than the Critical Level the contribution from the Facility is not significant. A review of the plot files has been undertaken to determine the impact at all other non-designated sites not specifically identified in Table 7.1 this has shown that at all sites the process contribution is less than the Critical Level the contribution from the Facility is not significant.

This is based on the K7 biomass plant operating at the ELV of 200 mg/Nm^3 (6% reference oxygen content) as taken from Process Guidance Note 1/02/(12), and the K8 operating at the ELV of 50 mg/Nm^3 (6% reference oxygen content) as taken from the IED. The greatest contributor to the predicted SO_2 impact is the K7 biomass plant. Monitoring from the K7 biomass plant has shown that emissions of SO_2 are lower than the proposed ELV of 200 mg/Nm^3.

12.4.2 Results – Short term

When determining the impact of the operations in relation to the short term Critical Level, it is appropriate to consider both normal and abnormal operating scenarios, noting that this is conservative as it assumes all plant operate concurrently during the worst-case conditions for dispersion.

Detailed results tables for each operating scenario are provided in Appendix C. This is supported by the following figures:

- Figure 36: Max Daily Mean NOx Process Contribution – Normal Operations – Proposed Operations – Likely Emissions
- Figure 37: Max Weekly Mean HF Process Contribution – Normal Operations – Proposed Operations
- Figure 38: Max Daily Mean HF Process Contribution – Normal Operations – Proposed Operations
- Figure 39: Max Daily Mean NOx Process Contribution – MDF 2 Offline – Proposed Operations – Likely Emissions

As shown for HF the impact is the same as normal operations when MDF 2 is offline. This is as HF is only released from the K8 biomass plant which normally vents to atmosphere via the MDF 1 drier, therefore the MDF 2 drier being offline does not change this.

12.4.2.1 NOx - Likely Emissions Scenario

As shown, for the likely emissions scenario the process contribution is less than 10% of the Critical Level, for both normal operations and when the MDF 2 drier is offline, at all European designated sites with the exception of River Dee and Bala Lake SAC. Therefore it can be concluded that emissions from the Facility are not significant at these sites and there is no likely significant effect, alone and in-combination with other sources.

The maximum impact at the River Dee and Bala SAC is 25.9% of the Critical Level during normal operations, which is reduced to 21.8% when the MDF 2 dryer is offline. The PEC does not exceed but is greater than 70% of the Critical Load.

The maximum impact at Chirk Castle SSSI is 43.1% of the Critical Level during normal operations, which is increased to 46.1% when the MDF 2 dryer is offline. The PEC does not exceed but is greater than 70% of the Critical Load.

The maximum impact at the two specifically identified ancient woodlands is 13.6% of the Critical Level during normal operations, which is reduced to 10.3% when the MDF 2 dryer is offline. As the process contribution is less than the Critical Level the contribution from the Facility is not significant. A review of the plot files has been undertaken to determine the impact at all other non-designated sites not specifically identified in Table 7.1 this has shown that at all sites the process contribution is less than the Critical Level the contribution from the Facility is not significant.

12.4.2.2 Hydrogen fluoride

As shown, process contribution is less than 10% of the Critical Level at all the sensitive receptors identified. Therefore it can be concluded that emissions from the Facility are not significant at these sites and there is no likely significant effect, alone and in-combination with other sources.

A review of the plot files has been undertaken to determine the impact at all other non-designated sites not specifically identified in Table 7.1 this has shown that at all sites the process contribution is less than the Critical Level the contribution from the Facility is not significant.

12.5 Deposition of emissions

The deposition Critical Loads are expressed as an annual deposition rate. Therefore, only the operating scenarios which occur for periods of more than a day have been considered. Of the scenarios identified in Section 3, only the following are expected to occur for periods of more than a day:

(1) Normal operations – MDF1 and MDF2 driers operating and emissions from the Bab 2 and Bab 3 driers emit to atmosphere via the SEKA. The only NOx emissions from site are from the K1 boiler, MDF 1 cyclone, MDF 2 cyclone, the WESP and the proposed PB WESP. The impact of this operating scenario has been considered further.

(2) MDF 1 offline – MDF 2 drier can use the exhaust gases from the K7 and K8 biomass plants and four gas engines, the electricity needed on site would be reduced so only four gas engines would be needed. Exhaust gases from all four gas engines can be accommodated within the MDF 2 drier. Therefore, the only NOx emissions from site would be from the K1 boiler, MDF 2 cyclone, the WESP and the proposed PB WESP – i.e. no change from normal operations.

(3) MDF 2 offline – MDF 1 drier can use the exhaust gases from the K7 and K8 biomass plants and three gas engines, the electricity needed on site would be reduced so only three gas engines would be needed; two of which would be used in MDF 1 drier, and one would need to vent to atmosphere via its own dedicated stack. Therefore, the only NOx emissions from site would be from the K1 boiler, MDF 1 drier, a single gas engine, the WESP and the proposed PB WESP. The impact of this operating scenario has been considered further.

12.5.1 Results – deposition

When determining the impact of the operations in relation to the long term Critical Load is it appropriate to consider the normal operating scenarios, noting that this is conservative as it assumes all plant continually operates and does not consider periods of reduced operations on site or shutdowns.

Detailed results tables for each operating scenario are provided in Appendix D. This is supported by the following figures:

- Figure 40: N Deposition Process Contribution – Normal Operations – Proposed Operations – Grassland
- Figure 41: N Deposition Process Contribution – Normal Operations – Proposed Operations – Woodland
- Figure 42: Acid Deposition Process Contribution – Normal Operations – Proposed Operations – Grassland
- Figure 43: Acid Deposition Process Contribution – Normal Operations – Proposed Operations – Woodland
- Figure 44: N Deposition Process Contribution – MDF 2 Offline – Proposed Operations – Grassland
- Figure 45: N Deposition Process Contribution – MDF 2 Offline – Proposed Operations – Woodland
- Figure 46: Acid Deposition Process Contribution – MDF 2 Offline – Proposed Operations – Grassland
- Figure 47: Acid Deposition Process Contribution – MDF 2 Offline – Proposed Operations – Woodland

12.5.1.1 N Deposition - Likely Emissions Scenario

As shown, for the likely emissions scenario the process contribution is less than 1% of the habitat specific Critical Load, for both normal operations and when the MDF 2 drier is offline, at all European designated sites. Therefore it can be concluded that emissions from the Facility are not significant at these sites and there is no likely significant effect, alone and in-combination with other sources.

The maximum impact at Chirk Castle SSSI is 4.6% of the minimum Critical Load for woodland habitats during normal operations and when the MDF 2 dryer is offline. Although, the PEC exceeds the Critical Load the contribution from the Facility is small. The Kronospan Facility has been operational since before the Chirk Castle SSSI was designated as a SSSI.

The maximum impact at the two specifically identified ancient woodlands is less than the Critical Load. A review of the plot files has been undertaken to determine the impact at all other non-designated sites not specifically identified in Table 7.1 this has shown that at all sites the process contribution is less than the minimum Critical Load for woodlands. Therefore, the contribution from the Facility is not significant.

12.5.1.2 Acid Deposition - Likely Emissions Scenario

As shown, process contribution is less than 1% of the upper Critical Load, for both normal operations and when the MDF 2 drier is offline, at all European designated sites. However, when considering the lower Critical Load the maximum contribution is slightly above 1% of the lower Critical Load.

The maximum impact at Chirk Castle SSSI is 8.2% of the lower Critical Level during normal operations and 14.0% when the MDF 2 dryer is offline. There is no upper Critical Load. This analysis is based on a Critical Load of 10kgN/ha/yr being applicable across the SSSI. The Kronospan Facility has been operational since before the Chirk Castle SSSI was designated as a SSSI.

The maximum impact at the two specifically identified ancient woodlands is less than the Critical Load. A review of the plot files has been undertaken to determine the impact at all other non-designated sites not specifically identified in Table 7.1 this has shown that at all sites the process contribution is less than the minimum Critical Load for woodlands. Therefore, the contribution from the Facility is not significant.

This is based on the K7 biomass plant operating at the ELV of 200 mg/Nm^3 (6% reference oxygen content) as taken from Process Guidance Note 1/02/(12), and the K8 operating at the ELV of 50 mg/Nm^3 (6% reference oxygen content) as taken from the IED. The greatest contributor to the predicted SO_2 impact is the K7 biomass plant. Monitoring from the K7 biomass plant has shown that emissions of SO_2 are lower than the proposed ELV of 200 mg/Nm^3.

12.6 Summary

With regard to the impact on ecology, only those operating scenarios which could occur for periods of at least one day have been considered. The results have shown that:

- At all European Designated sites the impact of process emissions is less than 1% of the long term and less than 10% of the short term Critical Level with the exception of River Dee and Bala Lake SAC.
- At the River Dee and Bala Lake SAC the maximum impact is slightly greater than 1% of the long term and 10% of the short term Critical Levels for NOx and SO_2. However, the annual mean PEC remains below 70% of the Critical Level. The peak daily mean does not exceed the Critical Level but does exceed 70% of the Critical Level.
- At all European Designated sites the impact of process emissions is less than 1% of the habitat specific long term Critical Load for nitrogen deposition. The impact is just over 1% of the lower Critical Load for acid deposition. However, the PEC is predicted to be well below 70% of the lower Critical Load for acid deposition. This is not deemed to be a significant impact.
- At Chirk Castle SSSI the impact of process emissions greater than 1% of the long term and 10% of the short term Critical Levels for NOx and SO_2. However, the PEC remains below 70% of the Critical Level. This is not deemed to be a significant impact.
- At Chirk Castle SSSI the impact of process emissions greater than 1% of the habitat specific long term Critical Loads for nitrogen and acid deposition. In both cases the existing deposition rate exceeds the specified Critical Load. However, in both cases the main contributor is from background sources. It is not clear if the current operations at the Kronospan site are included in the APIS background dataset.
- At all non-statutory designated sites the process contribution is not predicted to exceed the Critical Level or habitat specific Critical Load. This is not deemed to be a significant impact.

13 CONCLUSIONS

This Dispersion Modelling Assessment has been carried out to support the EP variation application for the Kronospan Facility. The Facility is currently permitted by both NRW and WCBC. It is proposed to consolidate the permits into a single permit under the jurisdiction of NRW. As part of this application Kronospan are also seeking permission for new Chip Plant and OSB line. A full detailed explanation of the agreed process of applying for the EP application is detailed within the Supporting Information report.

The dispersion modelling undertaken has used a number of highly conservative assumptions.

(1) All items of plant run at peak capacity when operating.

Each item of plant is not continually operated at peak capacity as operations are dependent upon production.

(2) Emissions from all plant are at the BAT AELs or ELVs.

Monitoring of the emissions from the existing combustion plant on-site show that these normally operate below the ELVs. The BAT AELs for the driers are easily achieved. The monitoring from the existing driers has shown that the emissions are well below the BAT AELs therefore a likely and worst case emissions scenario has been considered in relation to NOx.

(3) Operation of all items of plant occur during the worst-case weather conditions for dispersion;

It is unlikely that the non-standard operations would occur at the same time as the adverse conditions for dispersion of emissions occur

(4) The predicted impacts are based on the maximum predicted concentration using 5 years of weather data.

With regard the impact on human health, during normal operations, although the predicted process contribution cannot be screened out as 'insignificant' for all annual mean impacts of pollutants, there is little risk of the PEC exceeding any of the AQALs. During normal operations the short term impact can be screened out as 'insignificant' at all areas of relevant public exposure. Therefore, during normal operations the impact of the Proposed Facility is not deemed to be significant. In addition to the normal operations of the Facility consideration has also been made to the impact of a number of non-standard operating scenarios. These account for the impact when not all the MDF driers on site are operating and the combustion sources normally used in the MDF driers need to emit to atmosphere via other routes. In addition a scenario has been considered in which the biomass plants are offline and the gas heaters are needed to heat the oil for the continuous presses. This analysis has shown that for some scenarios the impact of non-standard operations would be greater than normal operations. However, in all instances there is little risk of any AQAL being exceeded at areas of relevant exposure.

With regard to the impact on ecology, only those operating scenarios which could occur for periods of at least one day have been considered. The results have shown that:

- At all European Designated sites the impact of process emissions is less than 1% of the long term and less than 10% of the short term Critical Level with the exception of River Dee and Bala Lake SAC. At this site the maximum impact is slightly greater than 1% of the long term and 10% of the short term Critical Levels for NOx and SO_2. However, the PEC remains below 70% of the Critical Level. This is not deemed to be a significant impact.
- At all European Designated sites the impact of process emissions is less than 1% of the habitat specific long term Critical Load for nitrogen deposition. The impact is just over 1% of the lower Critical Load for acid deposition. However, the PEC is predicted to be well below 70% of the lower Critical Load for acid deposition. This is not deemed to be a significant impact.
- At Chirk Castle SSSI the impact of process emissions greater than 1% of the long term and 10% of the short term Critical Levels for NOx and SO_2. However, the PEC remains below 70% of the Critical Level. This is not deemed to be a significant impact.

- At Chirk Castle SSSI the impact of process emissions greater than 1% of the habitat specific long term Critical Loads for nitrogen and acid deposition. In both cases the existing deposition rate exceeds the specified Critical Load. However, in both cases the main contributor is from background sources. It is not clear if the current operations at the Kronospan site are included in the APIS background dataset.
- At all non-statutory designated sites the process contribution is not predicted to exceed the Critical Level or habitat specific Critical Load. This is not deemed to be a significant impact.

Appendix A – Figures

Figure 1: Site Location

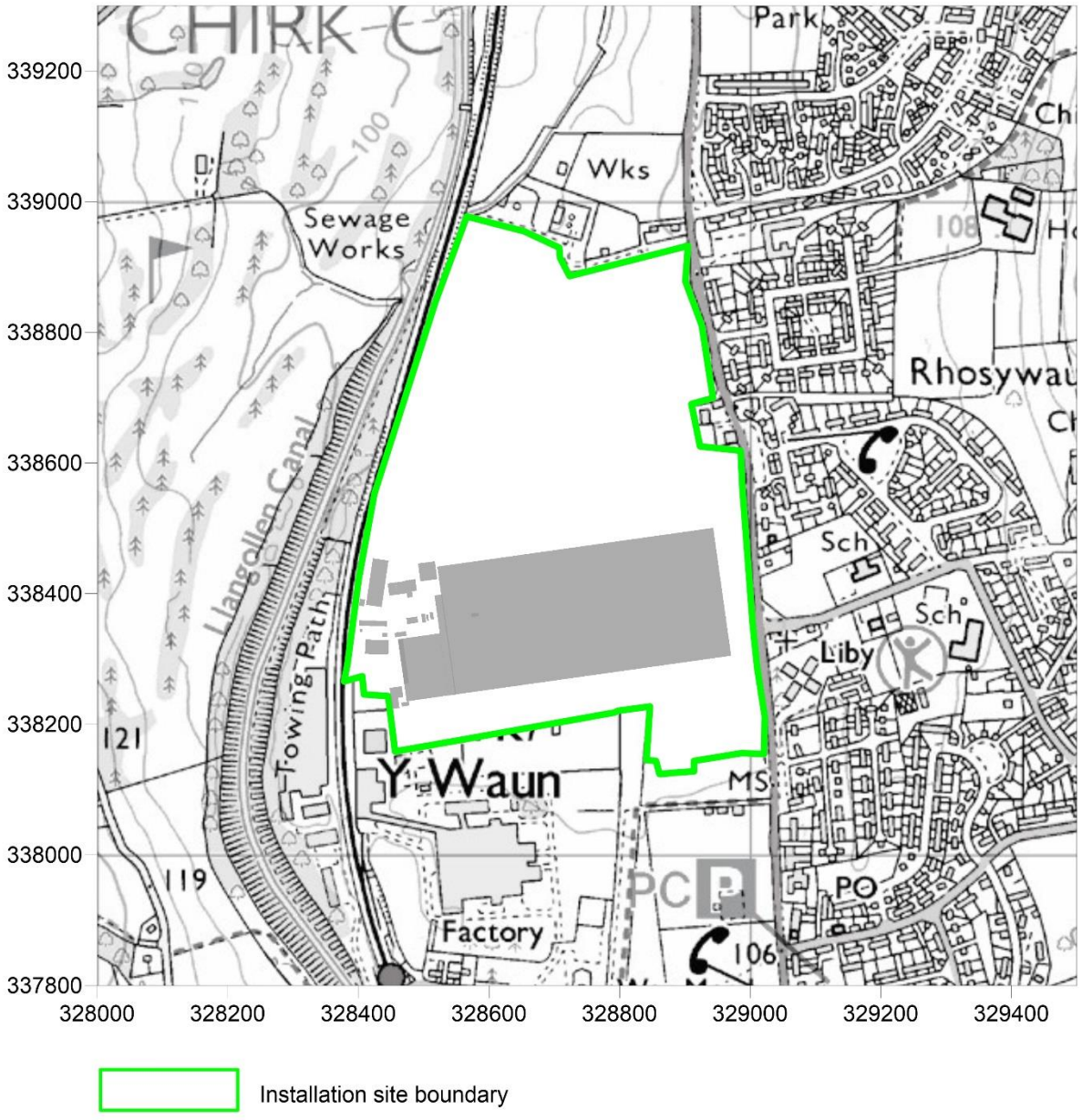


Figure 2: WCBC Monitoring Sites

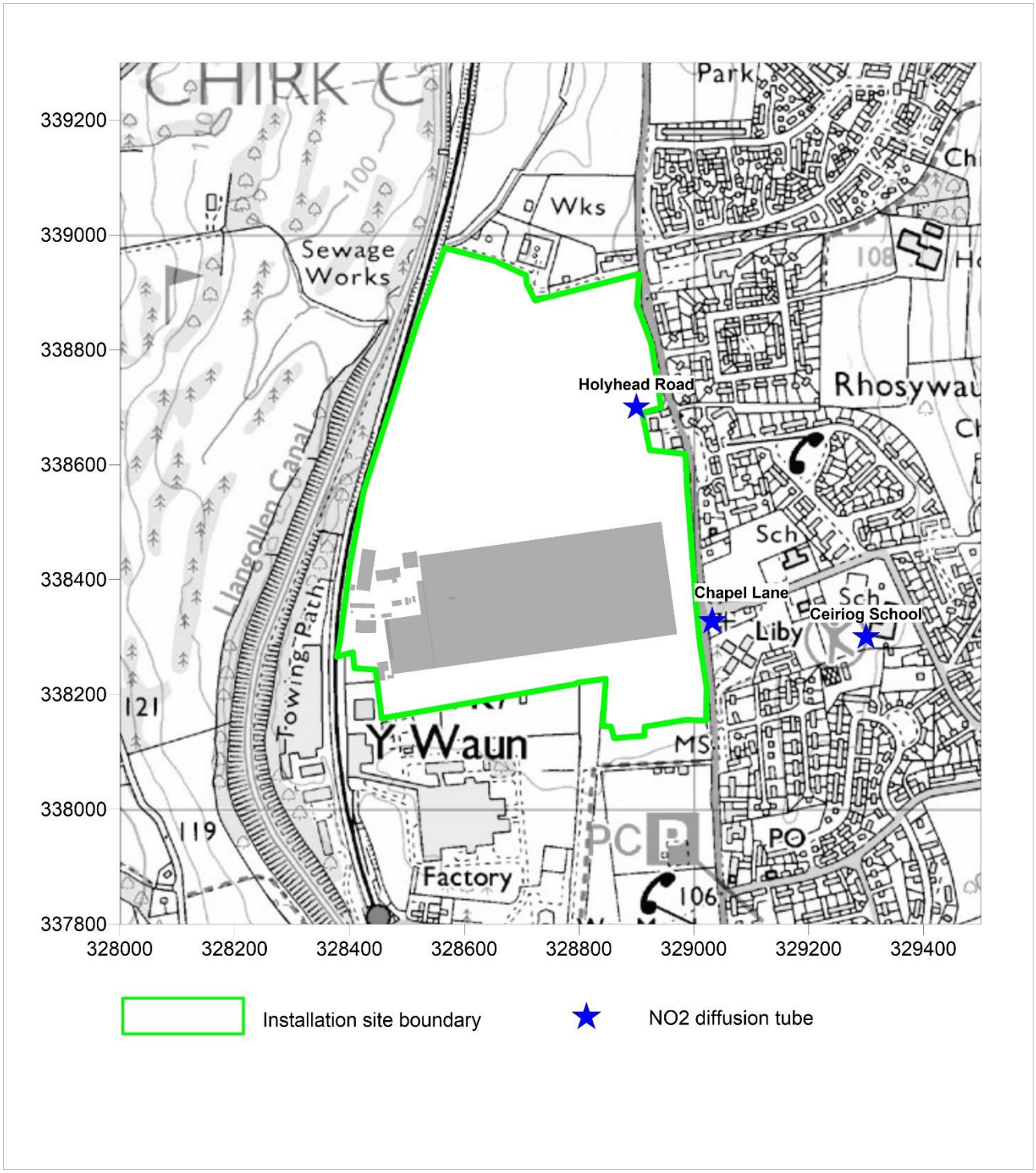


Figure 3: Ecological Sensitive Receptors

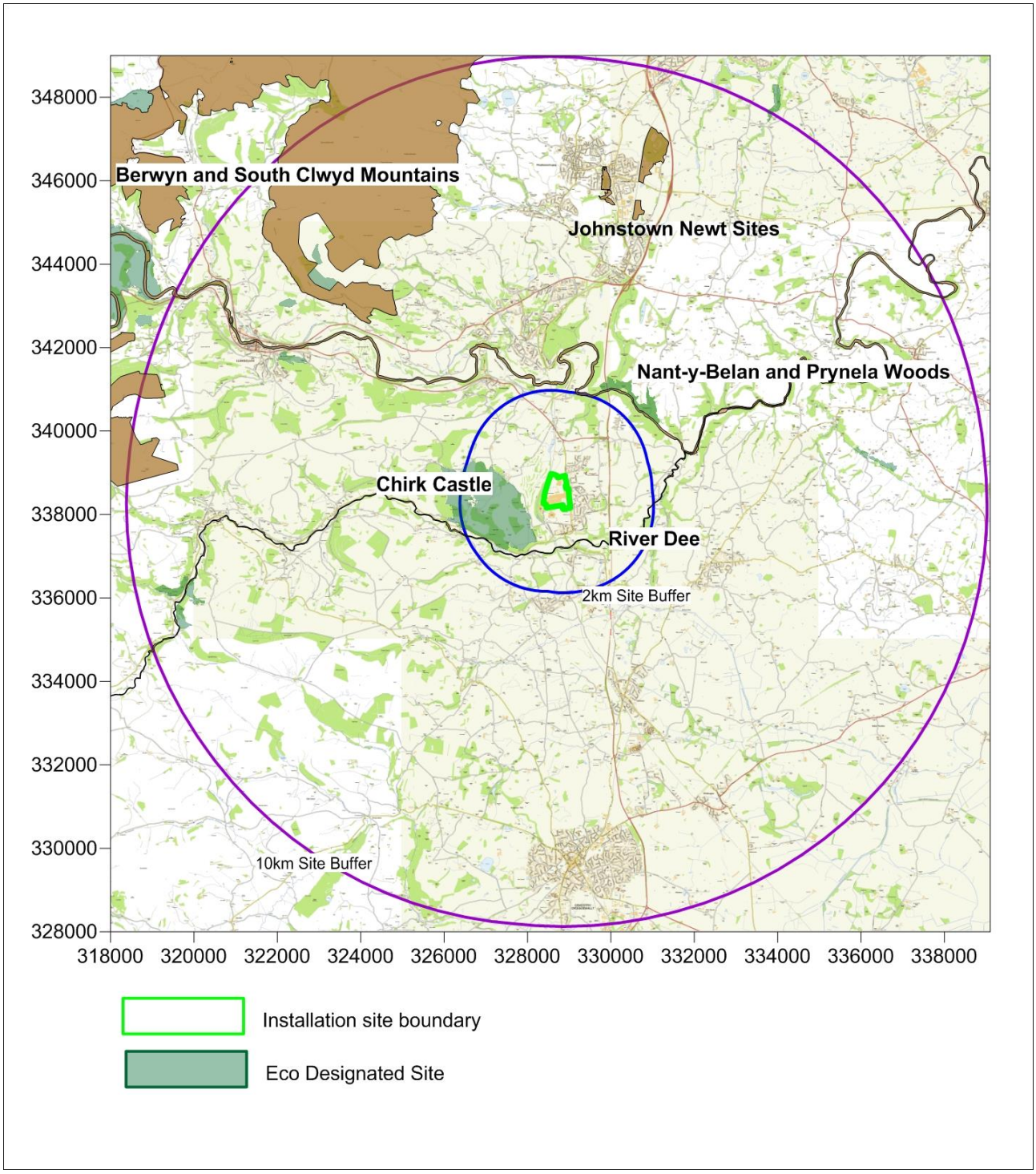


Figure 4: Wind Roses Shawbury 2013 to 2017

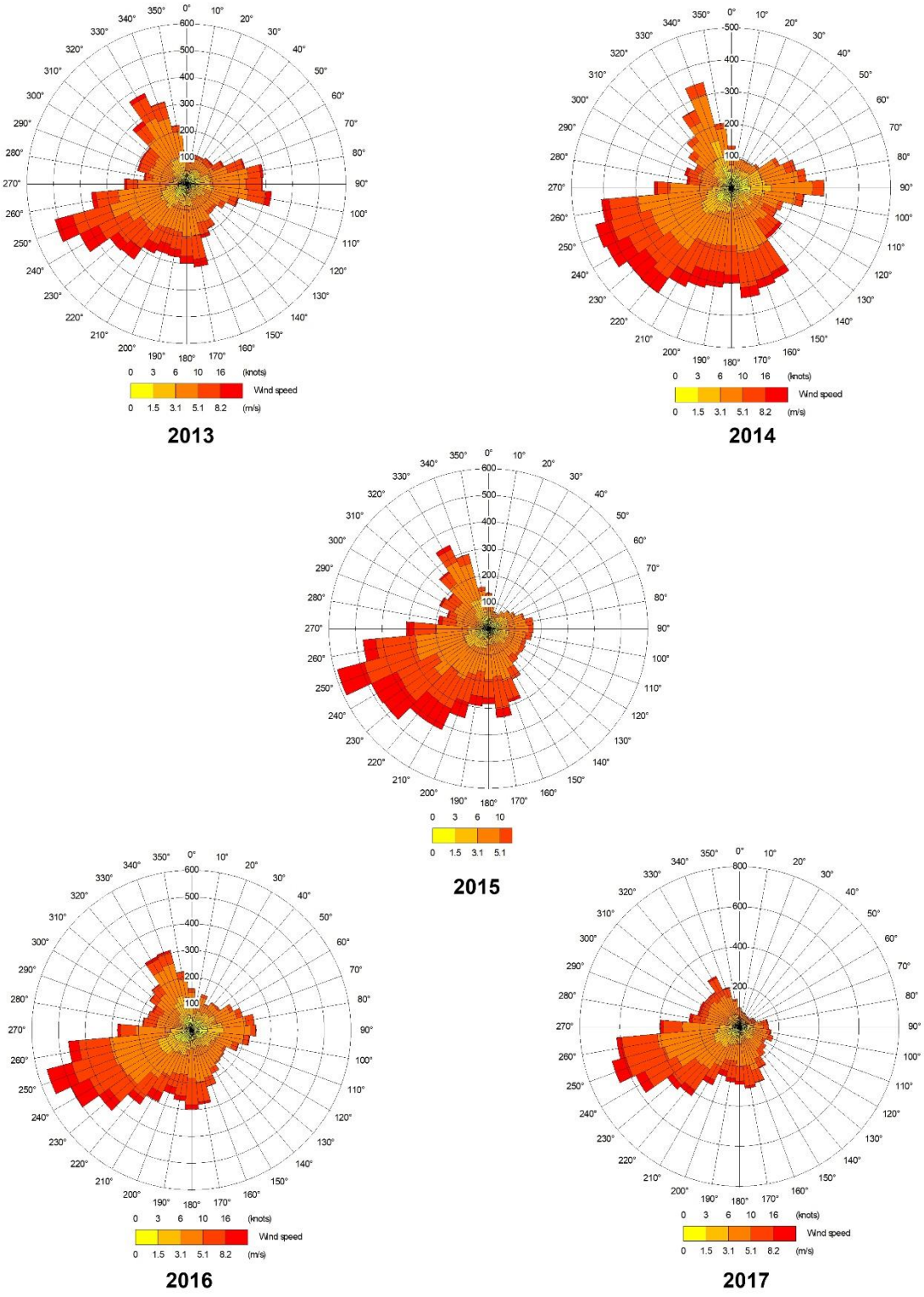


Figure 5: Point Sources

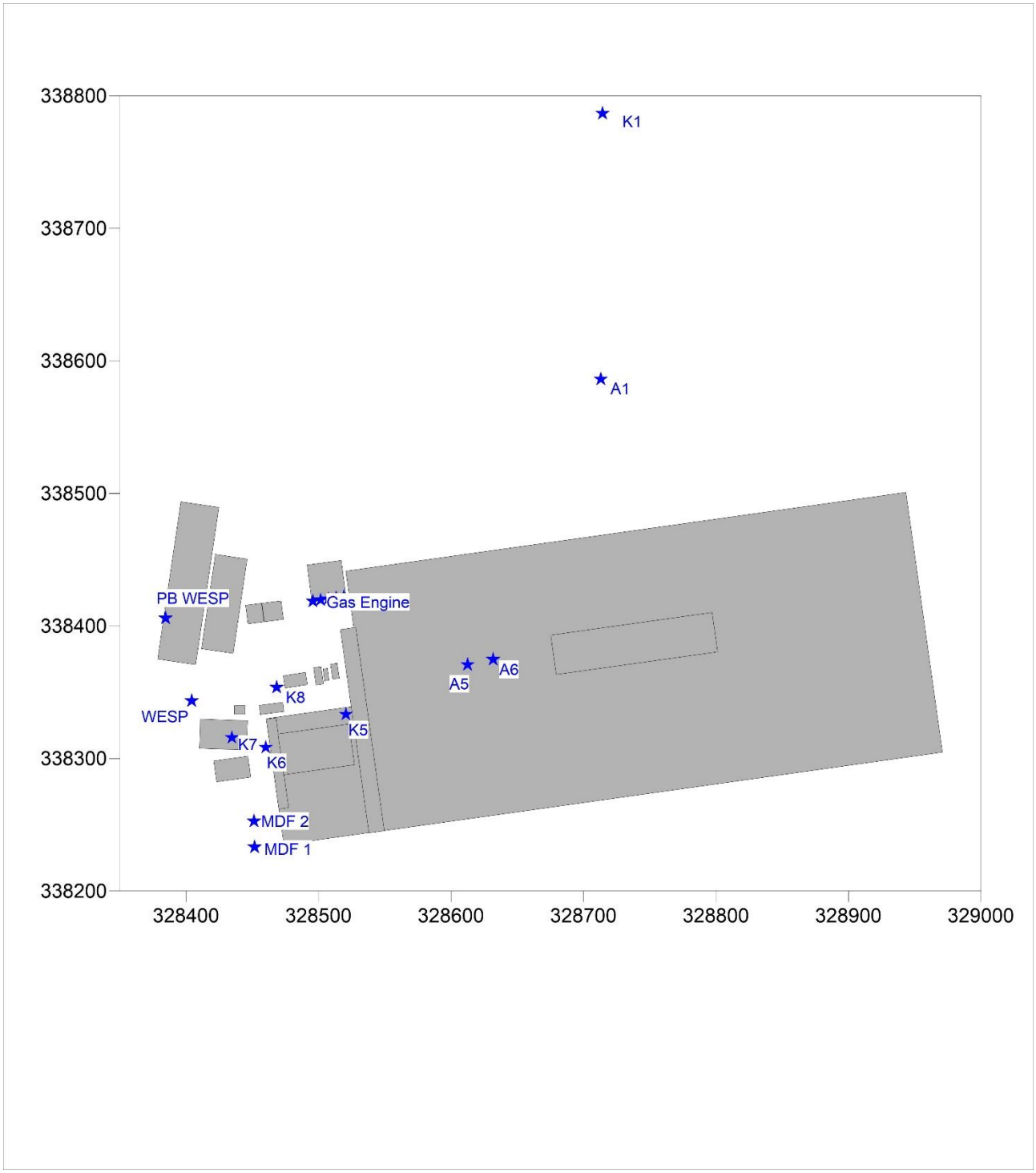


Figure 6: Buildings

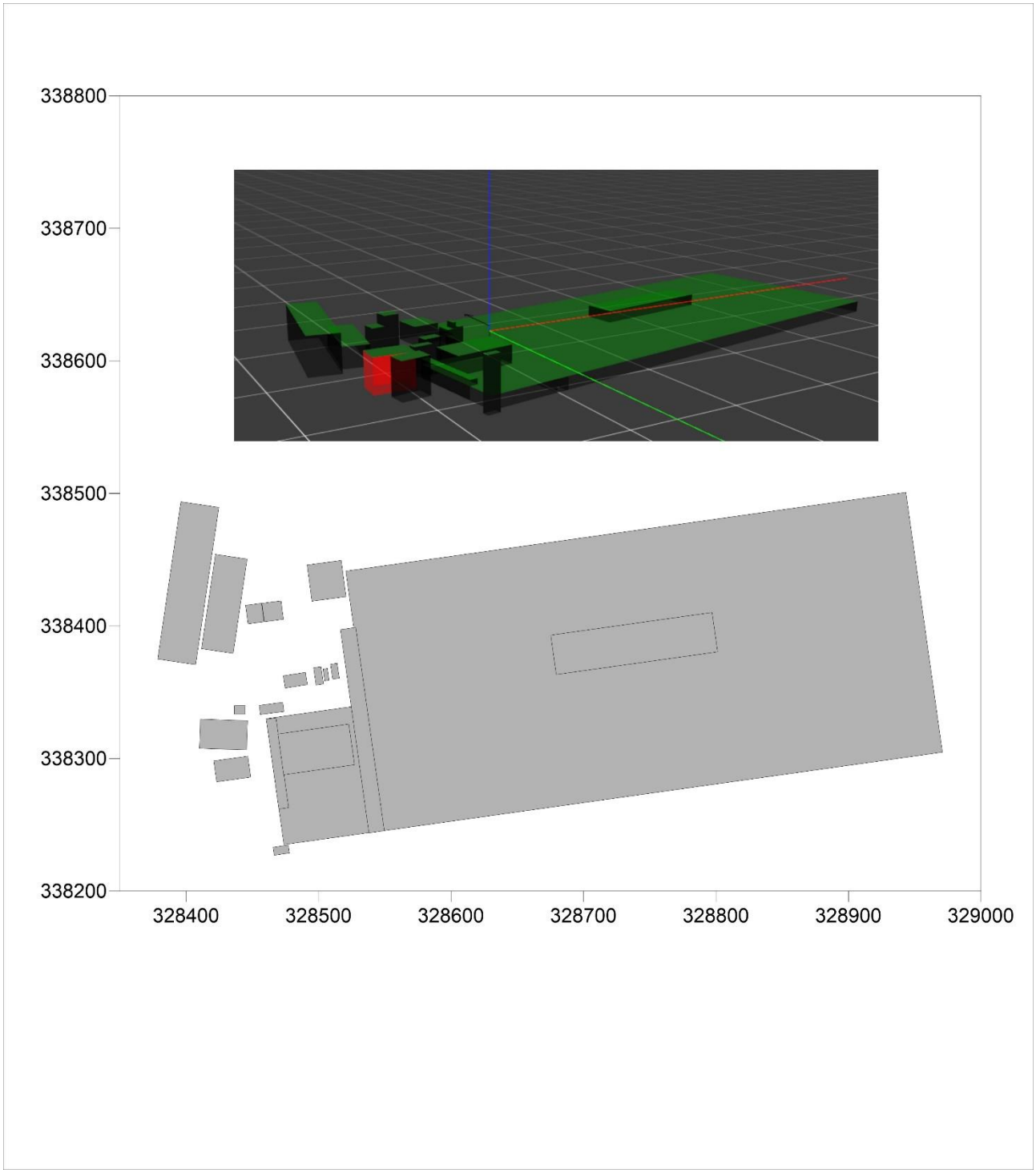


Figure 7: Annual Mean Nitrogen Dioxide PC – Normal Operations – Likely Emissions

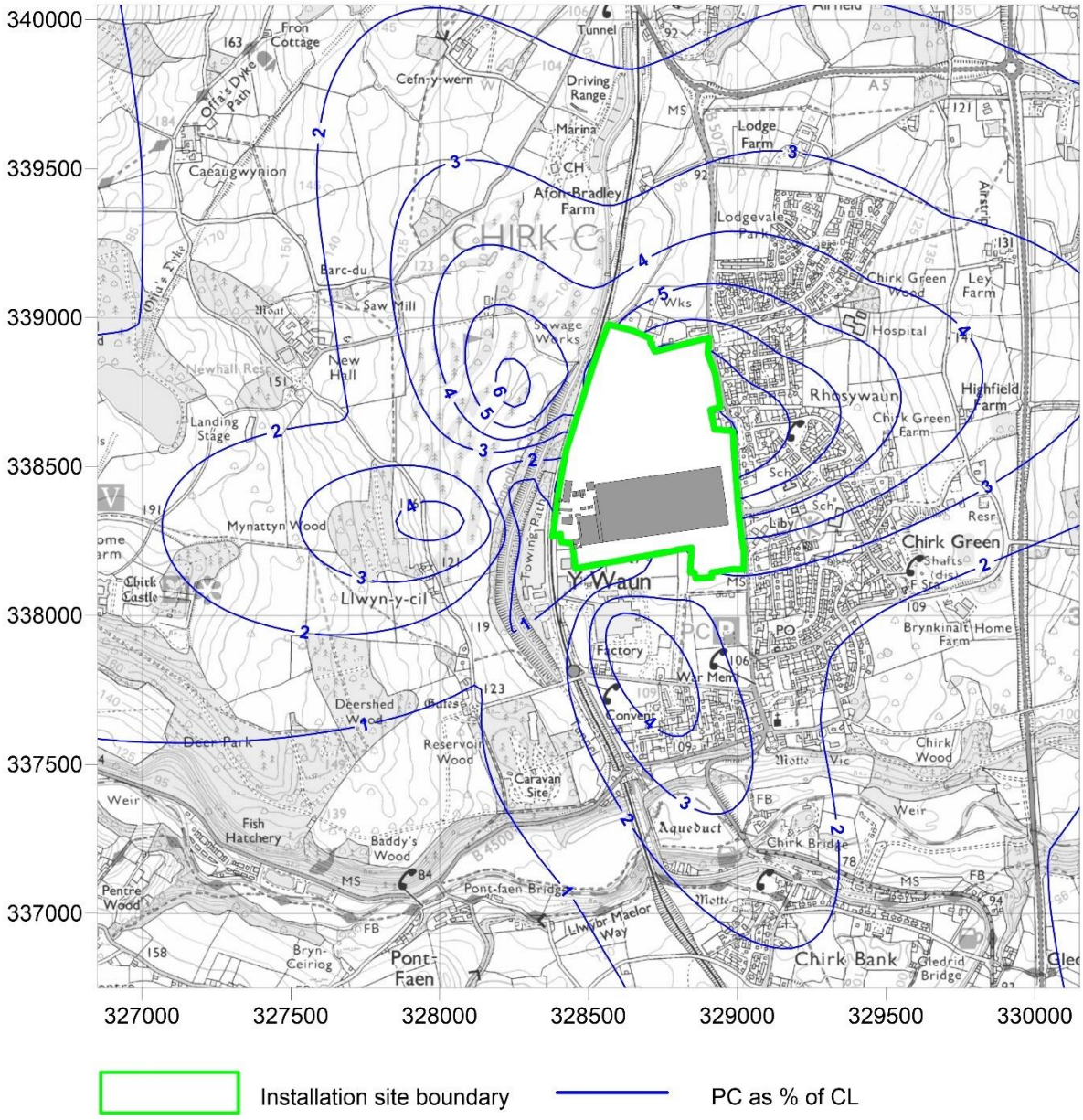


Figure 8: Annual Mean Nitrogen Dioxide PC – Normal Operations – Worst-Case Emissions

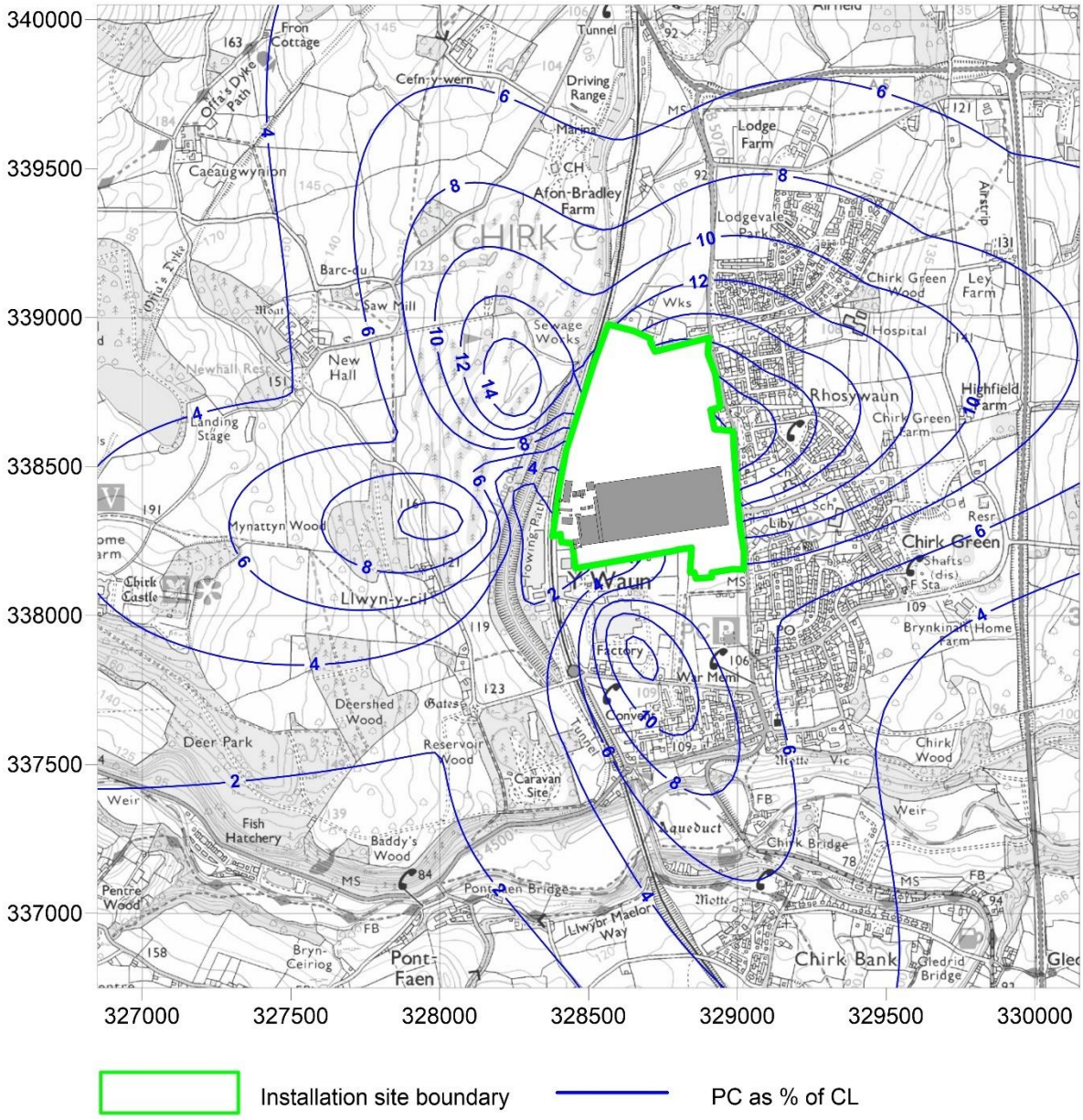


Figure 9: 99.79%ile of 1-hour Nitrogen Dioxide PC – Normal Operations –Likely Emissions

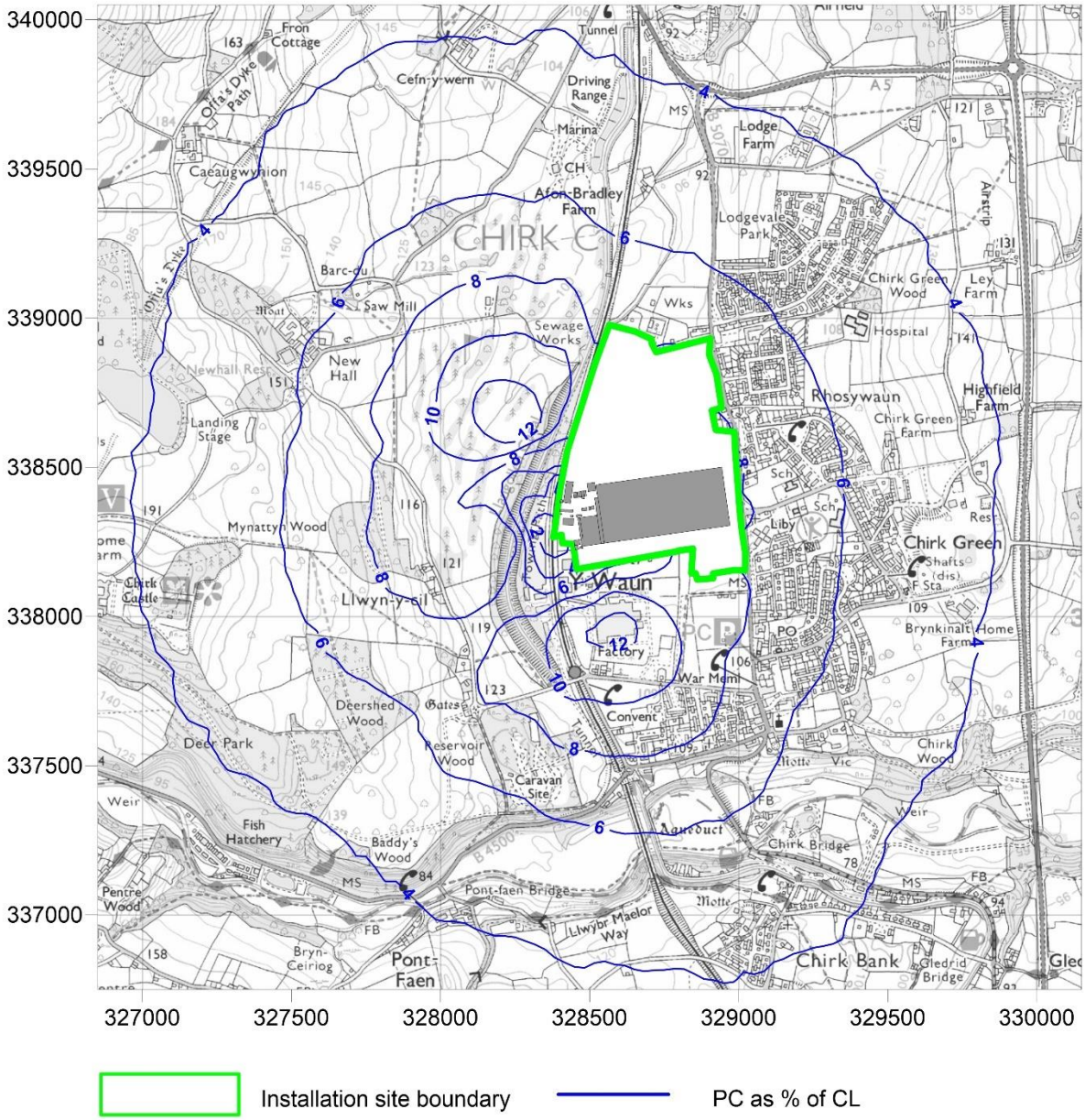


Figure 10: 99.79%ile of 1-hour Nitrogen Dioxide PC – Normal Operations – Worst-Case Emissions

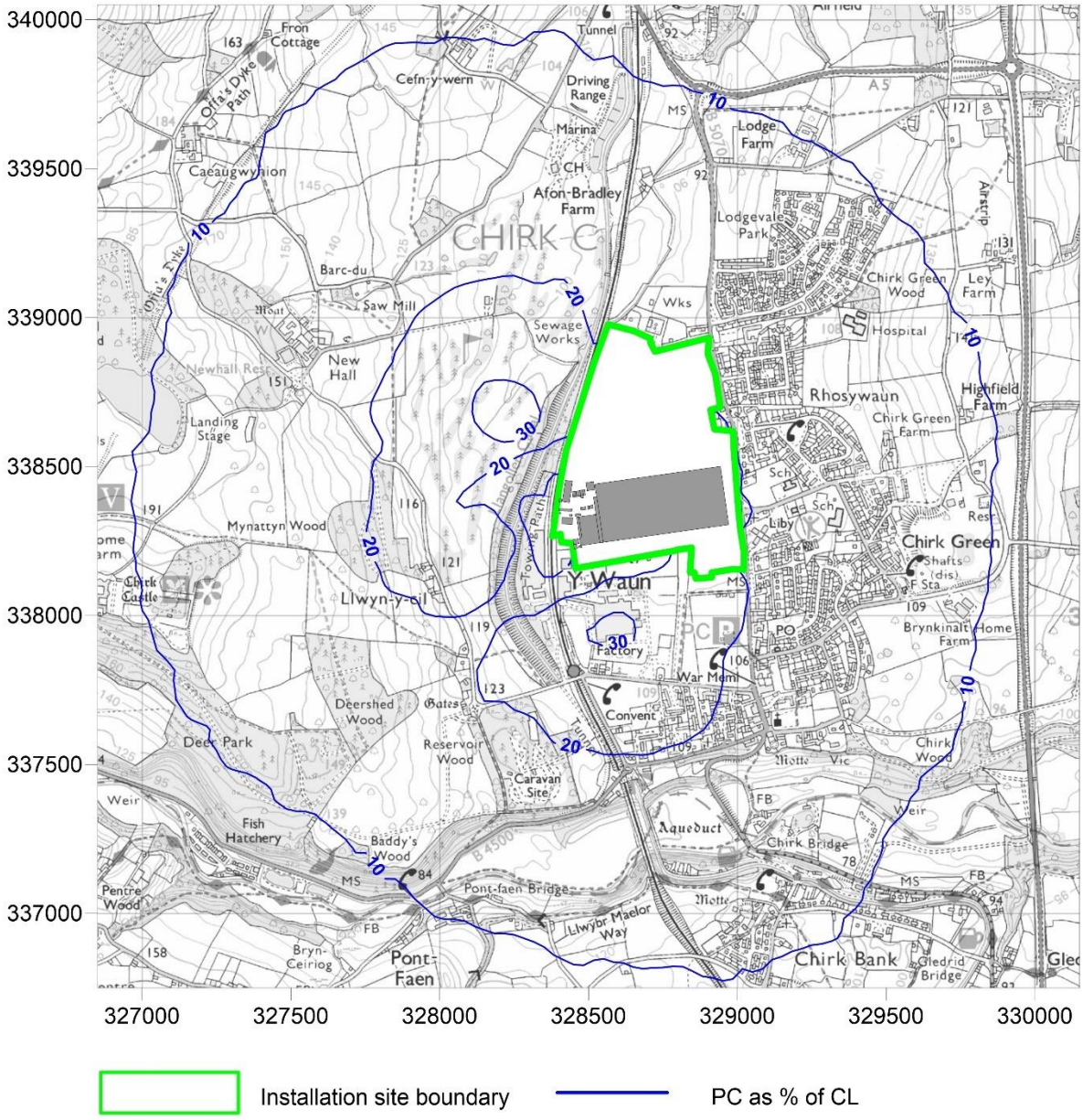


Figure 11: Annual Mean PM10 Process Contribution – Normal Operations

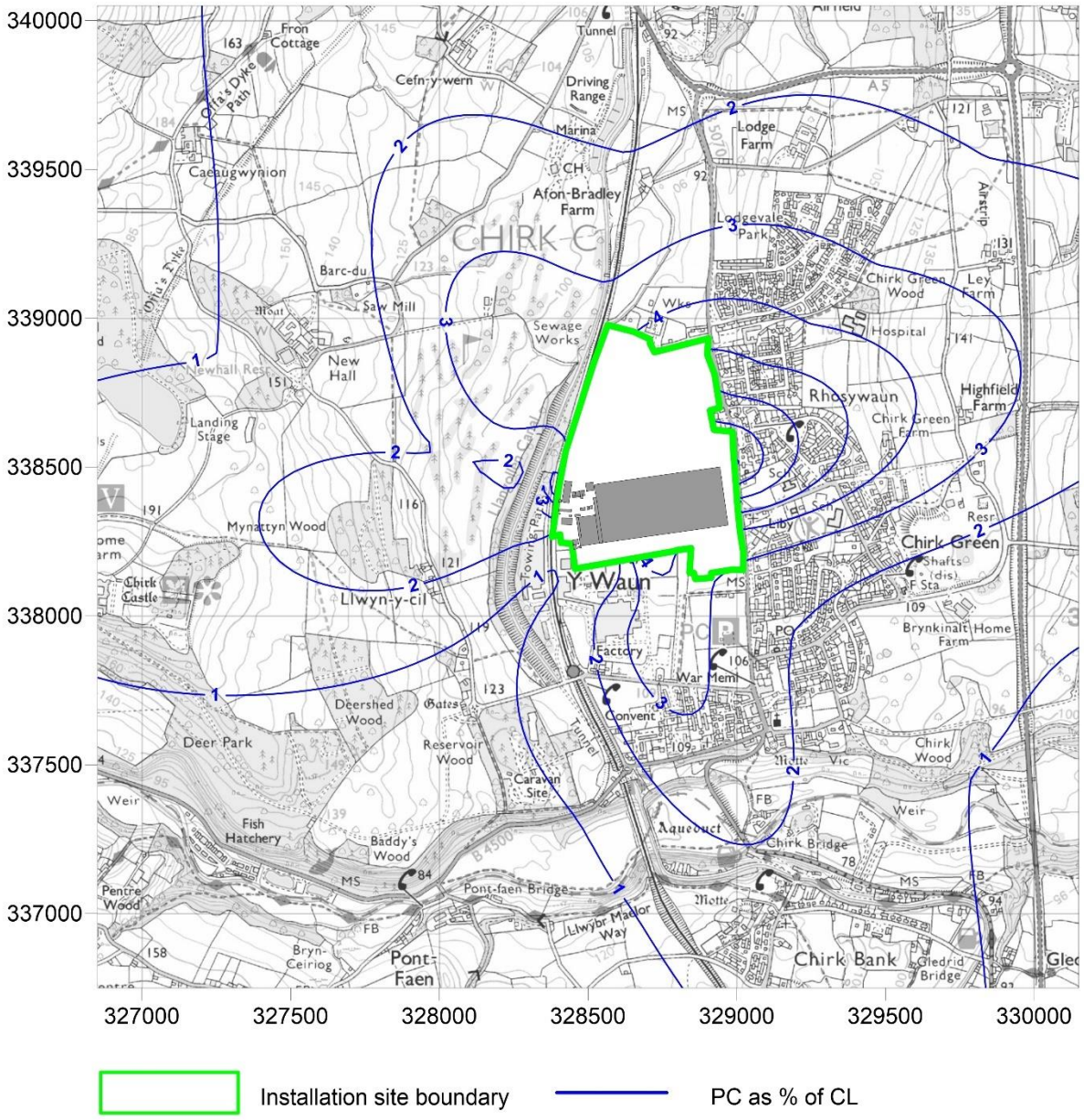


Figure 12: Annual Mean PM2.5 Process Contribution – Normal Operations

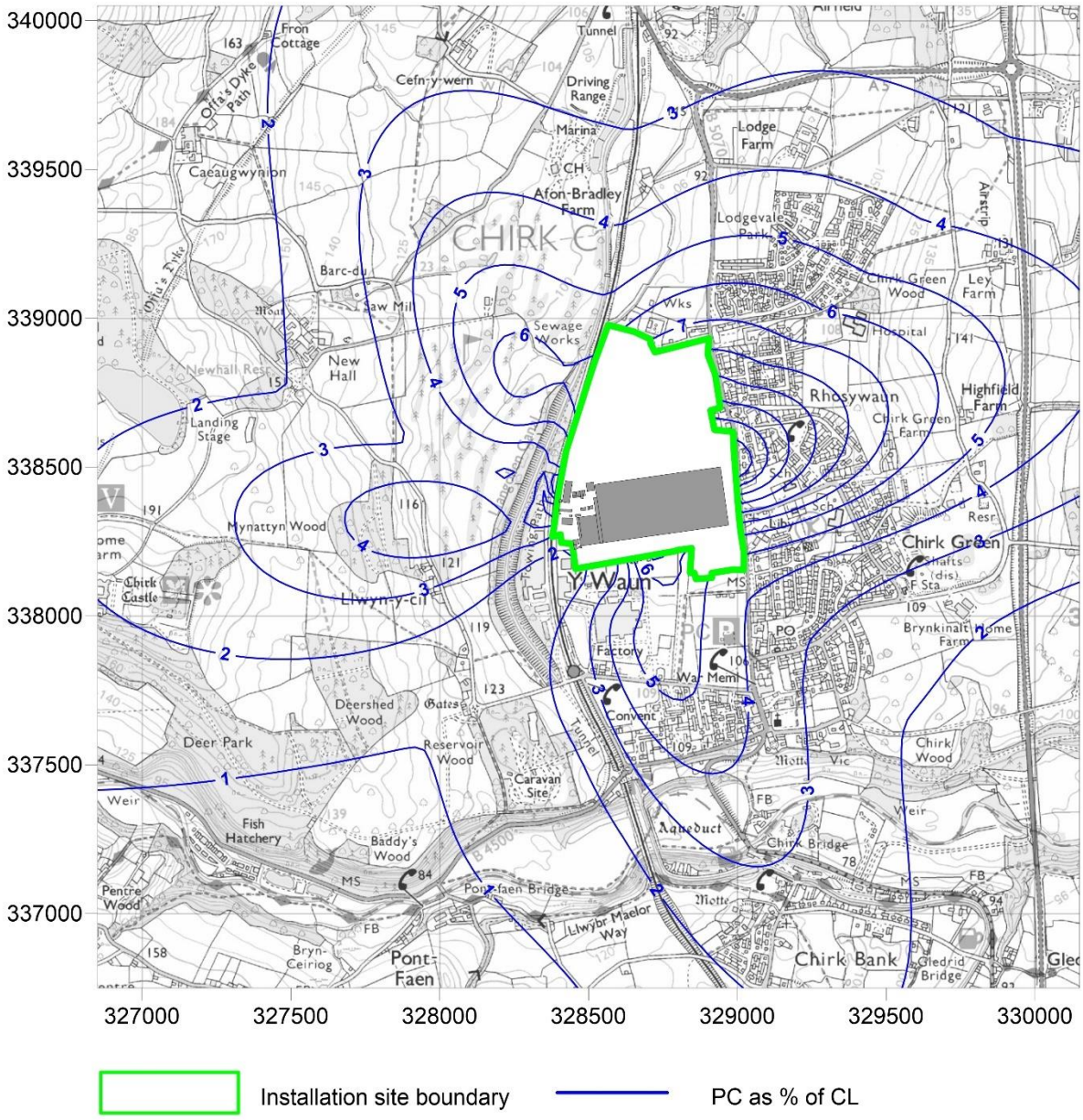


Figure 13: 90.41 %ile 24-hour PM10 Process Contribution – Normal Operations

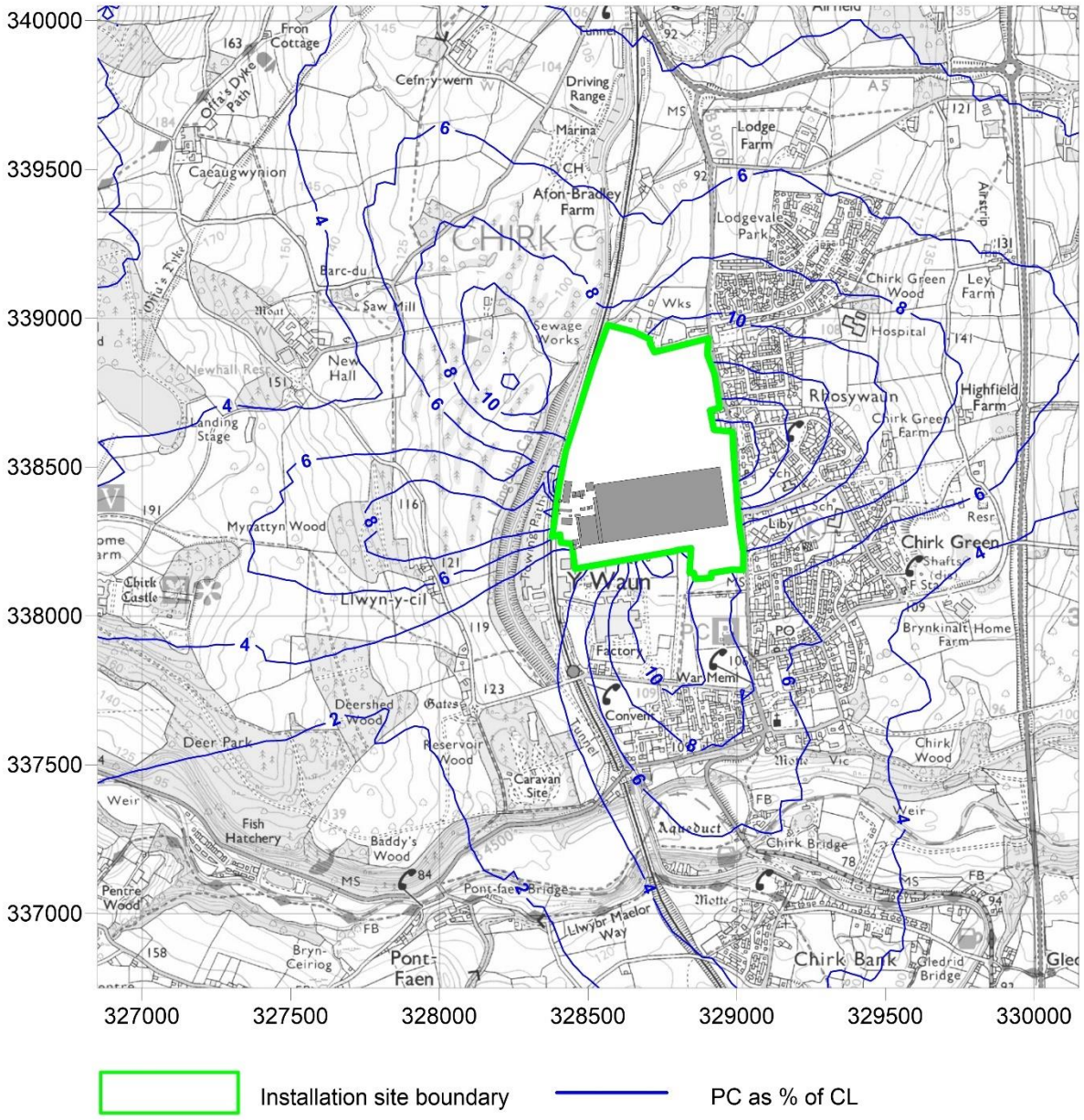


Figure 14: Annual Mean Formaldehyde Process Contribution – Normal Operations

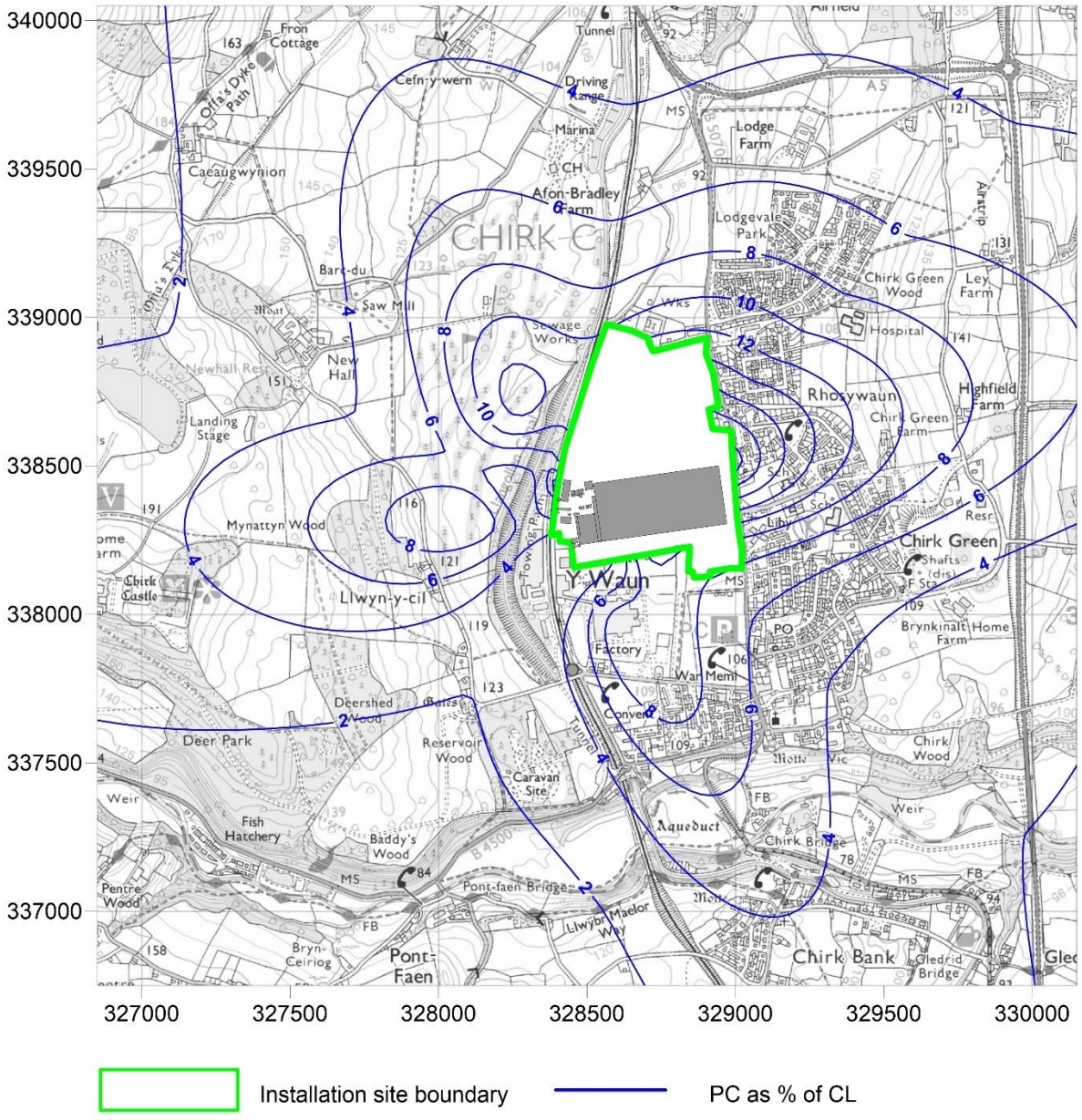


Figure 15: Maximum 1-hour Mean Formaldehyde Process Contribution – Normal Operations

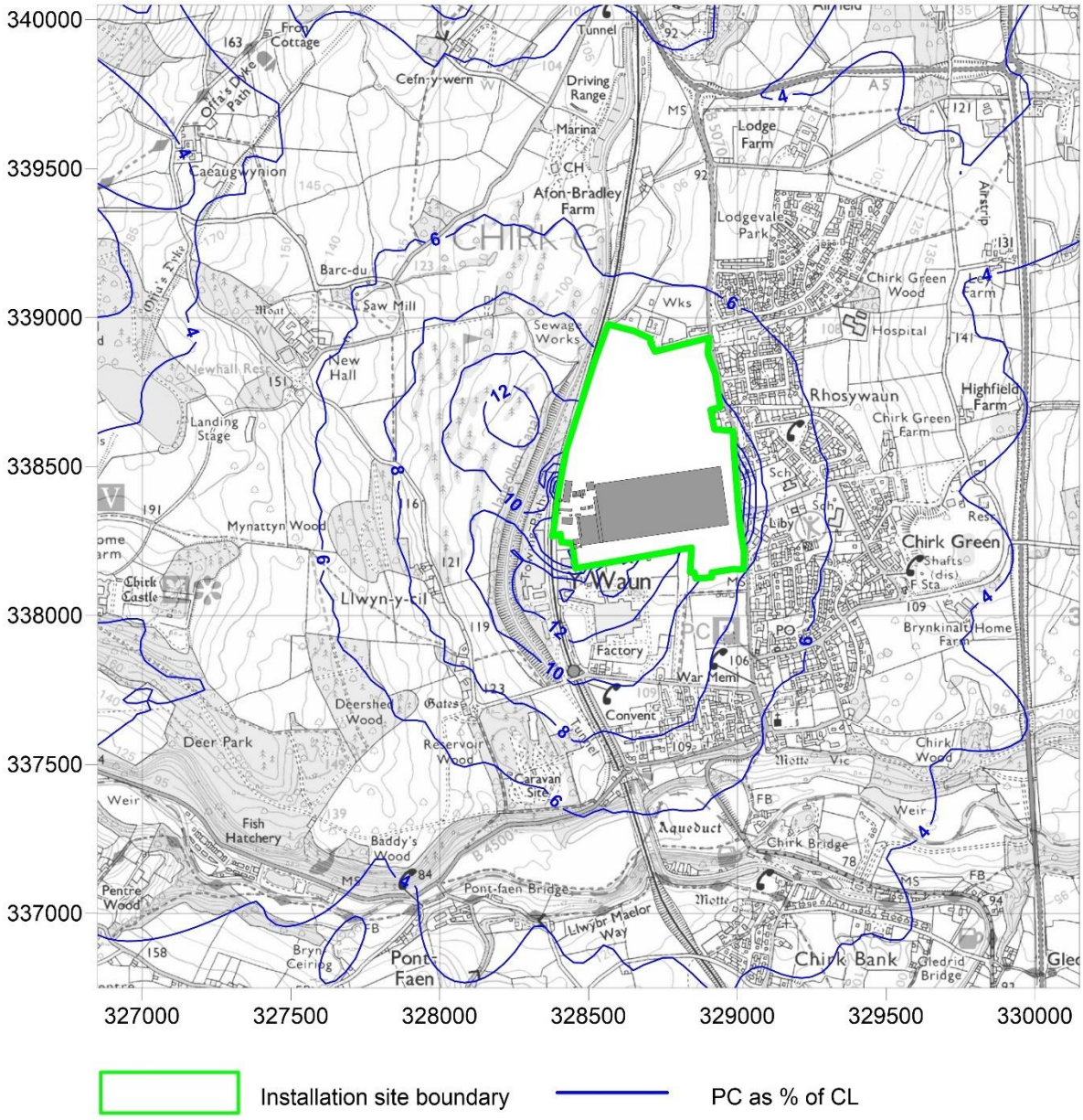


Figure 16: Annual Mean TVOC Process Contribution – Normal Operations

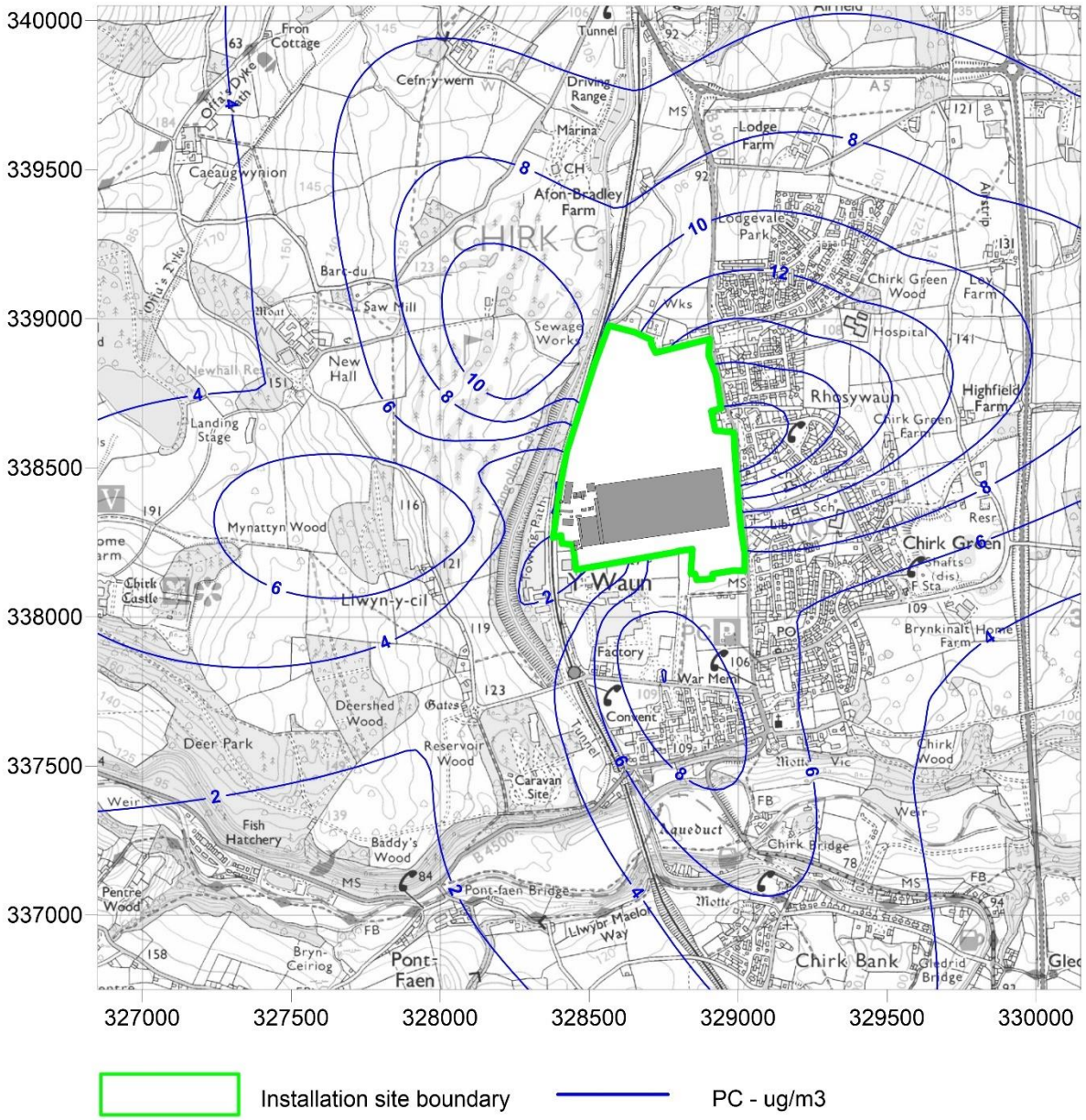


Figure 17: Maximum 1-hour Mean TVOC Process Contribution – Normal Operations

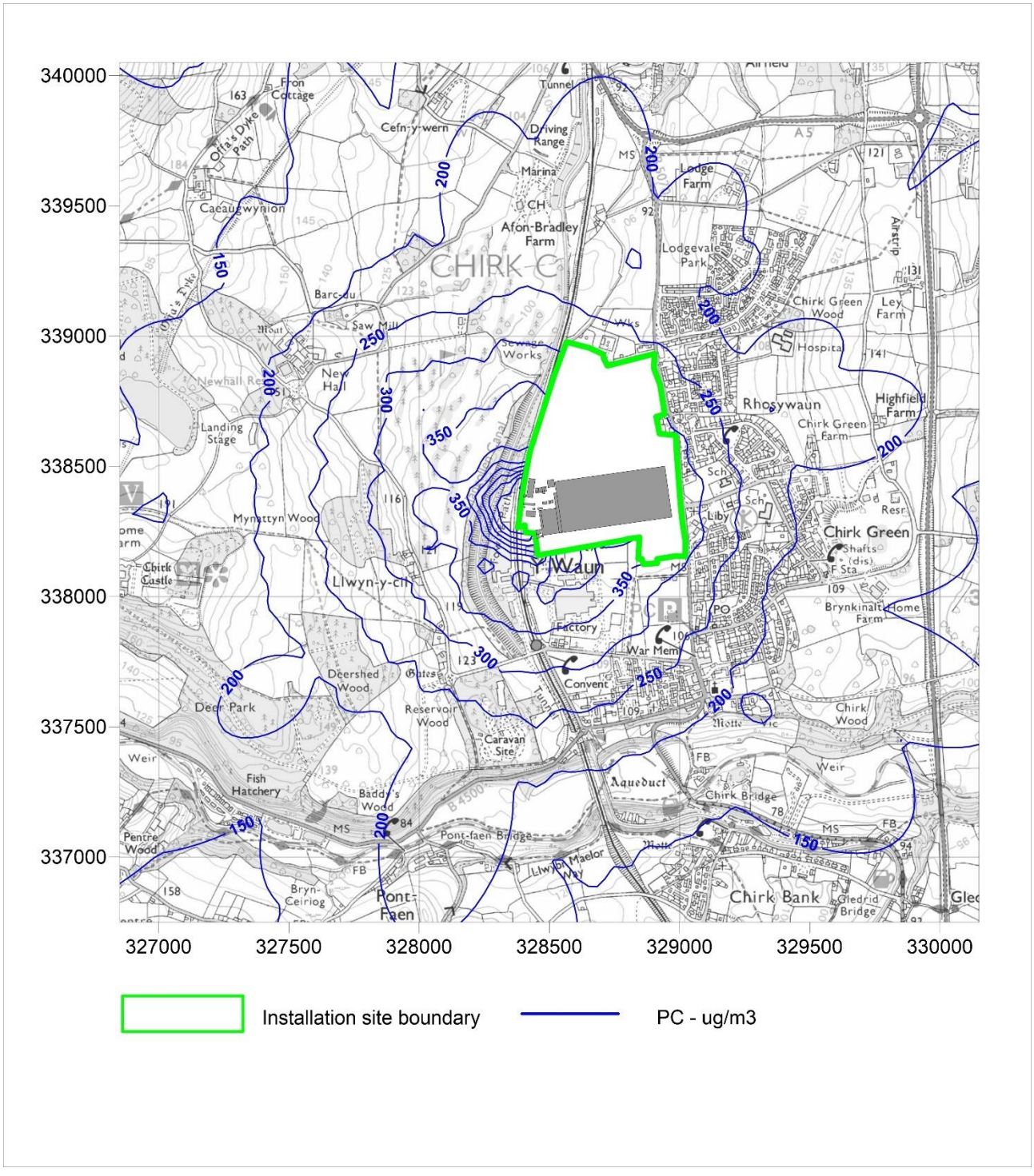


Figure 18: Annual Mean Nitrogen Dioxide Process Contribution – MDF 2 Offline – Likely Emissions

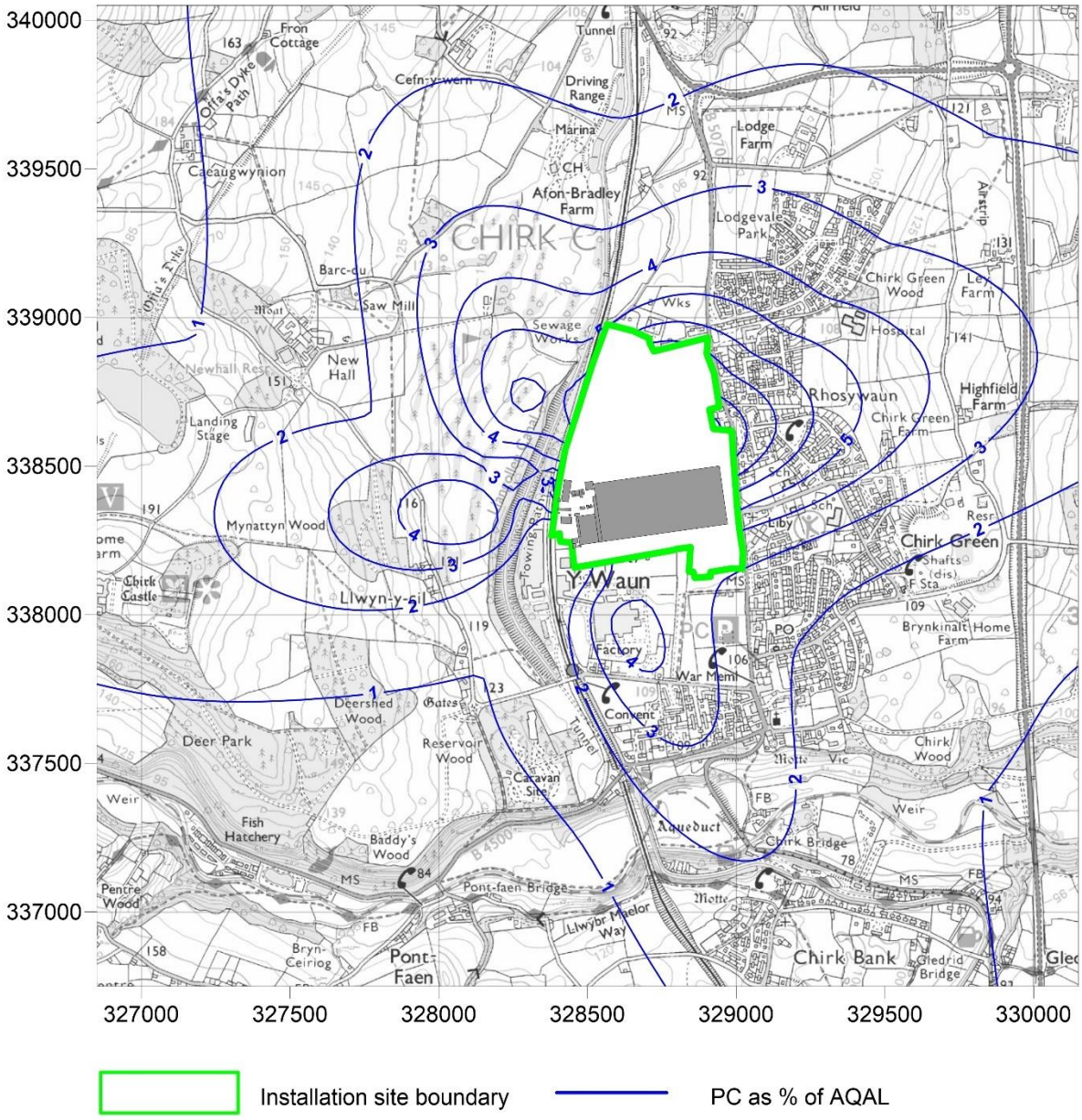


Figure 19: Annual Mean Nitrogen Dioxide Process Contribution – MDF 2 Offline – Worst-Case Emissions

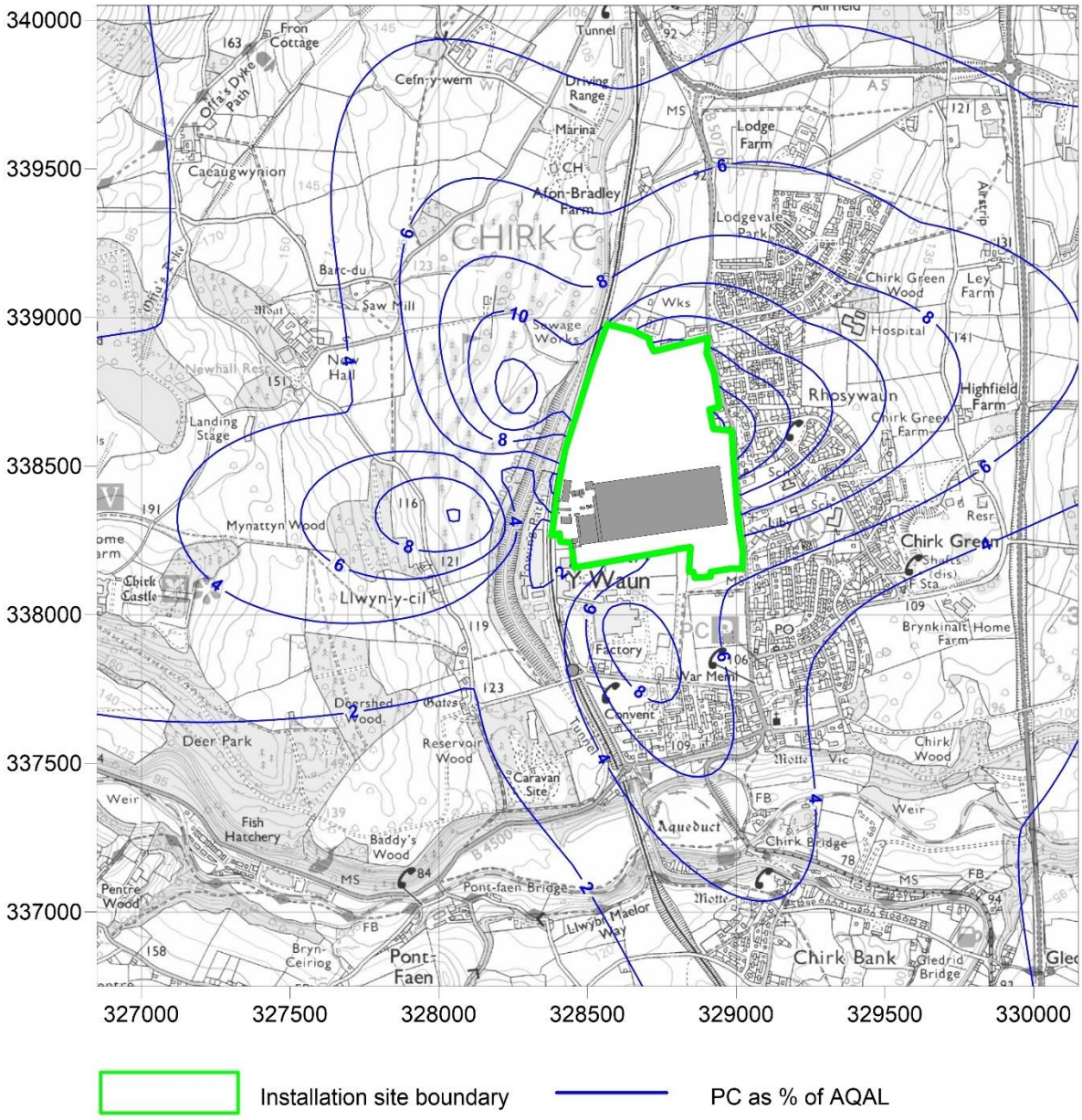


Figure 20: 99.79%ile 1-hour Mean Nitrogen Dioxide Process Contribution – MDF 2 Offline – Likely Emissions

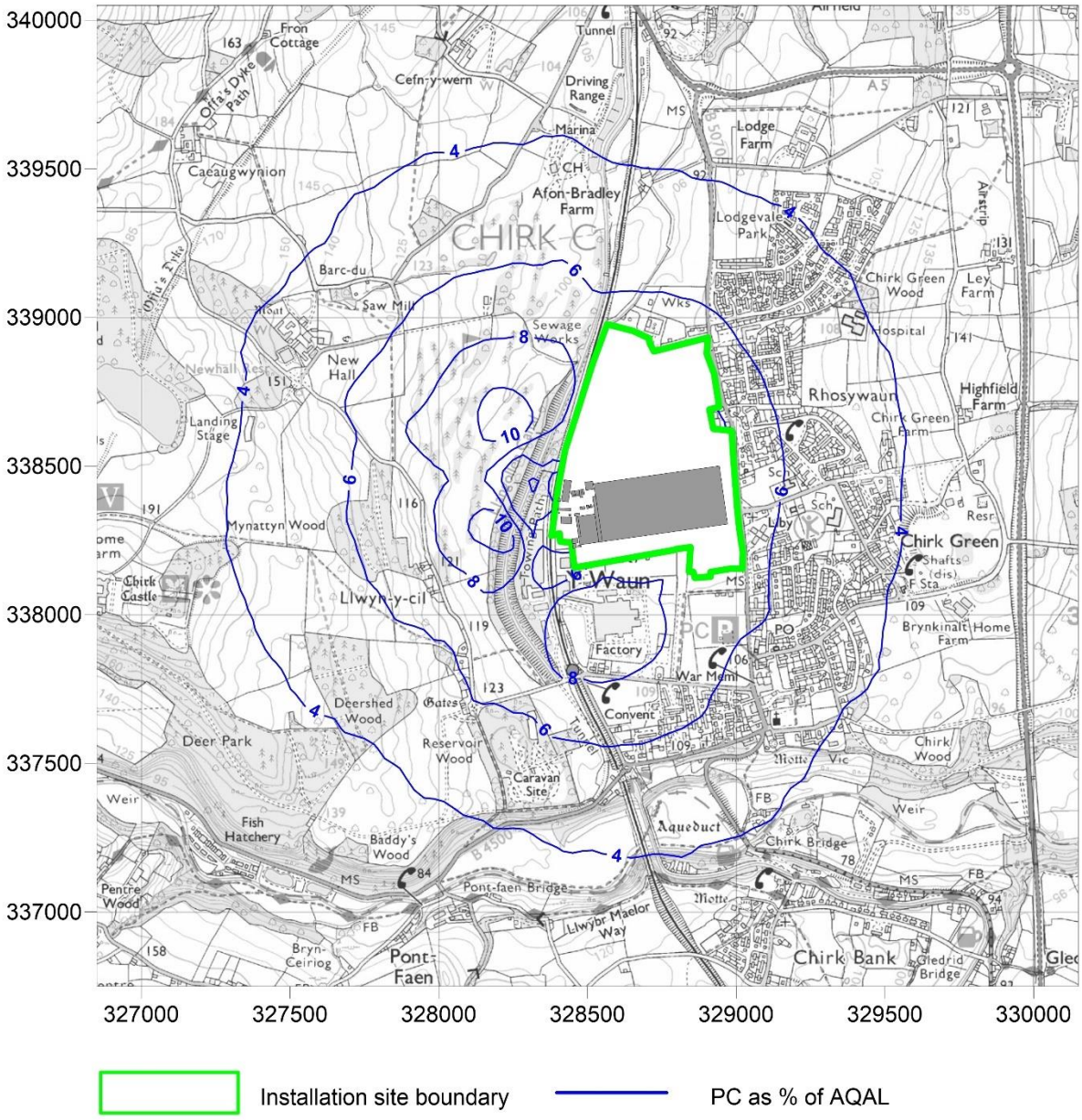


Figure 21: 99.79%ile 1-hour Mean Nitrogen Dioxide Process Contribution – MDF 2 Offline – Worst-Case Emissions

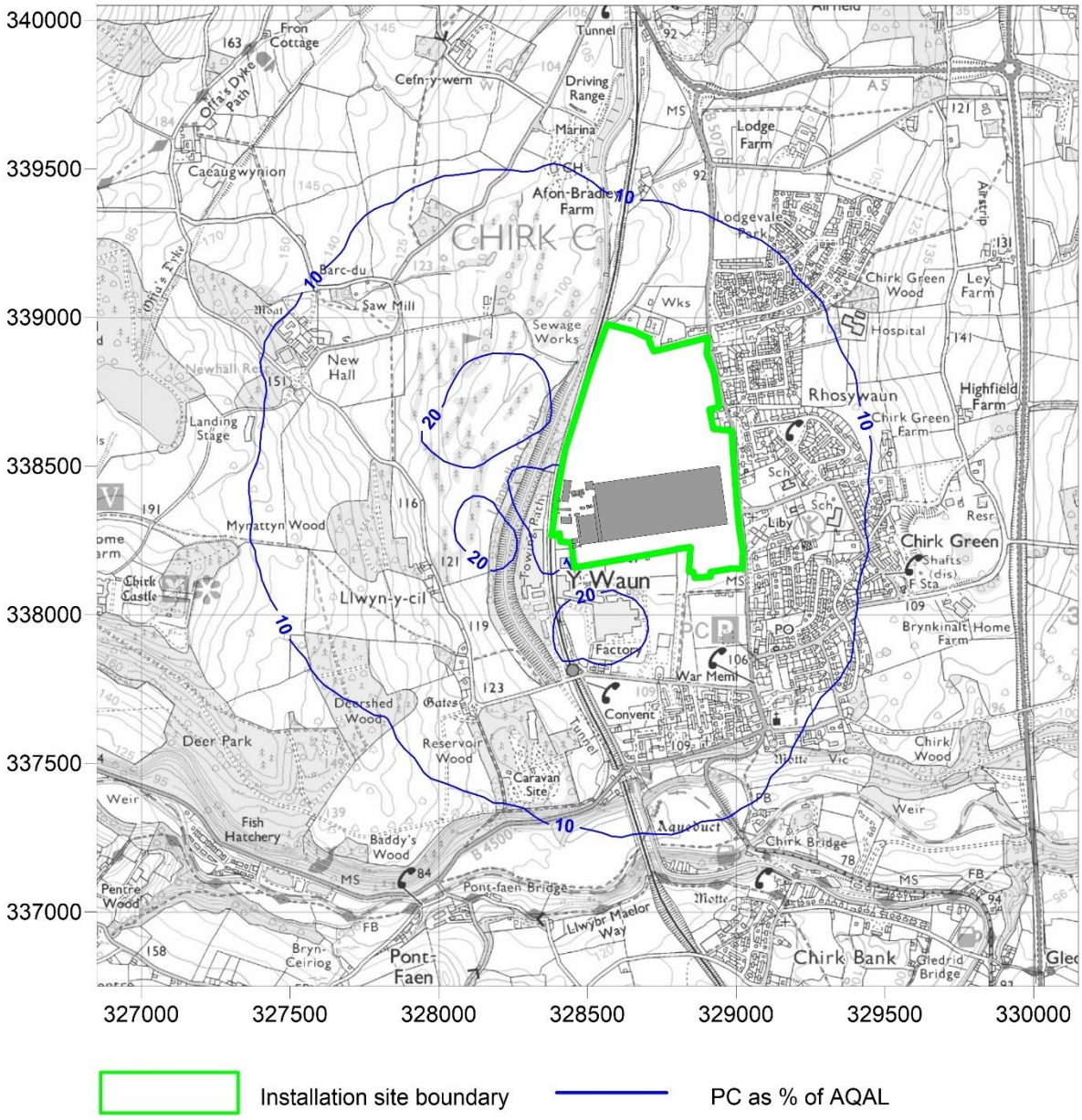


Figure 22: 99.18%ile 24-hour Mean Sulphur Dioxide Process Contribution – MDF 2 Offline

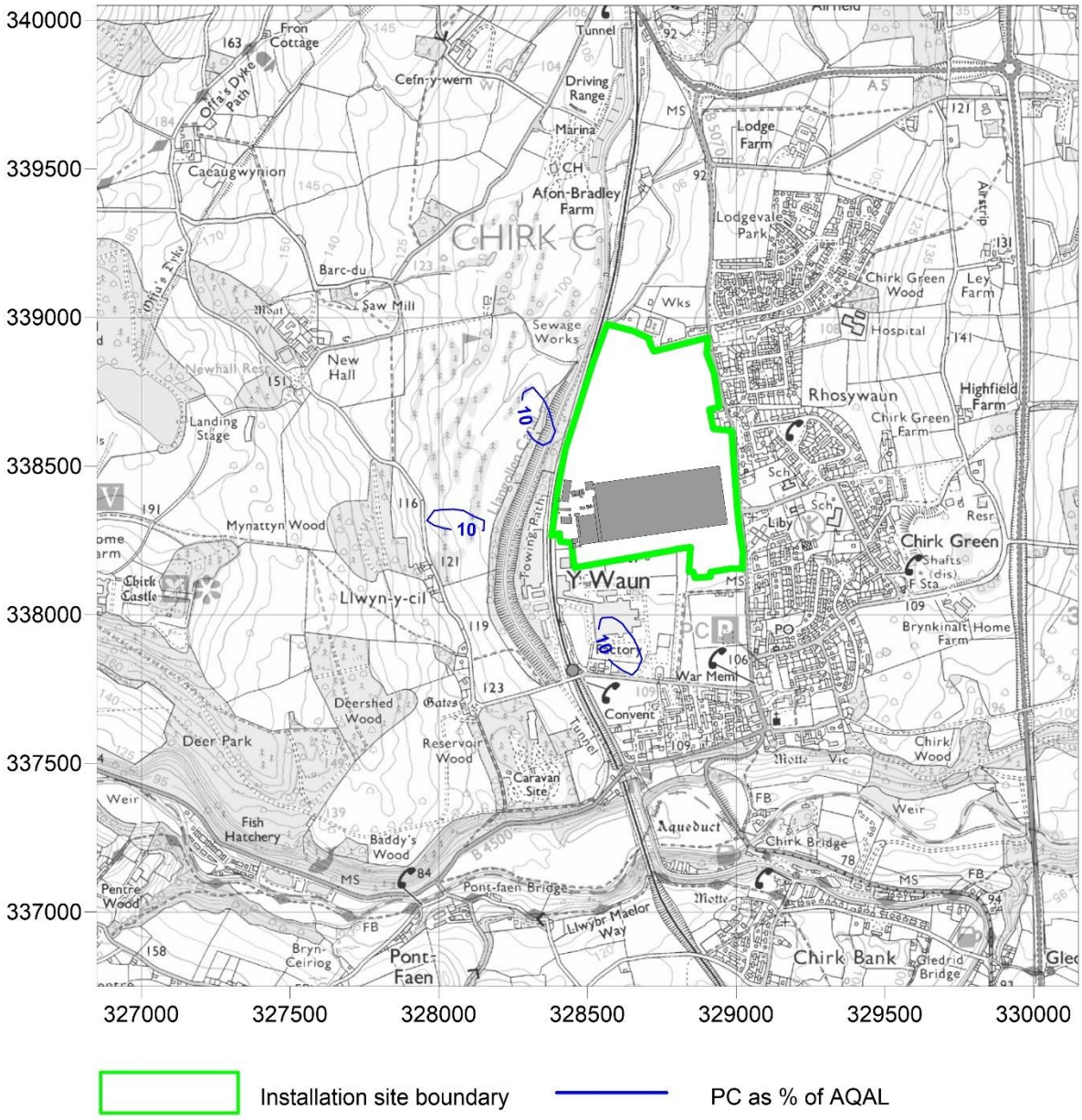


Figure 23: 99.73%ile 1-hour Mean Sulphur Dioxide Process Contribution – MDF 2 Offline

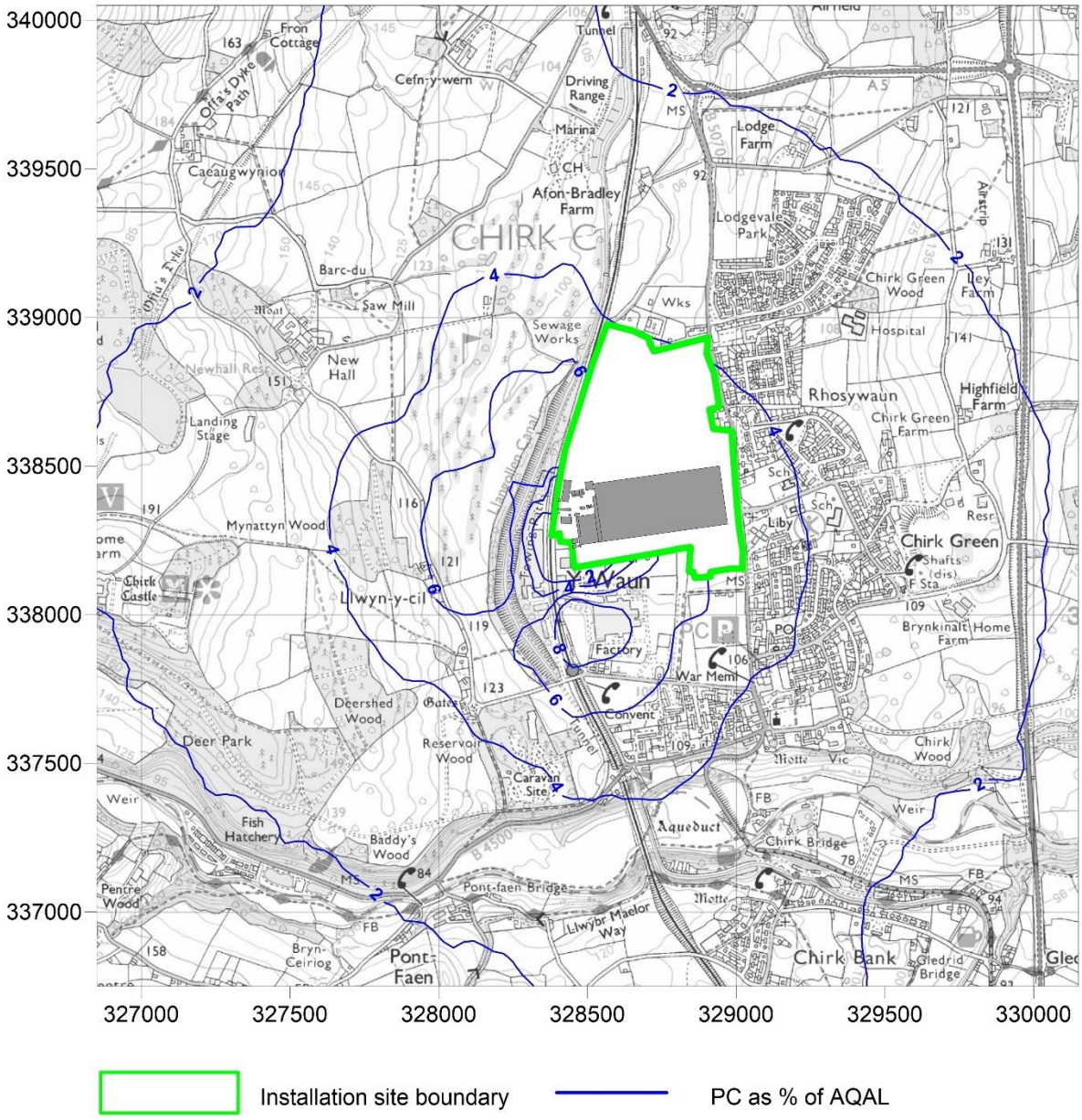


Figure 24: 99.9%ile 15-min Mean Sulphur Dioxide Process Contribution – MDF 2 Offline

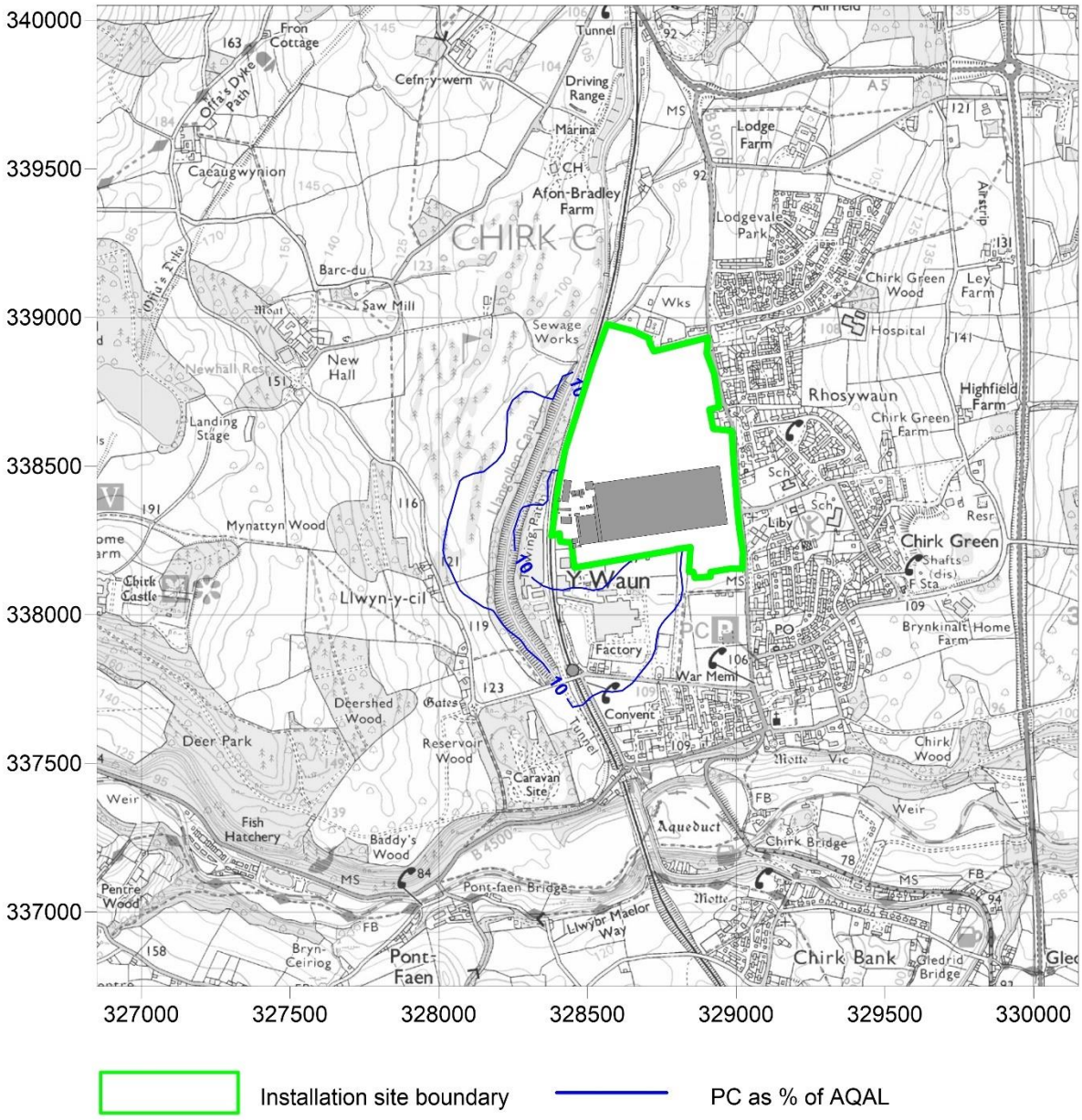


Figure 25: 99.79%ile 1-hour Mean Nitrogen Dioxide Process Contribution – MDF 1 and 2 Offline – Likely Emissions

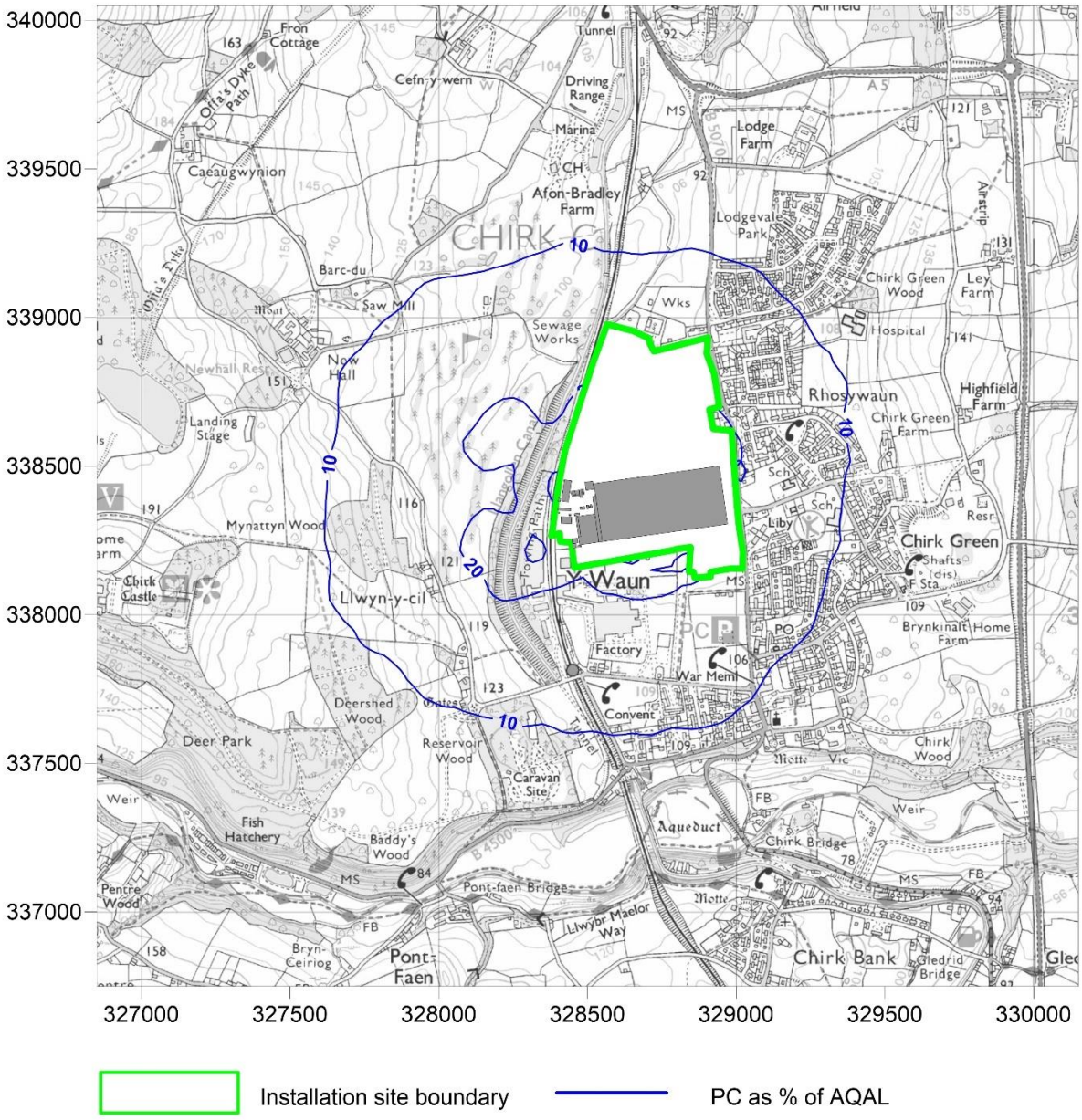


Figure 26: 99.79%ile 1-hour Mean Nitrogen Dioxide Process Contribution – MDF 1 and 2 Offline – Worst-Case Emissions

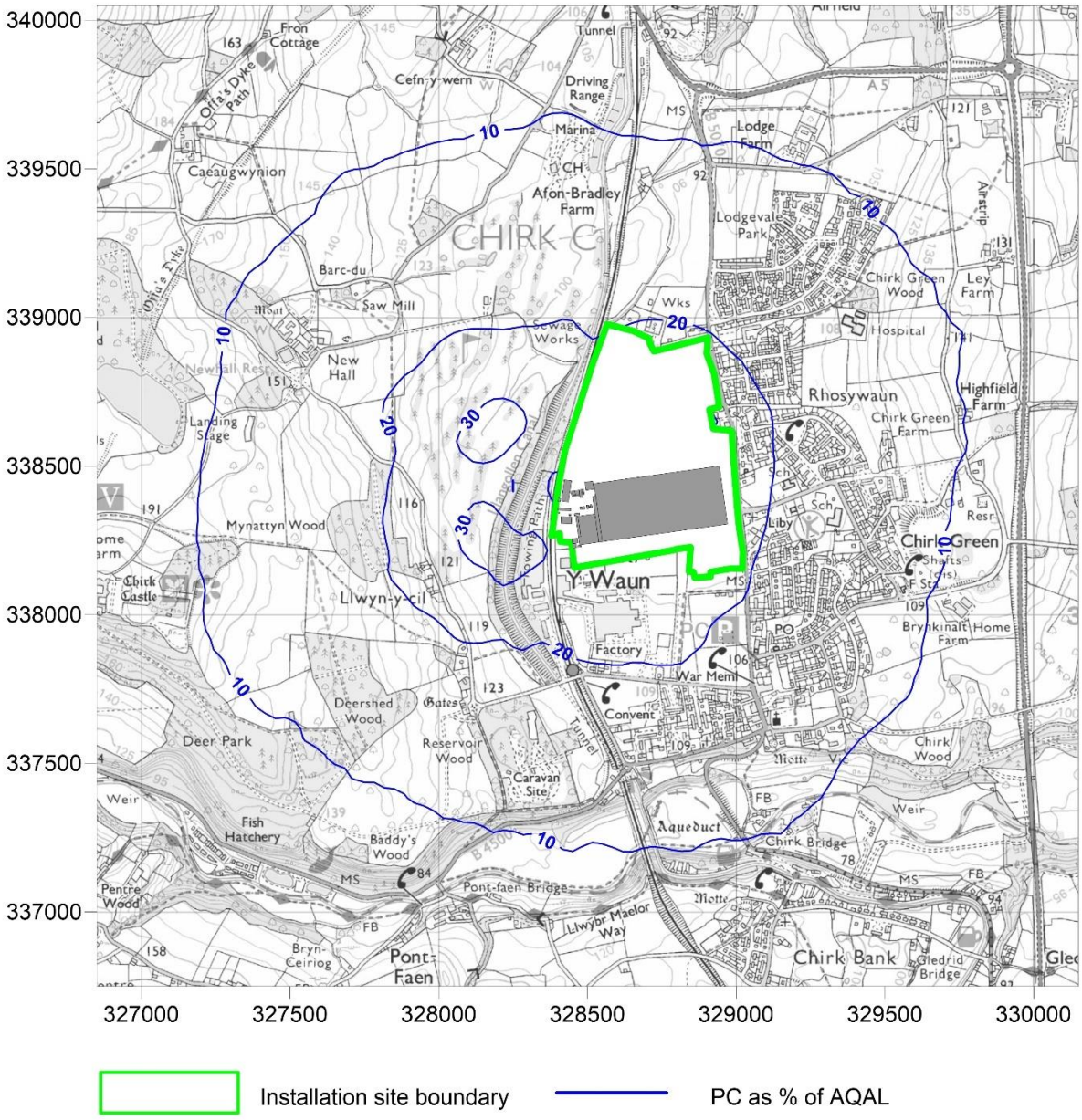


Figure 27: 99.18%ile 24-hour Mean Sulphur Dioxide Process Contribution – MDF 1 and 2 Offline

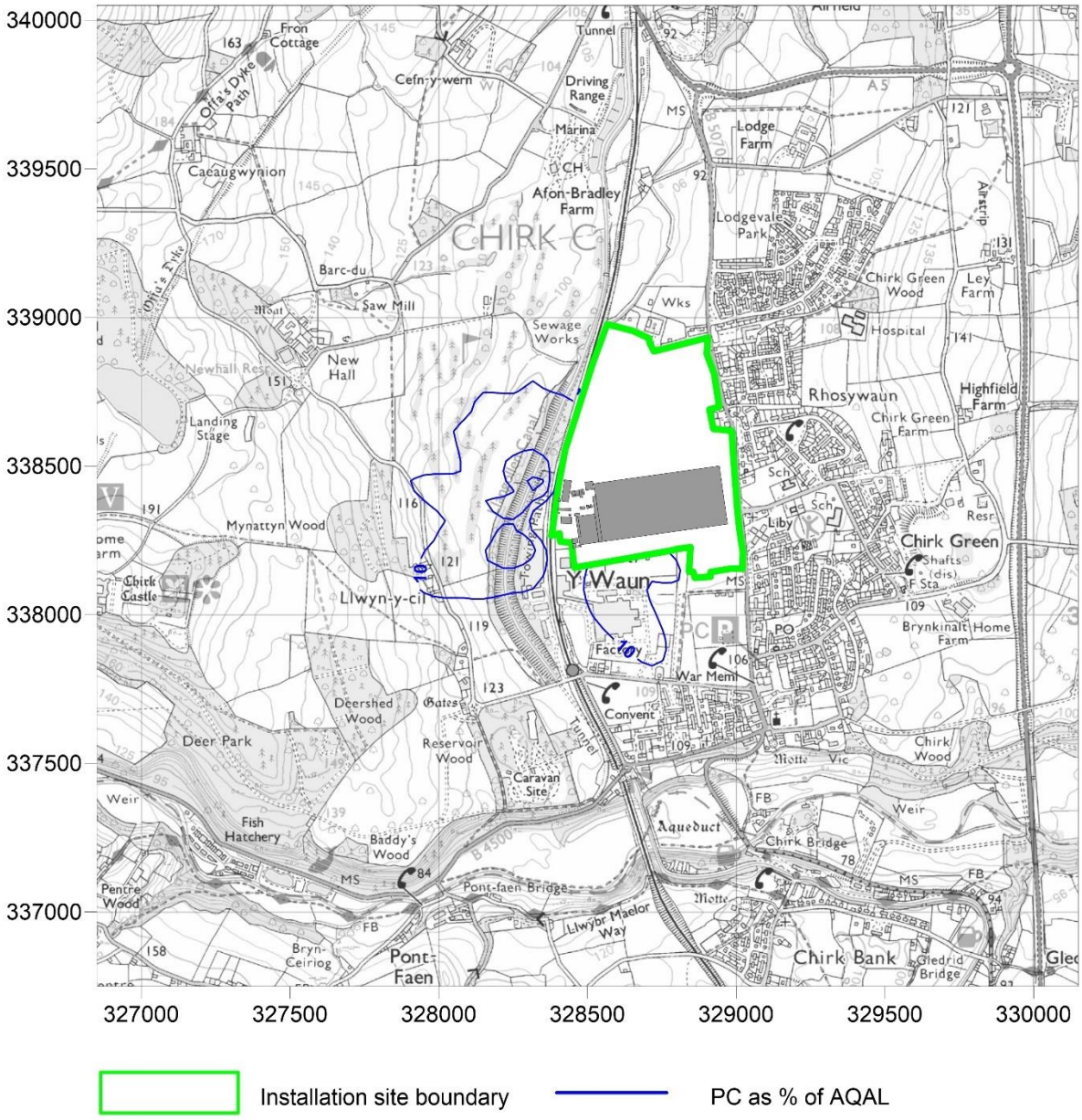


Figure 28: 99.73%ile 1-hour Mean Sulphur Dioxide Process Contribution – MDF 1 and 2 Offline

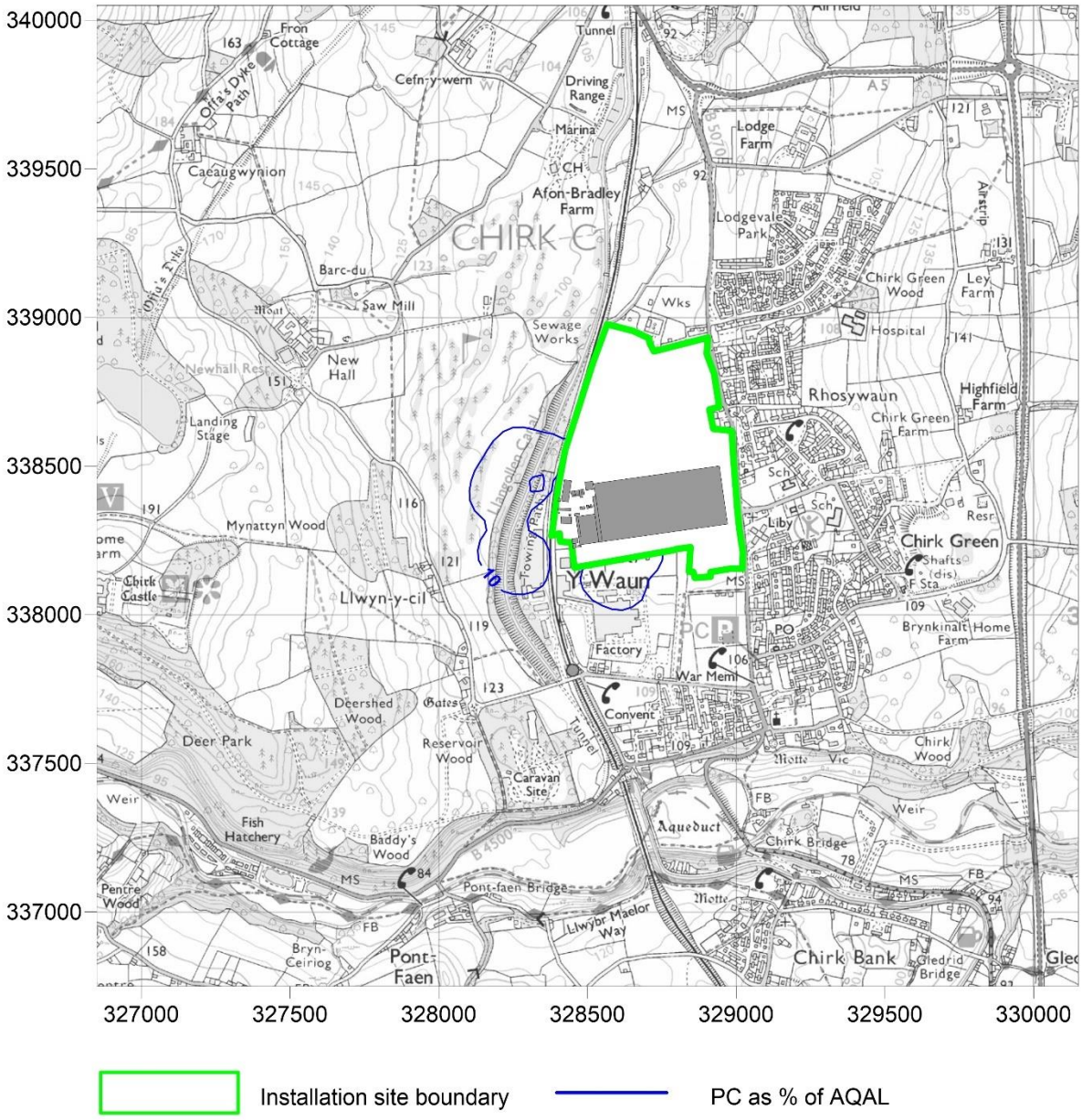


Figure 29: 99.9%ile 15-min Mean Sulphur Dioxide Process Contribution – MDF 1 and 2 Offline

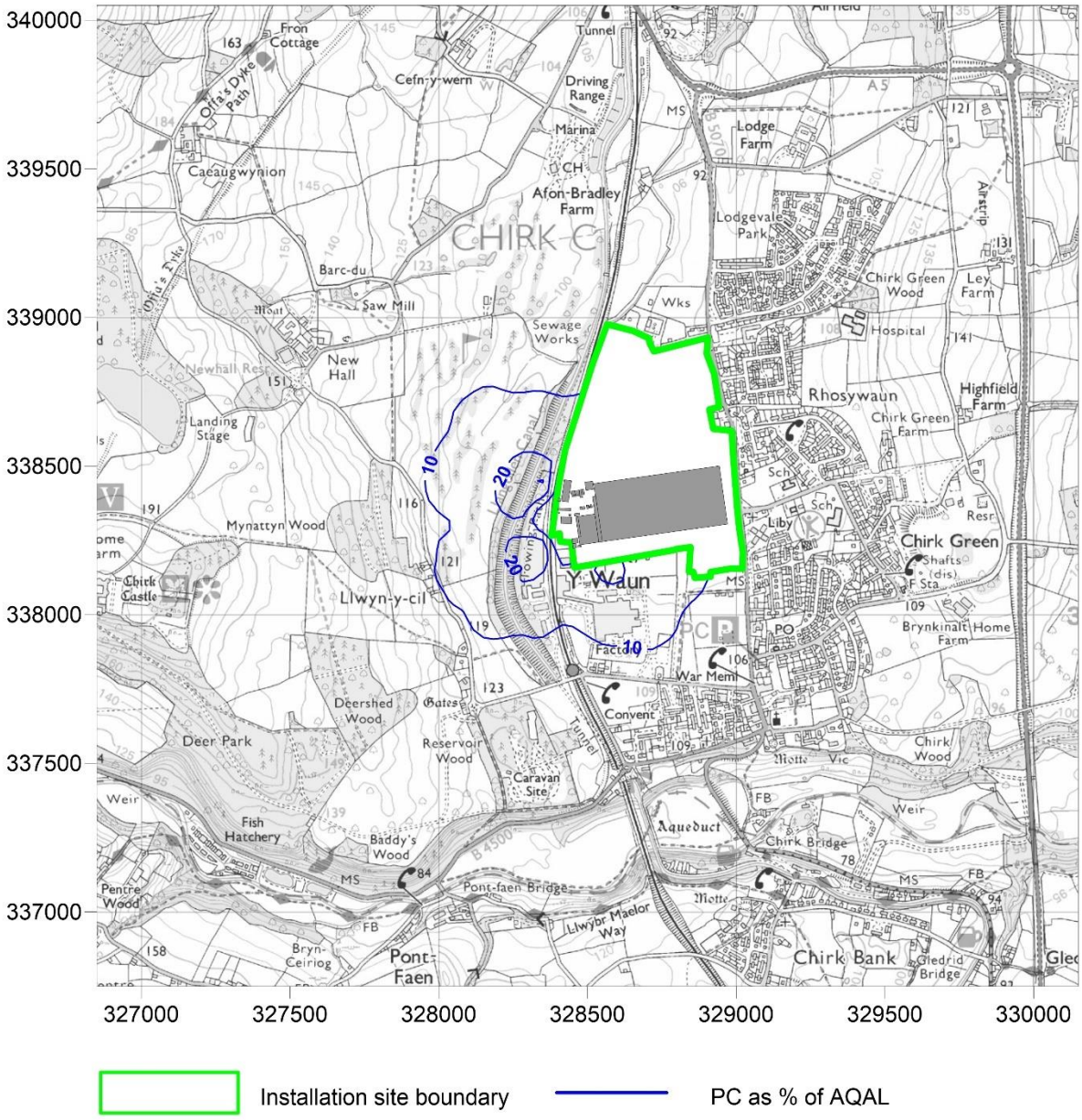


Figure 30: 99.79%ile 1-hour Mean Nitrogen Dioxide Process Contribution – K7 and K8 Offline – Likely Emissions

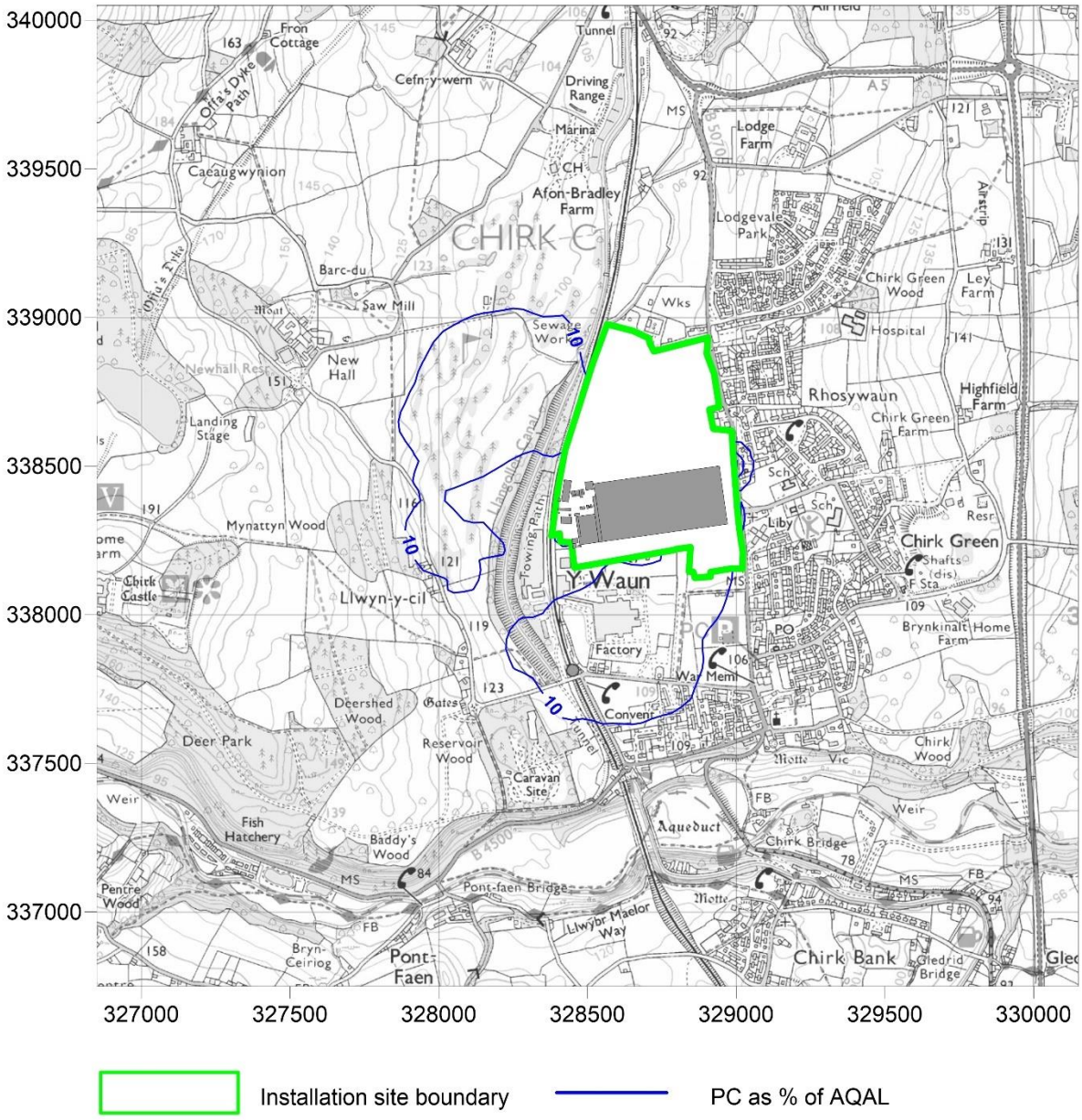


Figure 31: 99.79%ile 1-hour Mean Nitrogen Dioxide Process Contribution – K7 and K8 Offline – Worst-Case Emissions

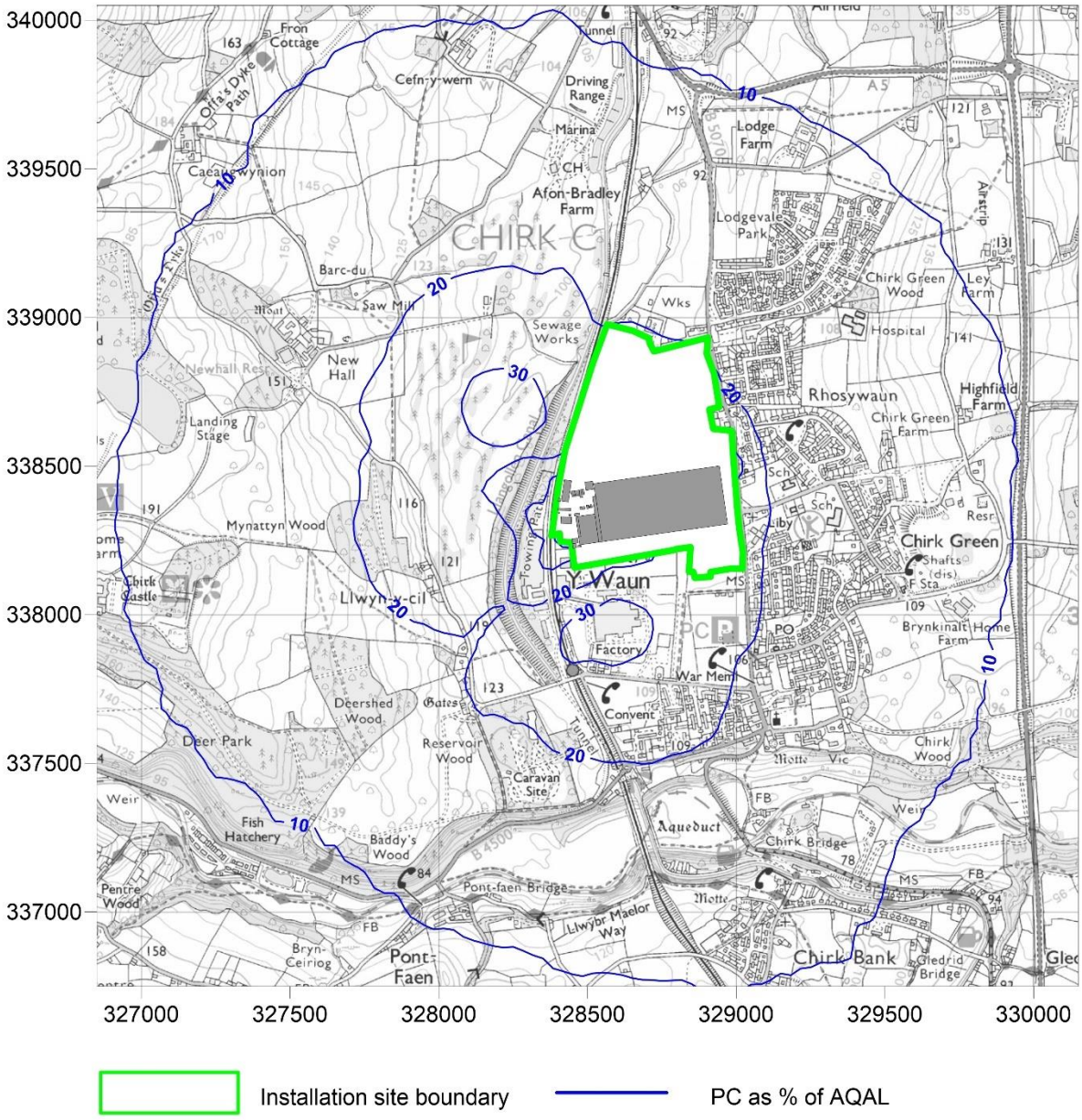


Figure 32: Annual Mean NOx Process Contribution – Normal Operations – Proposed Operations – Likely Emissions

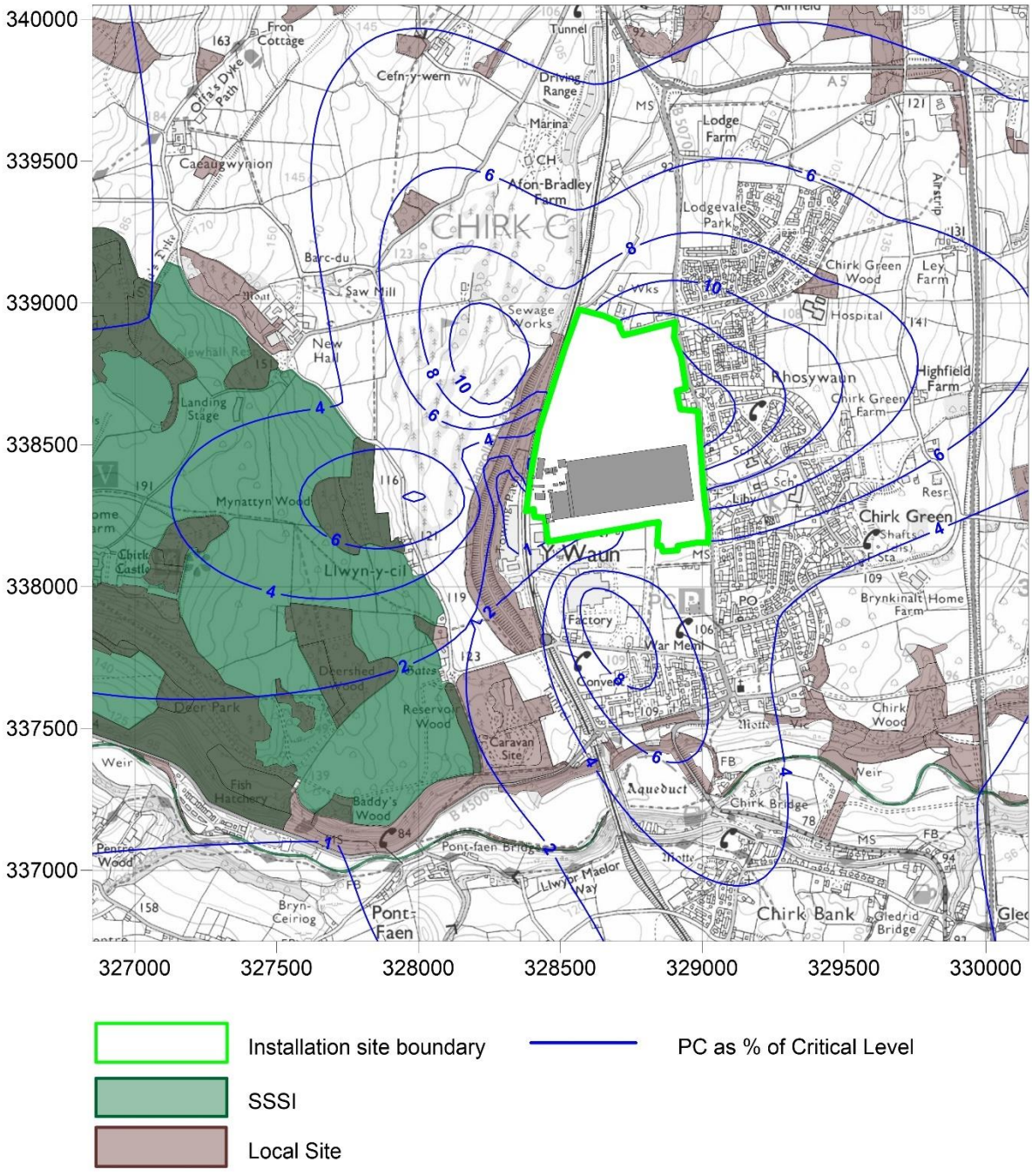


Figure 33: Annual Mean SO2 Process Contribution – Normal Operations – Proposed Operations

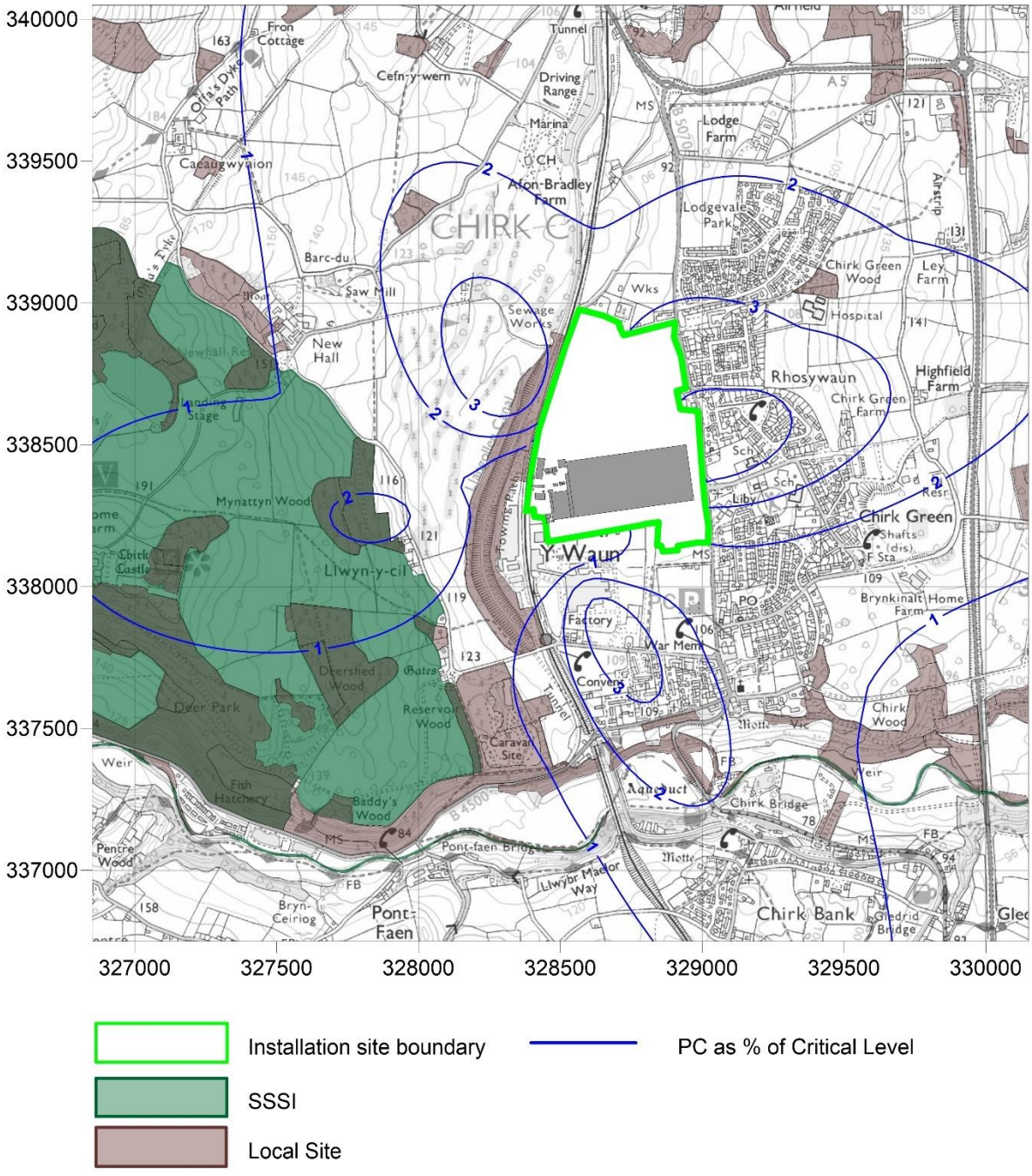


Figure 34: Annual Mean NOx Process Contribution – MDF 2 Offline – Proposed Operations – Likely Emissions

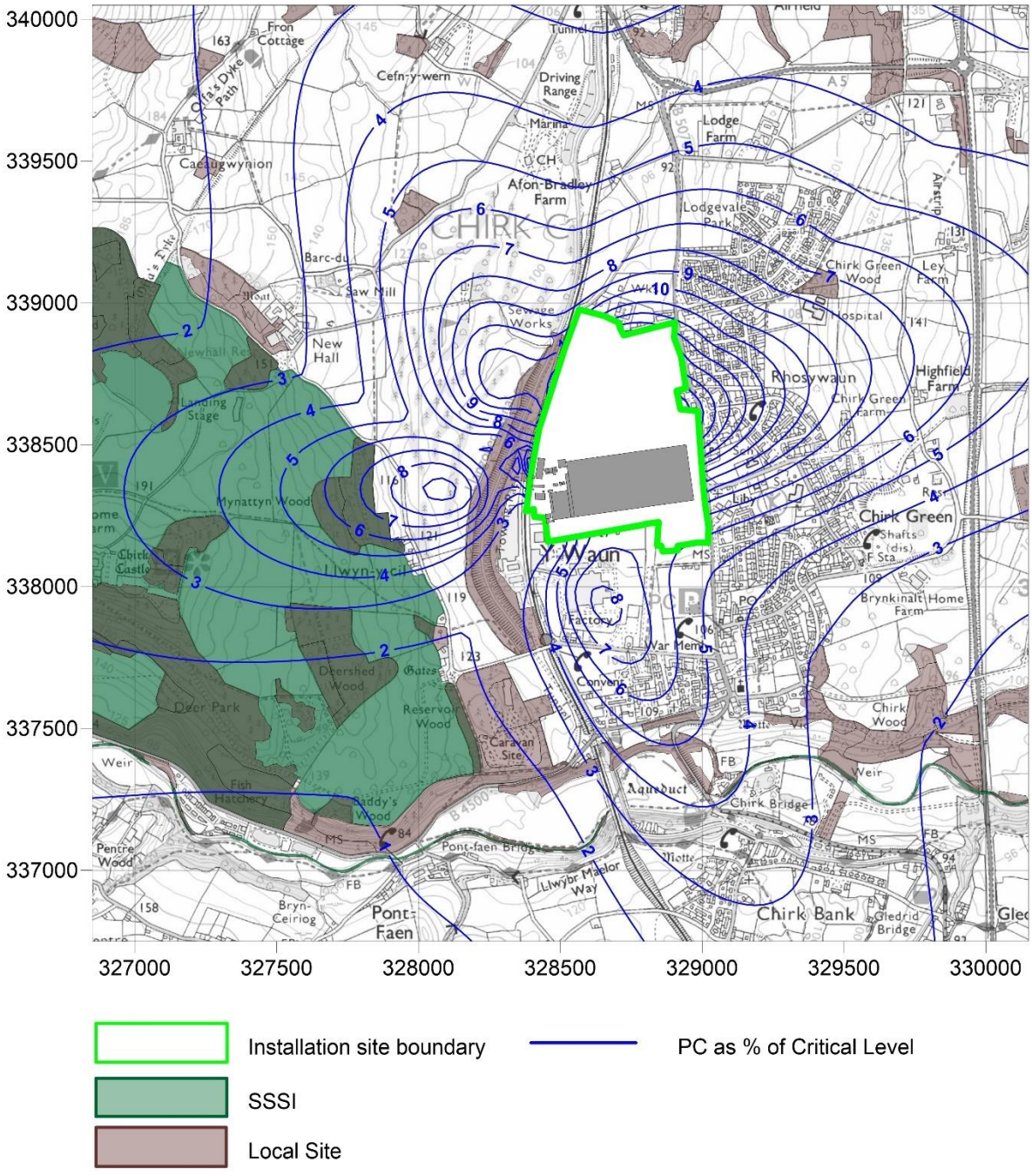


Figure 35: Annual Mean SO2 Process Contribution – MDF 2 Offline – Proposed Operations

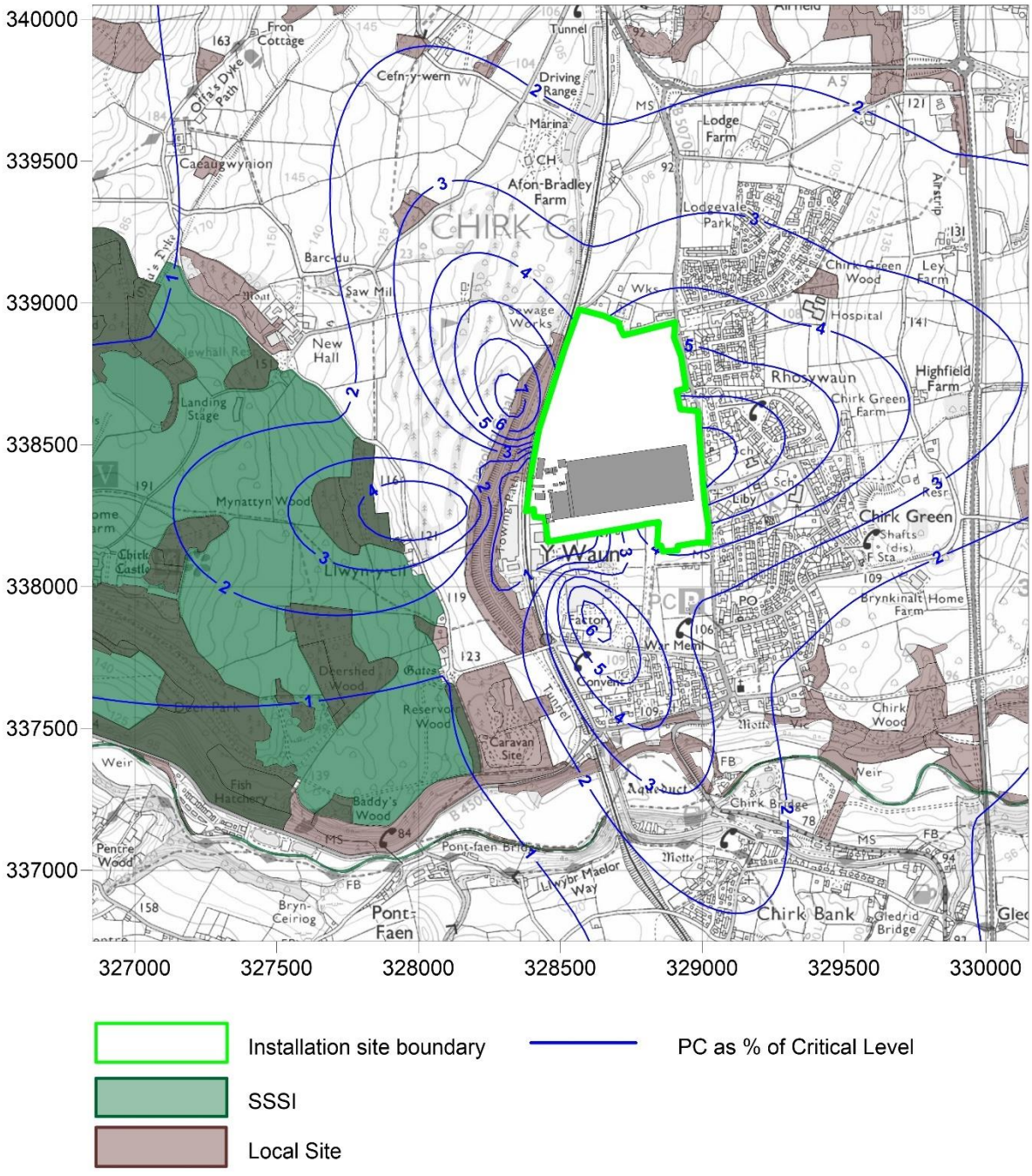


Figure 36: Max Daily Mean NOx Process Contribution – Normal Operations – Proposed Operations – Likely Emissions

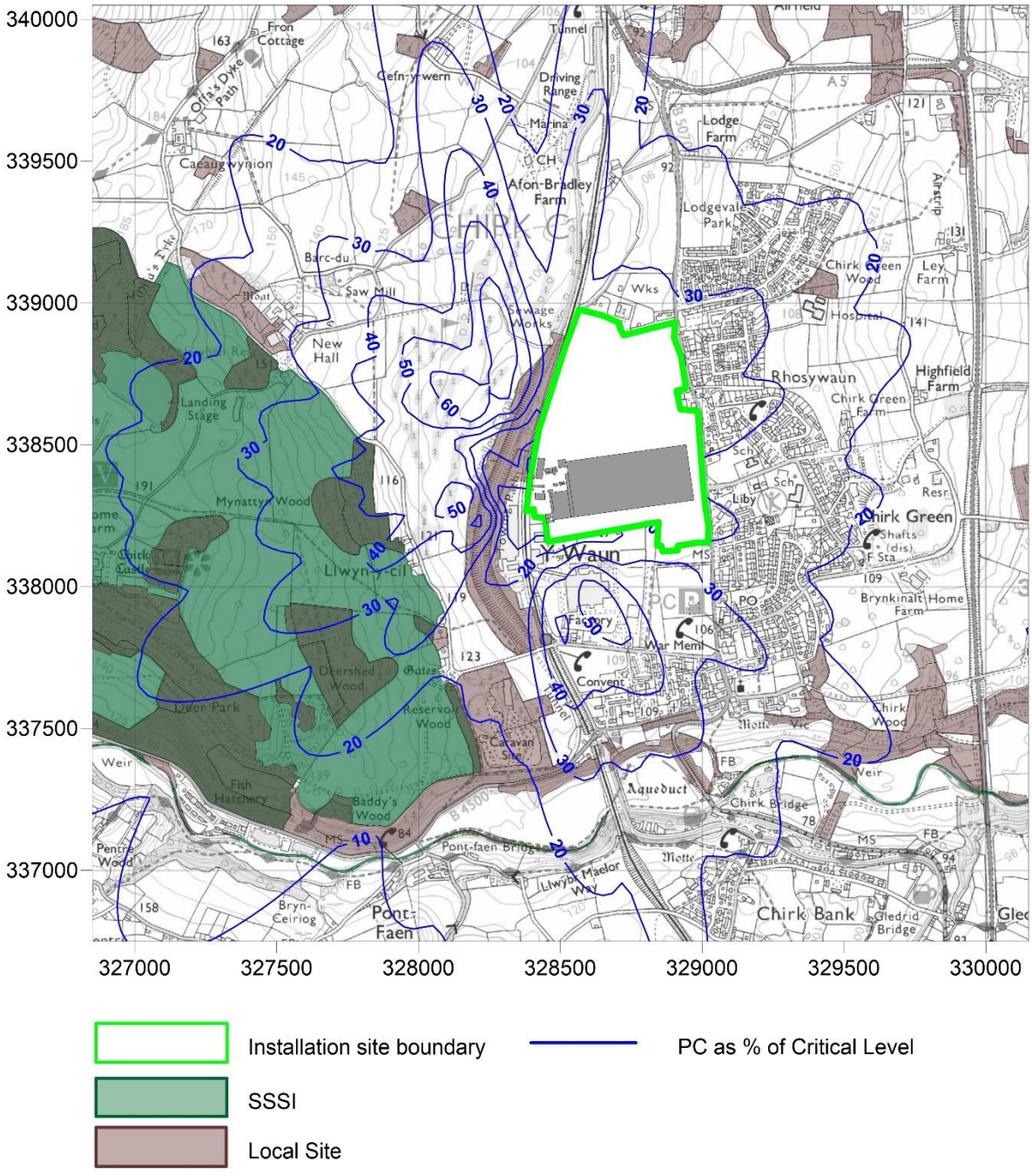


Figure 37: Max Weekly Mean HF Process Contribution – Normal Operations – Proposed Operations

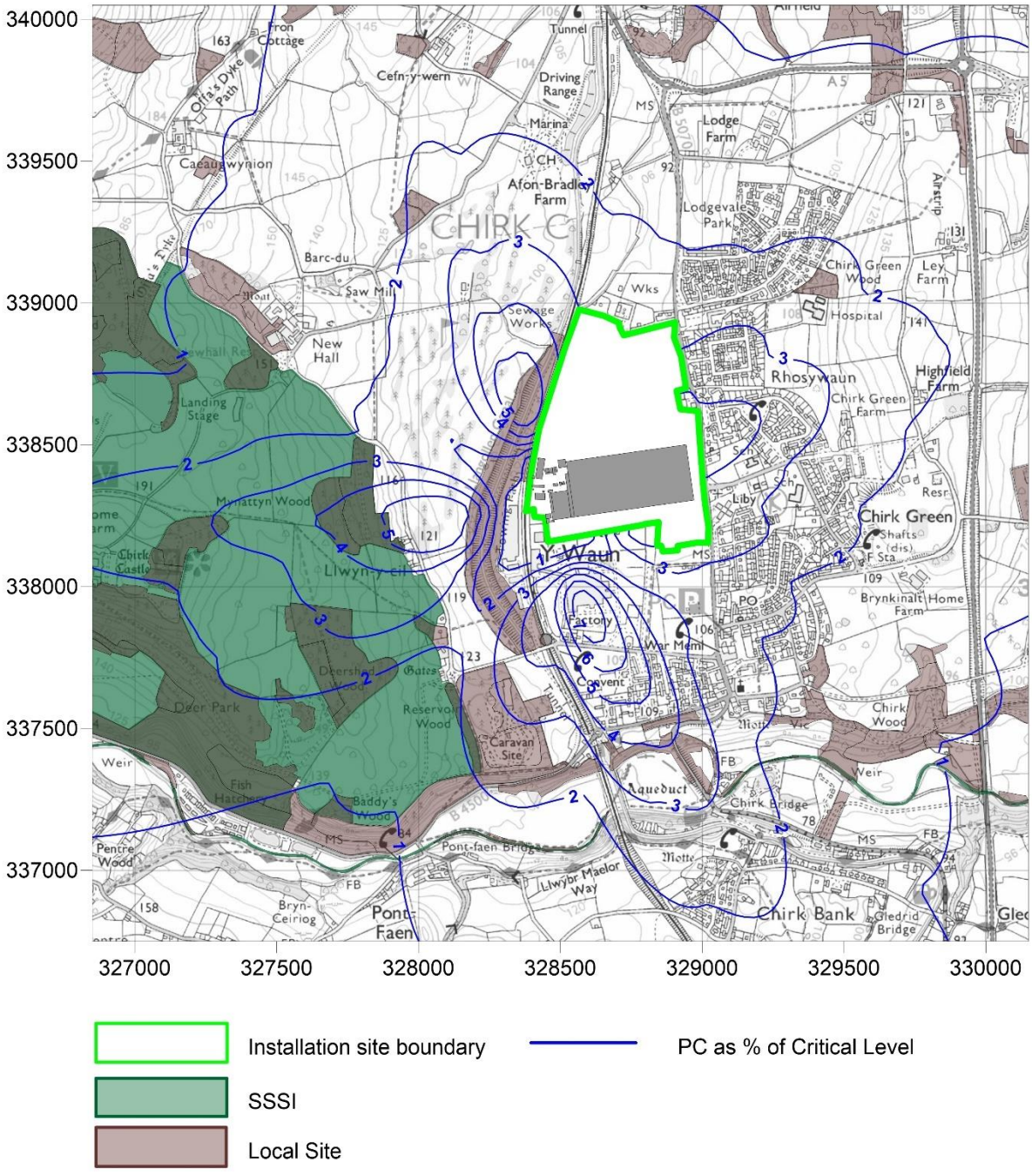


Figure 38: Max Daily Mean HF Process Contribution – Normal Operations – Proposed Operations

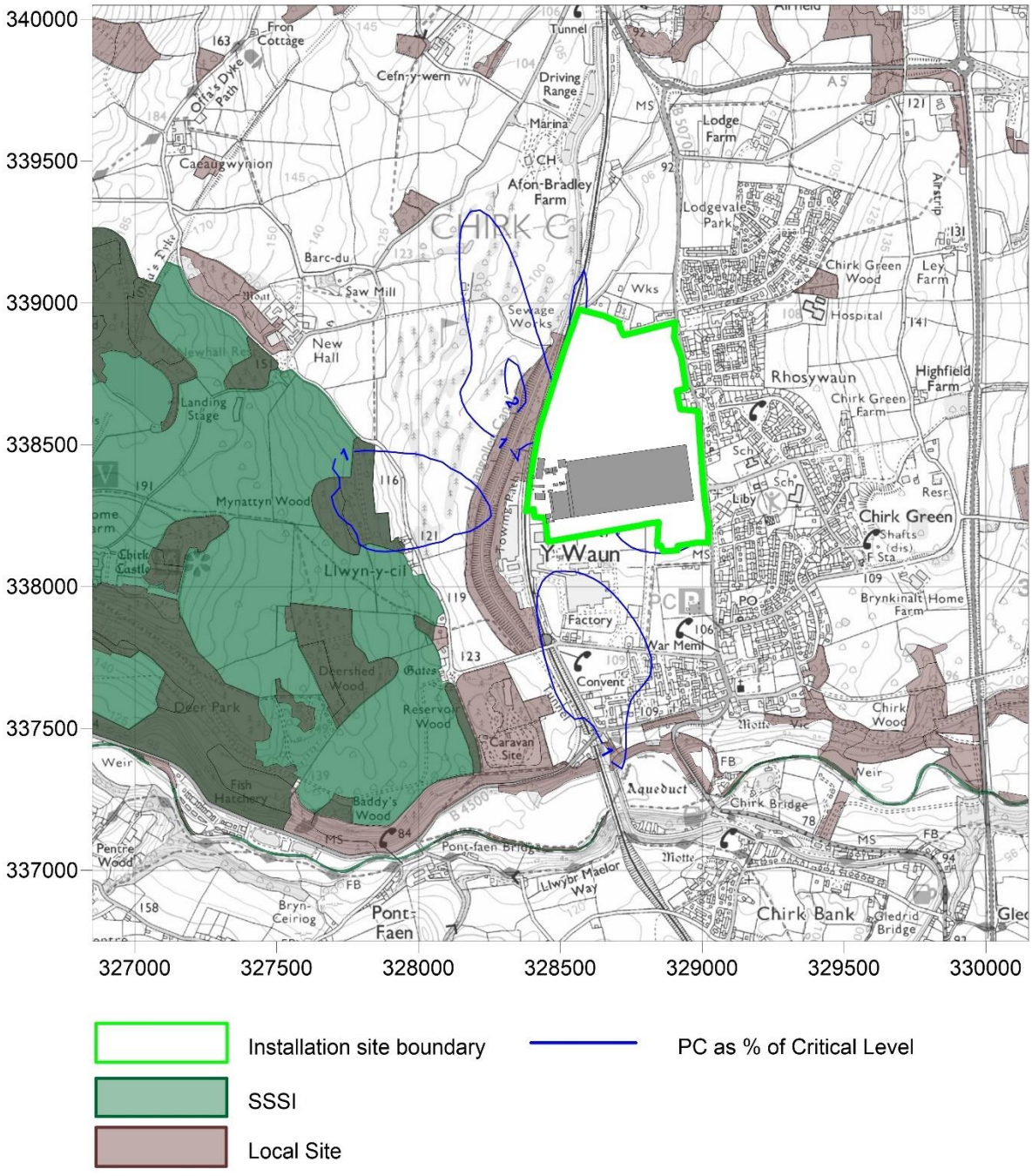


Figure 39: Max Daily Mean NOx Process Contribution – MDF 2 Offline – Proposed Operations – Likely Emissions

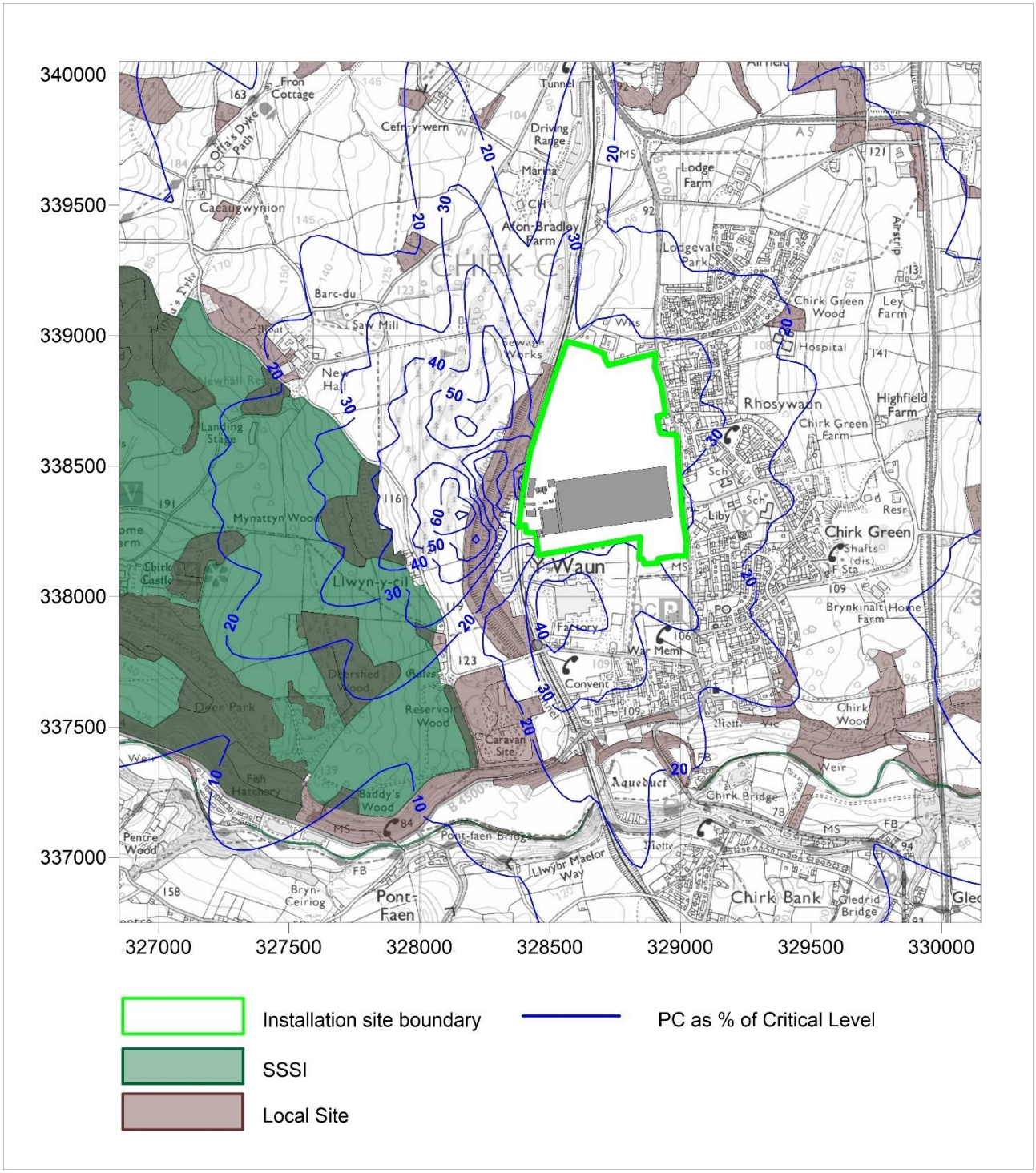


Figure 40: N Deposition Process Contribution – Normal Operations – Proposed Operations – Grassland

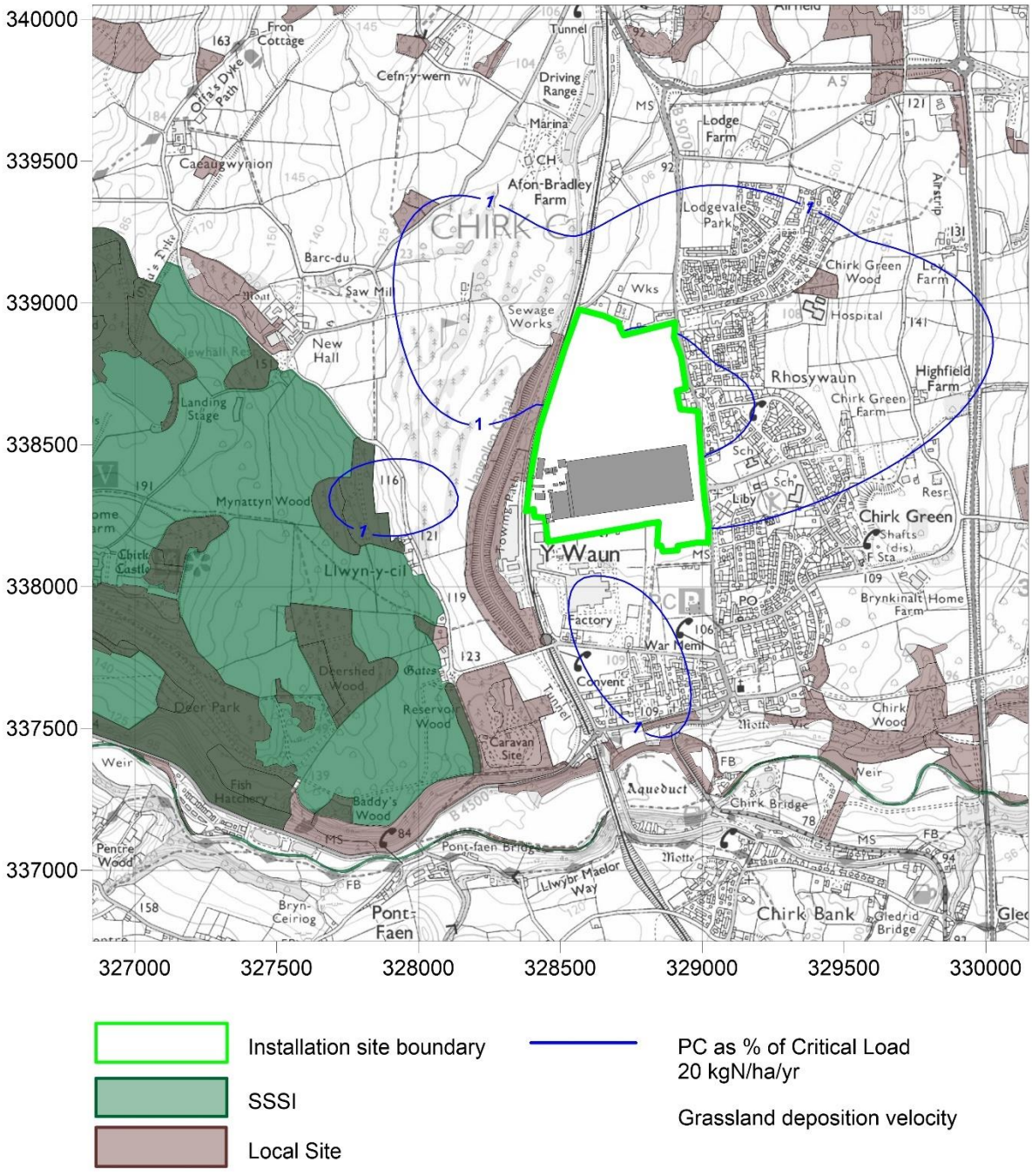


Figure 41: N Deposition Process Contribution – Normal Operations – Proposed Operations – Woodland

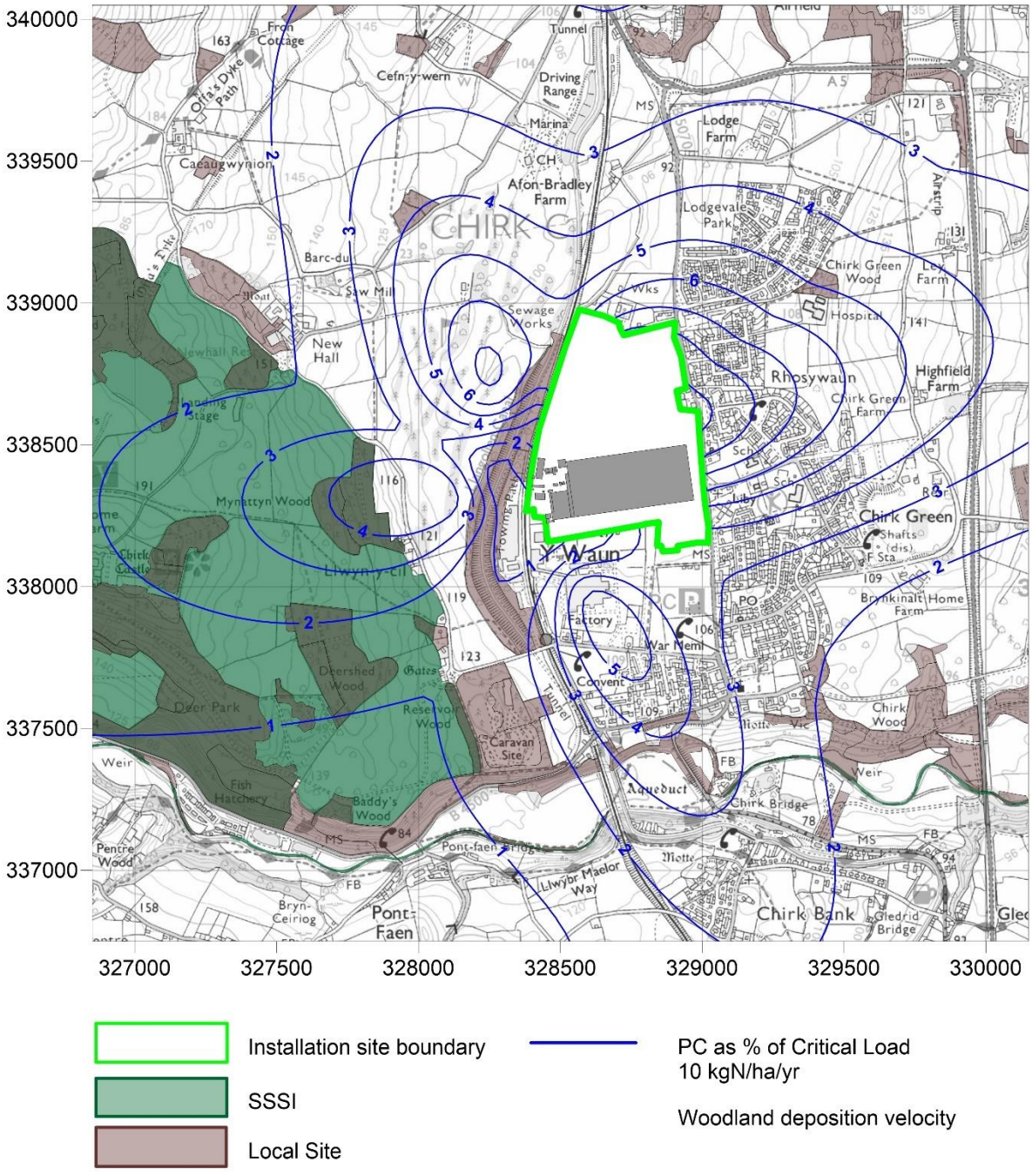


Figure 42: Acid Deposition Process Contribution – Normal Operations – Proposed Operations – Grassland

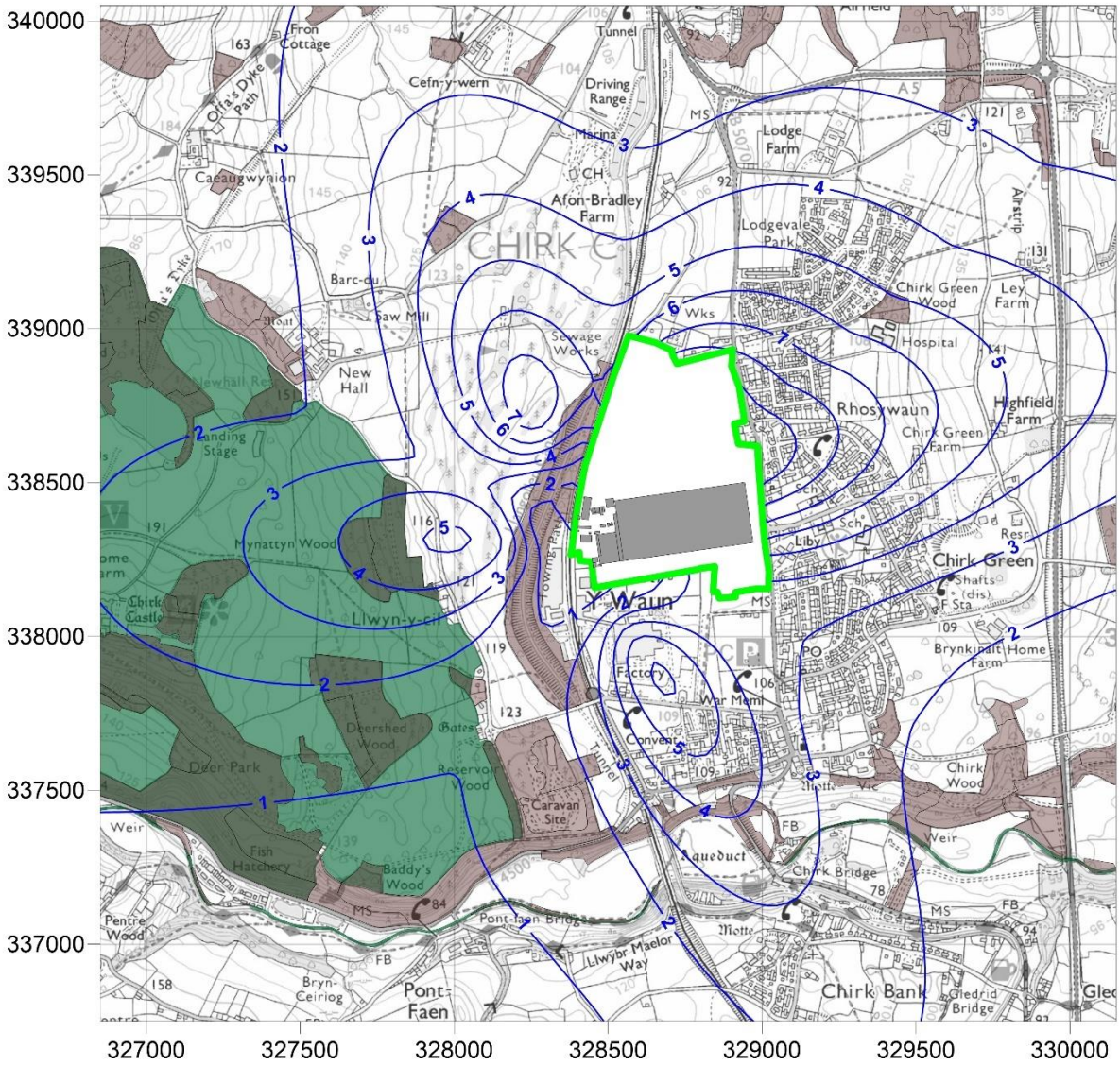


Figure 43: Acid Deposition Process Contribution – Normal Operations – Proposed Operations – Woodland

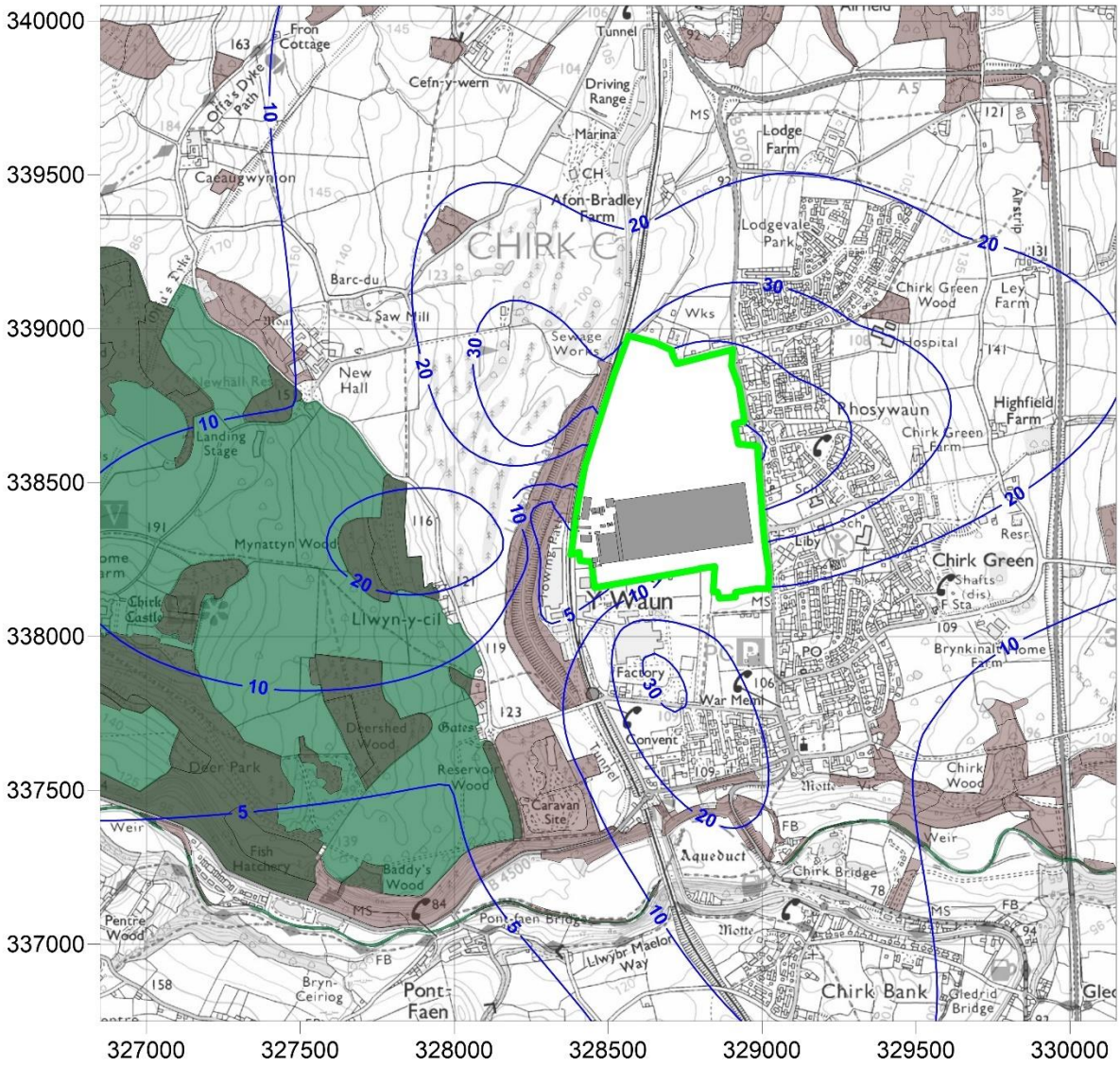


Figure 44: N Deposition Process Contribution – MDF 2 Offline – Proposed Operations – Grassland

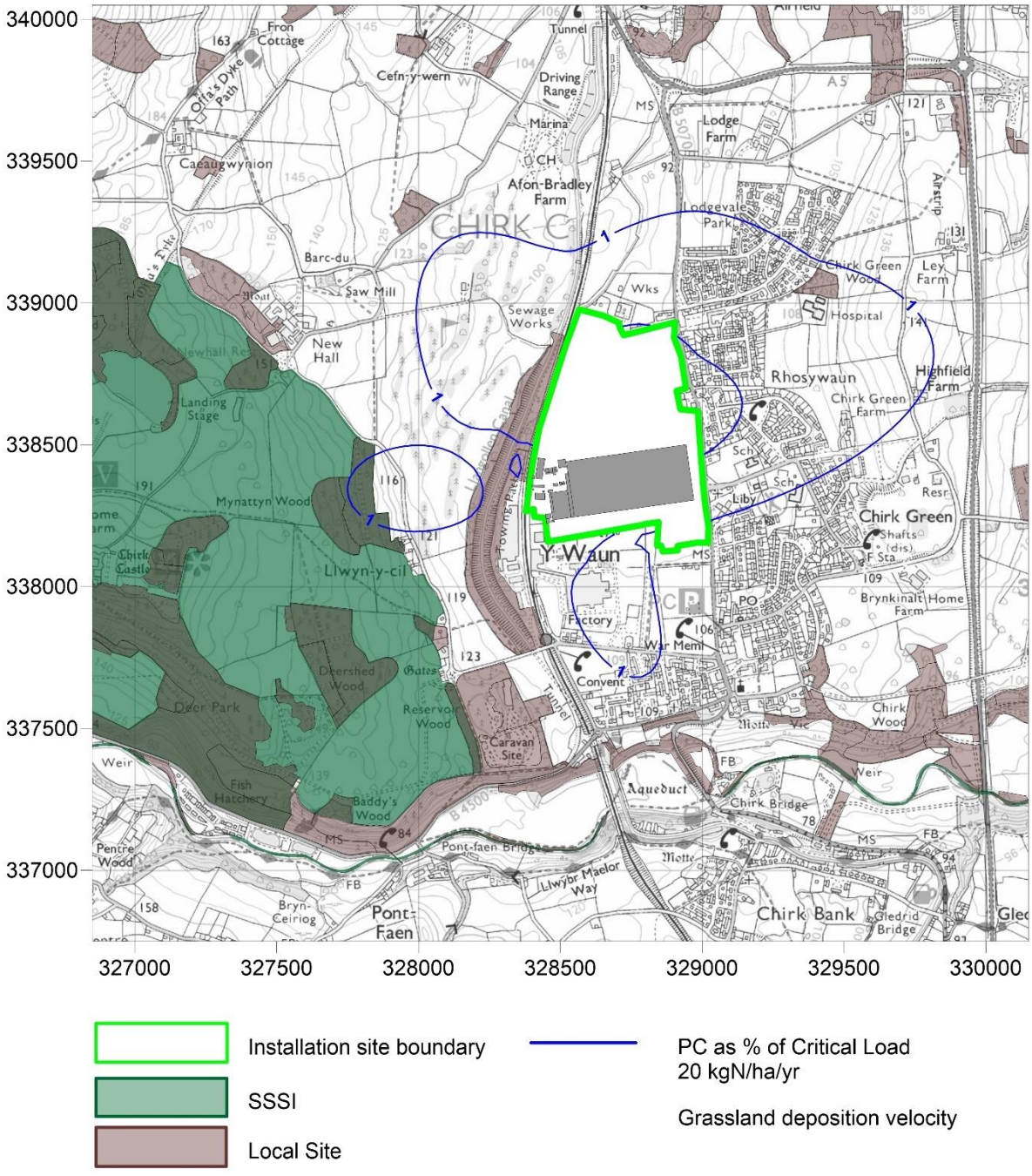


Figure 45: N Deposition Process Contribution – MDF 2 Offline – Proposed Operations – Woodland

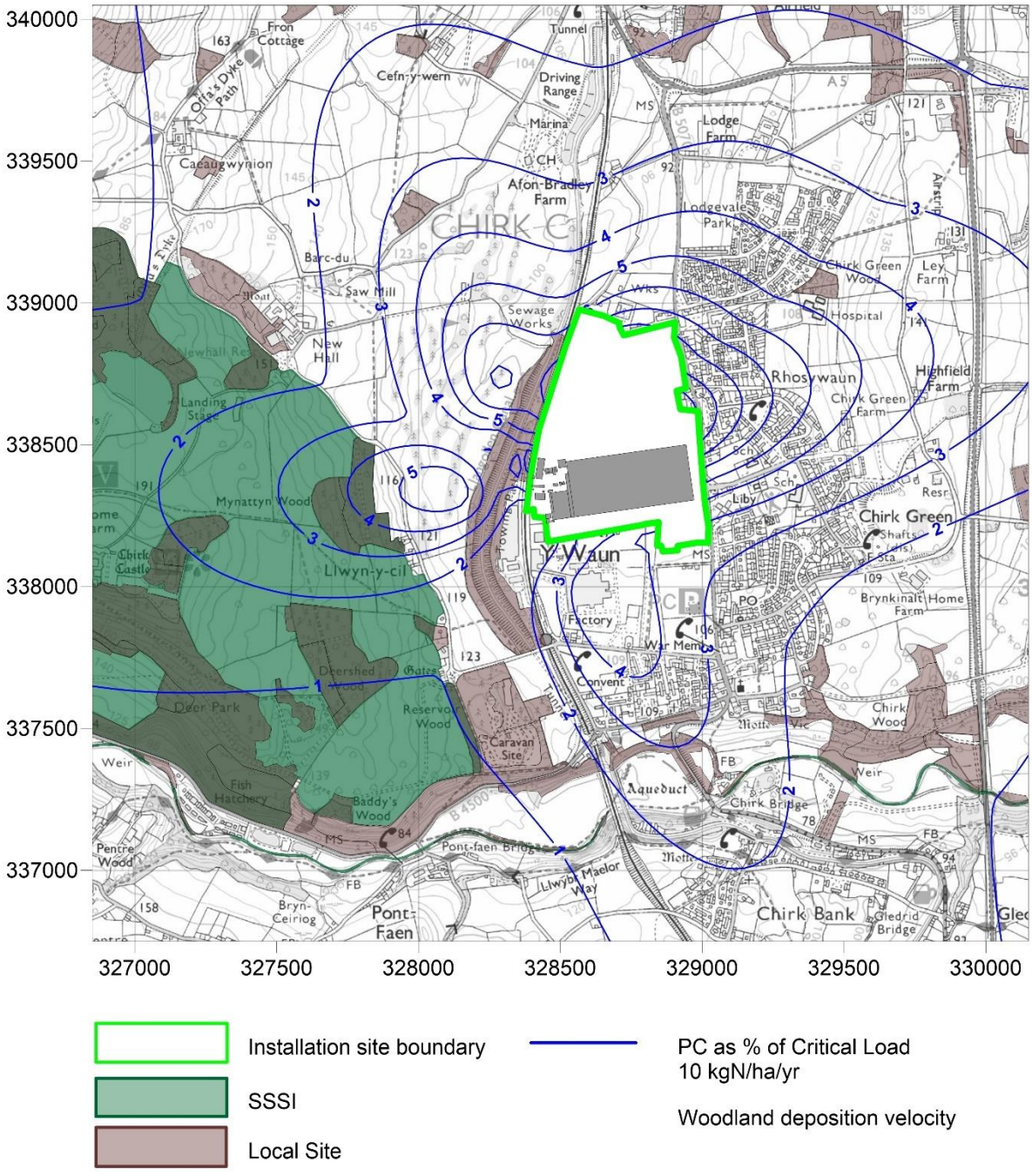


Figure 46: Acid Deposition Process Contribution – MDF 2 Offline – Proposed Operations – Grassland

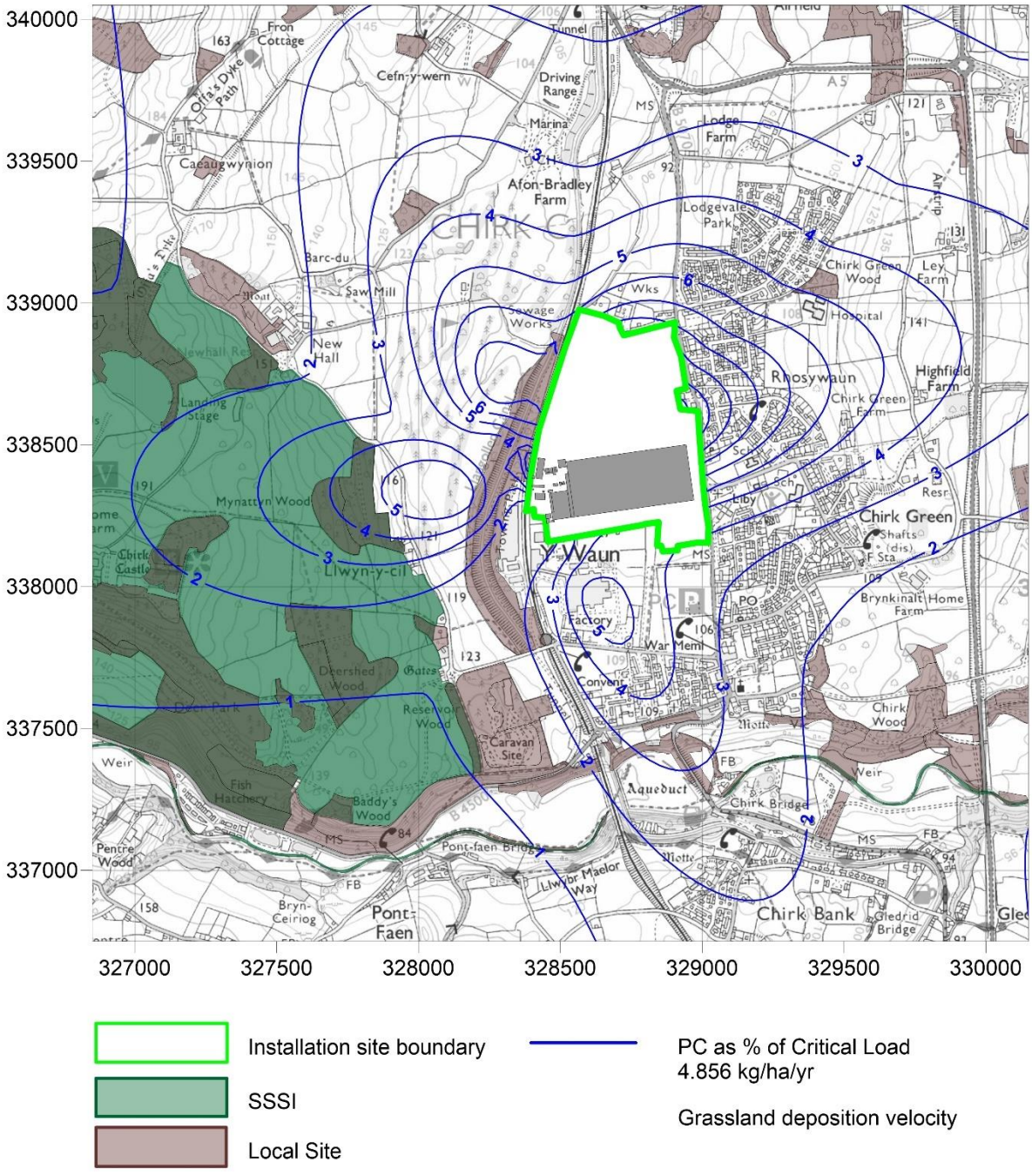
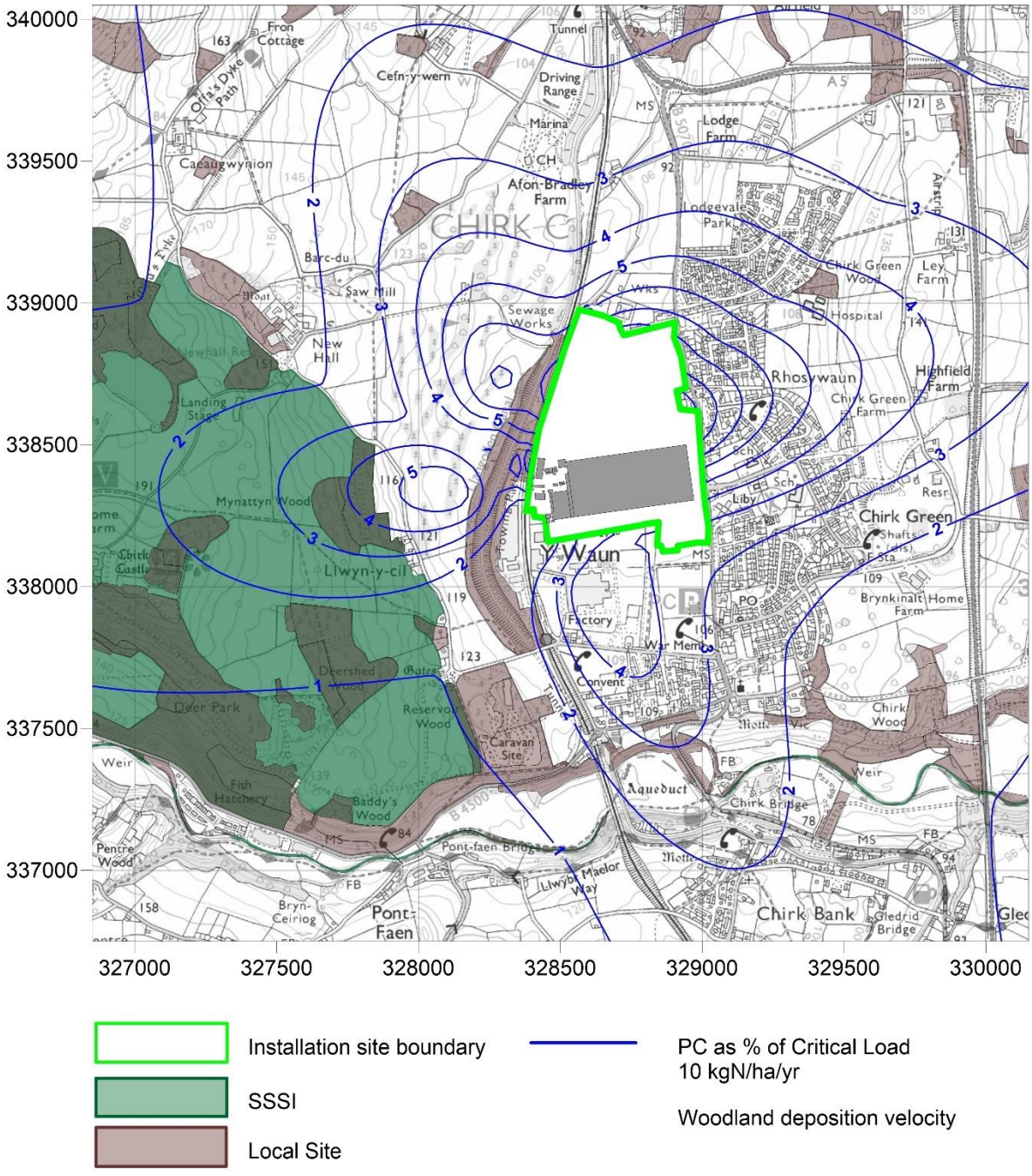


Figure 47: Acid Deposition Process Contribution – MDF 2 Offline – Proposed Operations – Woodland



Appendix B – Dispersion Model Inputs

Source Data – K1			
Item	**Unit**	**K1**	
Capacity	MW	2.25	
Stack data			
Height	m	10.2	
Internal diameter	m	0.5	
Flue gas exit velocity	m/s	5.3	
Flue gas conditions			
Temperature	°C	168	
Exit moisture content	% v/v	14.8	
Exit oxygen content	% v/v dry	3.8	
Reference oxygen content	% v/v dry	3	
Volume at reference conditions (dry, ref O2)	Nm^3/s	0.48	
Volume at actual conditions	Am^3/s	1.04	
Emissions			
Pollutant		**ELV (mg/Nm^3)**	**Release Rate (g/s)**
NOx		90	0.043

NOTES:
ELV taken from existing NRW permit.
All emissions are expressed at reference conditions of dry gas, 3% oxygen content, 273.15K.

Source Data – K5 Gas Heater			
Item	**Unit**	**K5**	
Capacity	MW	14.1	
Stack data			
Height	m	14.5	
Internal diameter	m	1	
Flue gas exit velocity	m/s	11.8	
Flue gas conditions			
Temperature	°C	310	
Exit moisture content	% v/v	15.1	
Exit oxygen content	% v/v dry	3.1	
Reference oxygen content	% v/v dry	3	
Volume at reference conditions (dry, ref O2)	Nm^3/s	3.68	
Volume at actual conditions	Am^3/s	9.30	
Emissions			
Pollutant		**ELV (mg/Nm^3)**	**Release Rate (g/s)**
NOx		200	0.736

NOTES:
ELV taken from existing NRW permit.
All emissions are expressed at reference conditions of dry gas, 3% oxygen content, 273.15K.

Source Data – K6 Gas Heater			
Item	**Unit**	**K6**	
Capacity	MW	16.5	
Stack data			
Height	m	21.44	
Internal diameter	m	1.6	
Flue gas exit velocity	m/s	9.6	
Flue gas conditions			
Temperature	°C	310	
Exit moisture content	% v/v	15.1	
Exit oxygen content	% v/v dry	3.1	
Reference oxygen content	% v/v dry	3	
Volume at reference conditions (dry, ref O2)	Nm^3/s	4.30	
Volume at actual conditions	Am^3/s	10.88	
Emissions			
Pollutant		**ELV (mg/Nm^3)**	**Release Rate (g/s)**
NOx		200	0.861

NOTES:
ELV taken from existing NRW permit.
All emissions are expressed at reference conditions of dry gas, 3% oxygen content, 273.15K.

Source Data – Gas Turbines			
Item	**Unit**	**Gas Turbines**	
Capacity	MW	20.5	
Stack data			
Height	m	35	
Internal diameter	m	1.512	
Flue gas exit velocity	m/s	11.6	
Flue gas conditions			
Temperature	°C	480	
Exit moisture content	% v/v	5.53	
Exit oxygen content	% v/v dry	16.57	
Reference oxygen content	% v/v dry	15	
Volume at reference conditions (dry, ref O2)	Nm^3/s	5.25	
Volume at actual conditions	Am^3/s	20.80	
Volume at STP	m^3/s	7.50	
Emissions			
Pollutant		**ELV (mg/Nm^3)**	**Release Rate (g/s)**
NOx		390	2.046

NOTES:
ELV taken from existing NRW permit.
All emissions are expressed at reference conditions of dry gas, 15% oxygen content, 273.15K.
Not modelled.

Source Data – Gas Engines			
Item	**Unit**	**Gas Engines**	
Capacity	MW	20.5	
Stack data			
Height	m	22	
Internal diameter	m	1.2	
Flue gas exit velocity	m/s	19.1	
Flue gas conditions			
Temperature	°C	206	
Exit moisture content	% v/v	9.72	
Exit oxygen content	% v/v dry	11.4	
Reference oxygen content	% v/v dry	5	
Volume at reference conditions (dry, ref O2)	Nm^3/s	6.59	
Volume at actual conditions	Am^3/s	21.40	
Volume at STP	m^3/s	10.90	
Emissions			
Pollutant		**ELV (mg/Nm^3)**	**Release Rate (g/s)**
NOx		280	1.641

NOTES:
ELV taken from existing NRW permit.
All emissions are expressed at reference conditions of dry gas, 5% oxygen content, 273.15K.

Source Data – K7 Biomass Plant		
Item	**Unit**	**K7 Biomass Plant**
Capacity	MW	21.28
Stack data		
Height	m	36.5
Internal diameter	m	2
Flue gas exit velocity	m/s	23.7
Flue gas conditions		
Temperature	°C	359
Exit moisture content	% v/v	20.8
Exit oxygen content	% v/v dry	6
Reference oxygen content	% v/v dry	6
Volume at reference conditions (dry, ref O2)	Nm^3/s	25.52
Volume at actual conditions	Am^3/s	74.58
Emissions		

Pollutant	ELV (mg/Nm^3)	Release Rate (g/s)
NOx	250	6.381
CO	650 (1)	16.591
PM	50	1.276
SO_2	200	5.105

NOTES:

ELVs proposed as set out in Supporting Information Document

All emissions are expressed at reference conditions of dry gas, 6% oxygen content, 273.15K.

(1) CO is not a listed pollutant the ELV modelled is the maximum monitored with an additional tolerance. The maximum monitored concentration was 605 mg/Nm^3

Source Data – K8 Biomass Plant		
Item	**Unit**	**K8 Biomass Plant**
Capacity	MW	38
Stack data		
Height	m	70
Internal diameter	m	1.69
Flue gas exit velocity	m/s	11.8
Flue gas conditions		
Temperature	°C	140
Exit moisture content	% v/v	20.8
Exit oxygen content	% v/v dry	11.6
Reference oxygen content	% v/v dry	6
Volume at reference conditions (dry, ref O2)	Nm^3/s	9.12
Volume at actual conditions	Am^3/s	26.54

Emissions		
Pollutant	**ELV (mg/Nm^3)**	**Release Rate (g/s)**
NOx	300	2.737
CO	75	0.684
PM	15	0.137
TVOC	15	0.137
HCl	15	0.137
SO_2	75	0.684
HF	3	0.027
Other Metals	0.5	4.562 mg/Nm^3
Cd and Tl	0.05	0.456 mg/Nm^3
Hg	0.05	0.456 mg/Nm^3
PCDDs	0.1 ng/Nm^3	0.912 pg/Nm^3
PCBs	0.0075	68.433 ng/Nm^3

NOTES:

ELVs proposed as set out in Supporting Information Document

All emissions are expressed at reference conditions of dry gas, 6% oxygen, 273.15K.

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

The Waste Incineration BREF provides a range of values for PCB emissions to air from European municipal waste incineration plants. This states that the annual average total PCBs is less than 0.005 mg/Nm3 (dry, 11% oxygen, 273K). In lieu of other available data, this has been assumed to be the emission concentration for the K8 biomass plant converted to 6% reference O2 content.

Source Data – Bab 2 Drier (or OSB 1)			
Item	**Unit**	**Bab 2 Drier (or OSB 1)**	
Capacity	MW	32	
Stack data			
Height	m	33	
Internal diameter	m	2	
Flue gas exit velocity	m/s	24.3	
Flue gas conditions			
Temperature	°C	150	
Exit moisture content	% v/v	12	
Exit oxygen content	% v/v dry	19.0	
Reference oxygen content	% v/v dry	18	
Volume at reference conditions (0°C, dry, ref O_2)	Nm^3/s	29.02	
Volume at actual conditions	Am^3/s	76.39	
Emissions			
Pollutant		**ELV (mg/Nm^3)**	**Release Rate (g/s)**
NOx – BAT AEL		250	7.254
NOx - typical		100	2.902

NOTES:
ELVs proposed as set out in Supporting Information Document
All emissions are expressed at reference conditions of dry gas, 18% oxygen content, 273.15K.
Emissions from the Bab 2 drier vents to atmosphere via the WESP.

Source Data – Bab 3 Drier (or OSB 2)		
Item	**Unit**	**Bab 3 Drier (or OSB 2)**
Capacity	MW	35
Stack data		
Height	m	27
Internal diameter	m	2
Flue gas exit velocity	m/s	23.4
Flue gas conditions		
Temperature	°C	150
Exit moisture content	% v/v	12
Exit oxygen content	% v/v dry	19
Reference oxygen content	% v/v dry	18
Volume at reference conditions (0°C, dry, ref O_2)	Nm^3/s	27.96
Volume at actual conditions	Am^3/s	73.61
Emissions		

Pollutant	**ELV (mg/Nm^3)**	**Release Rate (g/s)**
NOx – BAT AEL	250	6.991
NOx - typical	100	2.796

NOTES:
ELVs proposed as set out in Supporting Information Document
All emissions are expressed at reference conditions of dry gas, 18% oxygen content, 273.15K.
Emissions from the Bab 2 drier vents to atmosphere via the WESP.

Source Data – MDF 1 Cyclone		
Item	**Unit**	**MDF 1 Cyclone**
Capacity	MW	15
Stack data		
Height	m	50
Internal diameter	m	1.8
Flue gas exit velocity	m/s	22.1
Flue gas conditions		
Temperature	°C	63
Exit moisture content	% v/v	12
Exit oxygen content	% v/v dry	19
Reference oxygen content	% v/v dry	No Correction
Volume at reference conditions (dry, ref O2)	Nm^3/s	40.17
Volume at actual conditions	Am^3/s	56.18
Emissions		

Pollutant	ELV (mg/Nm^3)	Release Rate (g/s)
NOx – BAT AEL	250	10.043
NOx - typical	100	4.017
PM	20	0.897
TVOC	120	5.379
HC_2O	15	0.672

NOTES:
ELVs proposed as set out in Supporting Information Document
All emissions are expressed at reference conditions of dry gas, 18% oxygen content, 273.15K.

Source Data – MDF 2 Cyclone		
Item	**Unit**	**MDF 2 Cyclone**
Capacity	MW	32
Stack data		
Height	m	57
Internal diameter	m	2.96
Flue gas exit velocity	m/s	16.8
Flue gas conditions		
Temperature	°C	73
Exit moisture content	% v/v	12
Exit oxygen content	% v/v dry	18
Reference oxygen content	% v/v dry	No Correction
Volume at reference conditions (dry, ref O2)	Nm^3/s	80.25
Volume at actual conditions	Am^3/s	115.57

Emissions		
Pollutant	**ELV (mg/Nm^3)**	**Release Rate (g/s)**
NOx – BAT AEL	250	20.063
NOx - typical	100	8.025
PM	20	1.826
TVOC	120	10.958
HC_2O	15	1.370

NOTES:
ELVs proposed as set out in Supporting Information Document
All emissions are expressed at reference conditions of dry gas, 18% oxygen content, 273.15K.

Source Data – WESP		
Item	**Unit**	**WESP - Existing**
Capacity	MW	-
Stack data		
Height	m	65.5
Internal diameter	m	4.8
Flue gas exit velocity	m/s	17.4
Flue gas conditions		
Temperature	°C	37.8
Exit moisture content	% v/v	12
Exit oxygen content	% v/v dry	22.4
Reference oxygen content	% v/v dry	18
Volume at reference conditions (dry, ref O2)	Nm^3/s	243.9
Volume at actual conditions	Am^3/s	315.6
Emissions		
Pollutant	**ELV (mg/Nm^3)**	**Release Rate (g/s)**
NOx – BAT AEL	From Bab 2 and 3	14.245
NOx - typical	From Bab 2 and 3	5.698
PM	30	8.174
TVOC	200	54.495
HC_2O	15	4.087

NOTES:
ELVs proposed as set out in Supporting Information Document
All emissions are expressed at reference conditions of dry gas, 18% oxygen content, 273.15K.

Source Data – WESP		
Item	**Unit**	**WESP - OSB**
Capacity	MW	-
Stack data		
Height	m	65.5
Internal diameter	m	4.8
Flue gas exit velocity	m/s	19.7
Flue gas conditions		
Temperature	°C	40.2
Exit moisture content	% v/v	12
Exit oxygen content	% v/v dry	22.4
Reference oxygen content	% v/v dry	18
Volume at reference conditions (dry, ref O2)	Nm^3/s	272.5
Volume at actual conditions	Am^3/s	315.6
Emissions		

Pollutant	**ELV (mg/Nm^3)**	**Release Rate (g/s)**
NOx – BAT AEL	From OSB 1 and 2	14.245
NOx - typical	From OSB 1 and 2	5.698
PM	30	9.298
TVOC	400	123.978
HC_2O	20	6.199

NOTES:
ELVs proposed as set out in Supporting Information Document
All emissions are expressed at reference conditions of dry gas, 18% oxygen content, 273.15K.

Source Data – PB WESP		
Item	**Unit**	**PB WESP**
Capacity	MW	-
Stack data		
Height	m	50
Internal diameter	m	4
Flue gas exit velocity	m/s	17.7
Flue gas conditions		
Temperature	°C	65
Exit moisture content	% v/v	13
Exit oxygen content	% v/v dry	18
Reference oxygen content	% v/v dry	18
Volume at reference conditions (dry, ref O2)	Nm^3/s	111.1
Volume at actual conditions	Am^3/s	78.09
Emissions		

Pollutant	ELV (mg/Nm³)	Release Rate (g/s)
NOx – BAT AEL	250	19.521
NOx - typical	100	7.809
PM	30	2.343
TVOC	200	15.617
HC_2O	15	1.171

NOTES:
ELVs proposed as set out in Supporting Information Document
All emissions are expressed at reference conditions of dry gas, 18% oxygen content, 273.15K.

Source Data – A1			
Item	**Unit**	**A1**	
Capacity	MW	-	
Stack data			
Height	m	25	
Internal diameter	m	0.5	
Flue gas exit velocity	m/s	20.2	
Flue gas conditions			
Temperature	°C	248	
Volume at reference conditions	Nm^3/s	3.05	
Volume at actual conditions	Am^3/s	3.97	
Emissions			
Pollutant		**ELV (mg/Nm^3)**	**Release Rate (g/s)**
HC_2O		5	0.0153

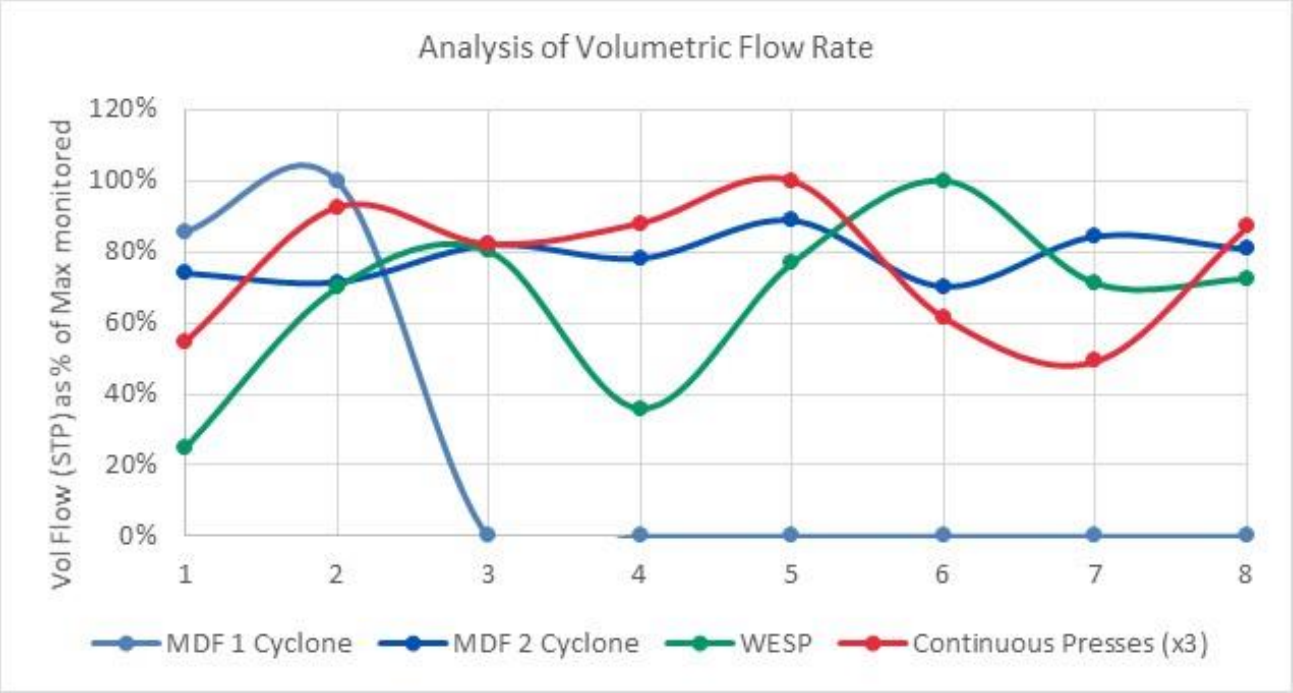
NOTES:
ELV taken from existing NRW permit.
All emissions are expressed at reference conditions of 273.15K, with no correction for water vapour content.

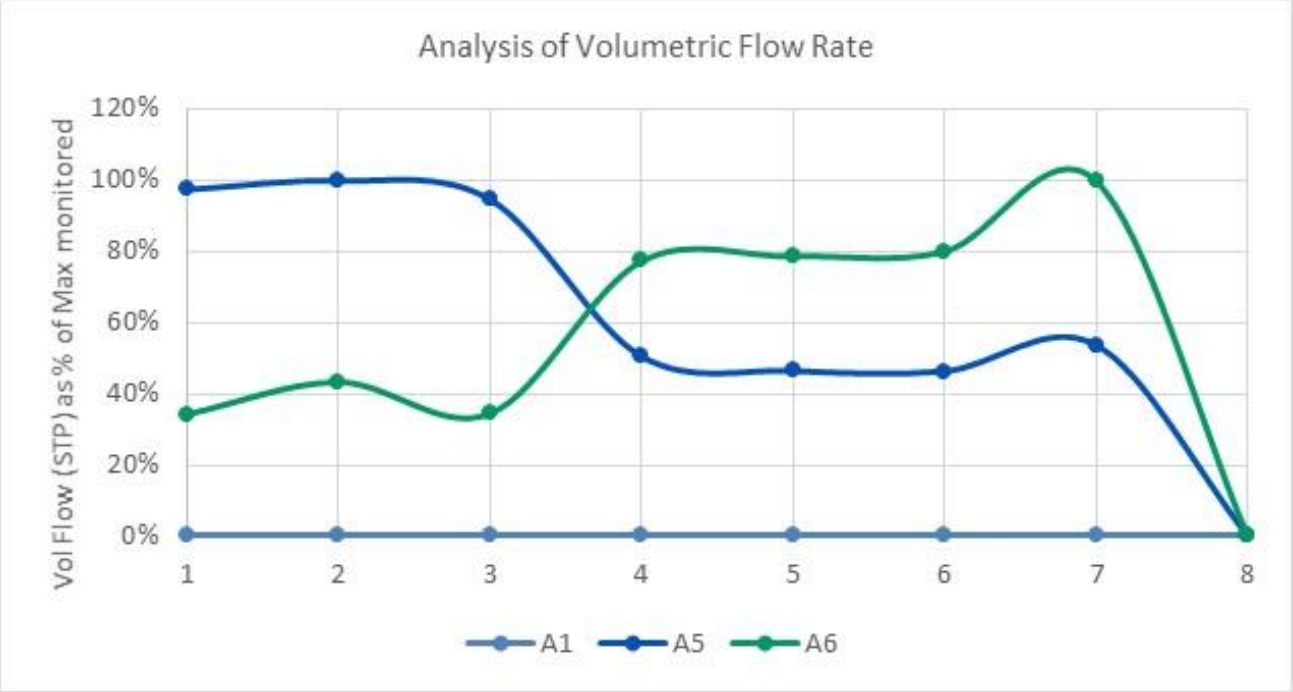
Source Data – A5			
Item	**Unit**	**A5**	
Capacity	MW	-	
Stack data			
Height	m	17.5	
Internal diameter	m	1.65	
Flue gas exit velocity	m/s	13.3	
Flue gas conditions			
Temperature	°C	29	
Volume at reference conditions	Nm^3/s	325.6	
Volume at actual conditions	Am^3/s	28.5	
Emissions			
Pollutant		**ELV (mg/Nm^3)**	**Release Rate (g/s)**
PM		20	0.512
TVOC		50	1.281
HC_2O		5	0.128

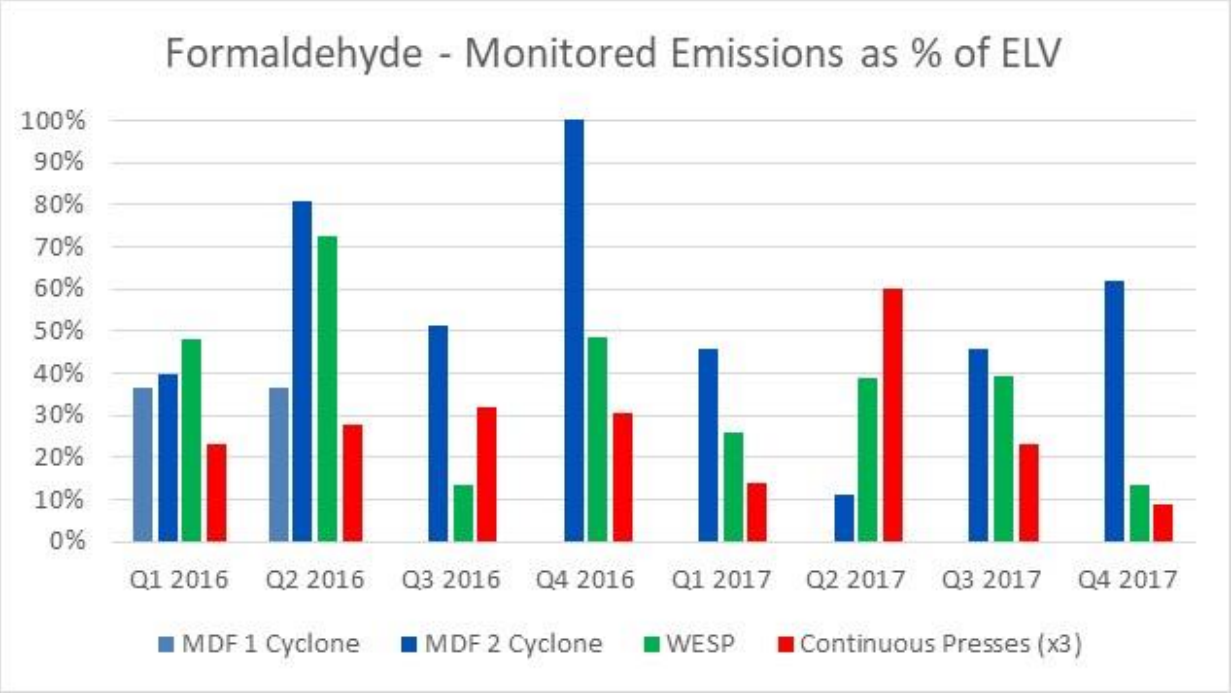
NOTES:
ELV taken from existing NRW permit.
All emissions are expressed at reference conditions of 273.15K, with no correction for water vapour content.

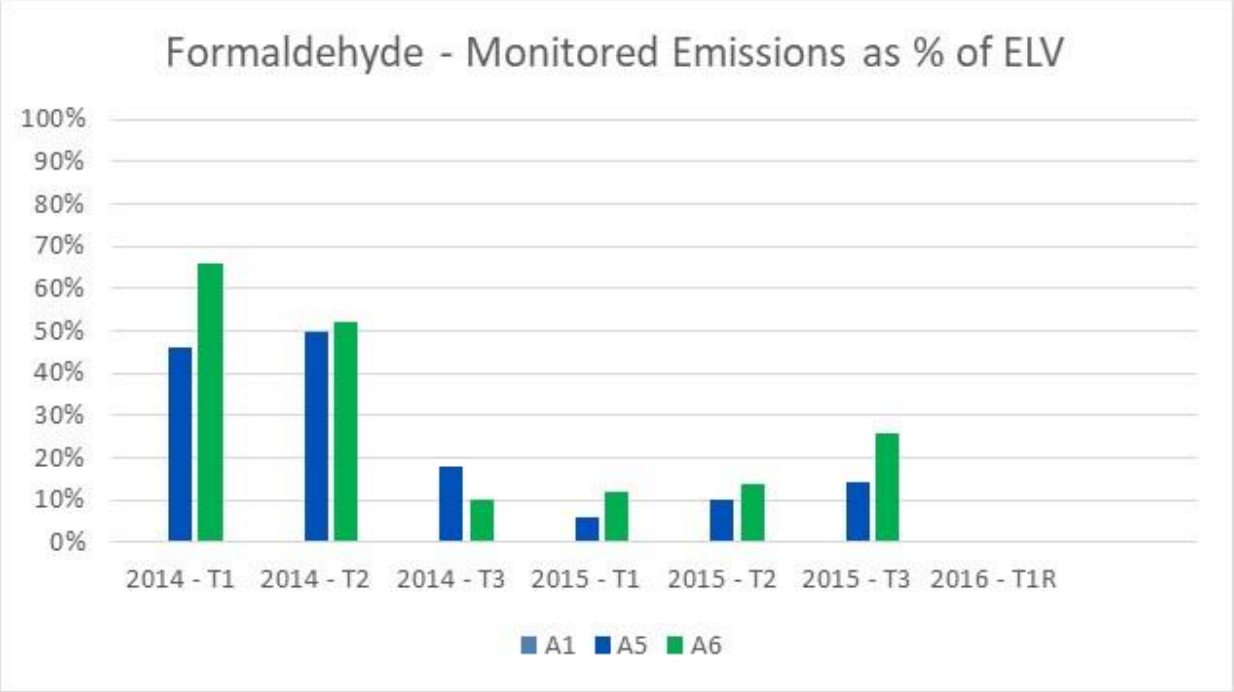
Source Data – A6			
Item	**Unit**	**A6**	
Capacity	MW	-	
Stack data			
Height	m	16	
Internal diameter	m	0.9	
Flue gas exit velocity	m/s	10.5	
Flue gas conditions			
Temperature	°C	35.5	
Volume at reference conditions	Nm^3/s	5.8	
Volume at actual conditions	Am^3/s	6.7	
Emissions			
Pollutant		**ELV (mg/Nm^3)**	**Release Rate (g/s)**
PM		20	0.116
TVOC		50	0.289
HC_2O		5	0.029

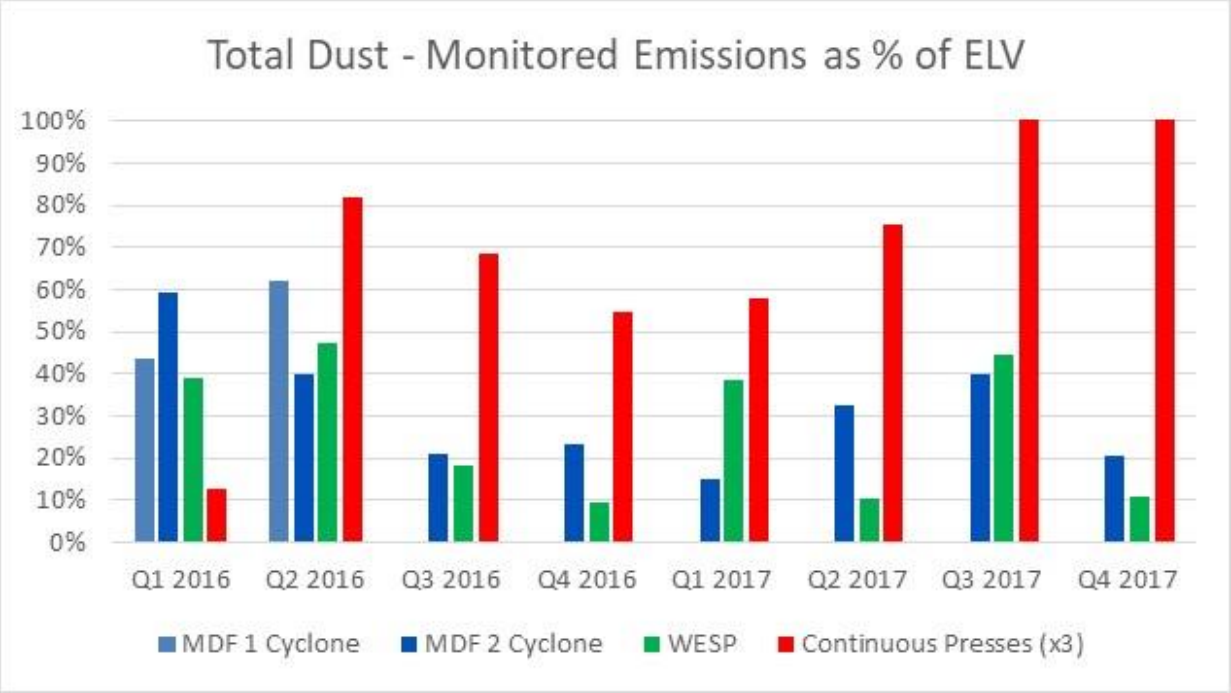
NOTES:
ELV taken from existing NRW permit.
All emissions are expressed at reference conditions of 273.15K, with no correction for water vapour content.

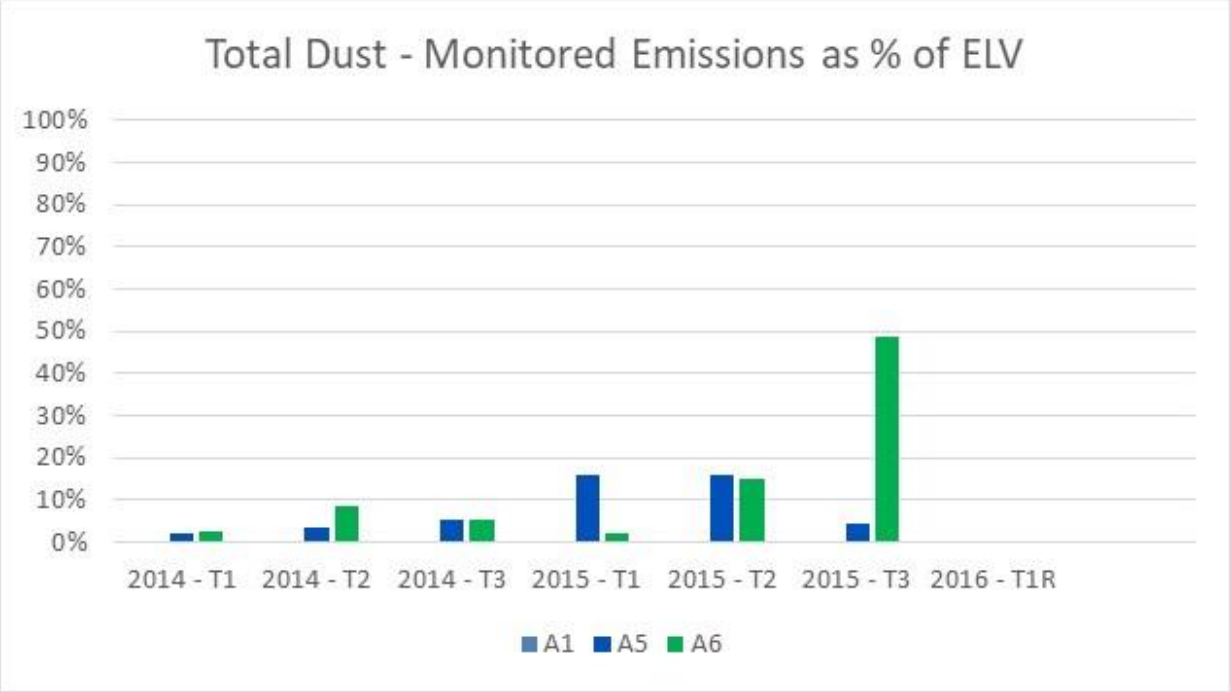

Analysis of Volumetric Flow Rate
Vol Flow (STP) as % of Max monitored
120%
100%
80%
60%
40%
20%
0%
1
2
3
4
5
6
7
8
MDF 1 Cyclone
MDF 2 Cyclone
WESP
Continuous Presses (x3)


Analysis of Volumetric Flow Rate
Vol Flow (STP) as % of Max monitored
120%
100%
80%
60%
40%
20%
0%
1
2
3
4
5
6
7
8
A1
A5
A6


Formaldehyde - Monitored Emissions as % of ELV
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Q1 2016
Q2 2016
Q3 2016
Q4 2016
Q1 2017
Q2 2017
Q3 2017
Q4 2017
MDF 1 Cyclone
MDF 2 Cyclone
WESP
Continuous Presses (x3)


Formaldehyde - Monitored Emissions as % of ELV
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2014 - T1
2014 - T2
2014 - T3
2015 - T1
2015 - T2
2015 - T3
2016 - T1R
A1
A5
A6


Total Dust - Monitored Emissions as % of ELV
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Q1 2016
Q2 2016
Q3 2016
Q4 2016
Q1 2017
Q2 2017
Q3 2017
Q4 2017
MDF 1 Cyclone
MDF 2 Cyclone
WESP
Continuous Presses (x3)


Total Dust - Monitored Emissions as % of ELV
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2014 - T1
2014 - T2
2014 - T3
2015 - T1
2015 - T2
2015 - T3
2016 - T1R
A1
A5
A6

Appendix C – Detailed Results Tables

Table AC.1: Results Summary – Normal Operations												
Pollutant	Quantity	Units	AQAL	Bg	Point of Maximum Impact				Maximum Impact outside Installation Boundary			
					PC		PEC		PC		PEC	
					Conc.	As % of AQAL	Conc.	As % of AQAL	Conc.	As % of AQAL	Conc.	As % of AQAL
Nitrogen dioxide – Likely Case	Annual mean	µg/m³	40	11.10	3.67	9.2%	14.77	36.9%	3.31	8.3%	14.41	36.0%
	99.79th %ile of hourly means	µg/m³	200	22.20	27.82	13.9%	50.02	25.0%	27.82	13.9%	50.02	25.0%
Nitrogen dioxide – Worse Case	Annual mean	µg/m³	40	11.10	8.93	22.3%	20.03	50.1%	8.13	20.3%	19.23	48.1%
	99.79th %ile of hourly means	µg/m³	200	22.20	69.45	34.7%	91.65	45.8%	69.45	34.7%	91.65	45.8%
Particulates (PM_{10})	Annual mean	µg/m³	40	14.50	3.49	8.7%	17.99	45.0%	3.23	8.1%	17.73	44.3%
	90.4th %ile of daily means	µg/m³	50	29.00	9.69	19.4%	38.69	77.4%	8.98	18.0%	37.98	76.0%
Particulates ($PM_{2.5}$)	Annual mean	µg/m³	25	10.10	3.49	14.0%	13.59	54.4%	3.23	12.9%	13.33	53.3%
Formaldehyde	Annual mean	µg/m³		1.00	1.15	23.1%	2.15	43.1%	1.03	20.6%	2.03	40.6%
	Hourly mean	µg/m³		2.00	31.36	31.4%	33.36	33.4%	16.35	16.4%	18.35	18.4%
TVOCs	Annual mean	µg/m³	-	-	19.47		-	-	19.42		-	-
	Hourly mean	µg/m³	-	-	541.97		-	-	499.07		-	-
Carbon monoxide	8 hour running mean	µg/m³	10,000	446.00	48.88	0.5%	494.88	4.9%	48.88	0.5%	494.88	4.9%
Sulphur dioxide	99.18th %ile of daily means	µg/m³	125	6.80	8.29	6.6%	15.09	12.1%	8.29	6.6%	15.09	12.1%
	99.73rd %ile of hourly means	µg/m³	350	6.80	17.99	5.1%	24.79	7.1%	17.99	5.1%	24.79	7.1%

Table AC.1: Results Summary – Normal Operations												
Pollutant	Quantity	Units	AQAL	Bg	Point of Maximum Impact				Maximum Impact outside Installation Boundary			
					PC		PEC		PC		PEC	
					Conc.	As % of AQAL	Conc.	As % of AQAL	Conc.	As % of AQAL	Conc.	As % of AQAL
	99.9th %ile of 15 min. means	µg/m³	266	6.80	20.46	7.7%	27.26	10.2%	20.46	7.7%	27.26	10.2%
Hydrogen chloride	Hourly mean	µg/m³	750	1.42	1.85	0.2%	3.27	0.4%	1.19	0.2%	2.61	0.3%
Hydrogen fluoride	Annual mean	µg/m³	16	2.35	0.01	0.04%	2.36	14.7%	0.01	0.04%	2.36	14.7%
	Hourly mean	µg/m³	160	4.70	0.36	0.23%	5.06	3.2%	0.23	0.15%	4.93	3.1%
Mercury	Annual mean	ng/m³	250	1.27	0.18	0.07%	1.45	0.6%	0.18	0.07%	1.45	0.6%
	Hourly mean	ng/m³	7500	2.54	9.23	0.12%	11.77	0.2%	5.96	0.08%	8.50	0.1%
Cadmium	Annual mean	ng/m³	5	0.09	0.18	3.6%	0.27	5.4%	0.18	3.5%	0.27	5.3%
	Hourly mean	ng/m³	-	0.18	9.23	-	9.41	-	5.96	-	6.14	-
Dioxins and Furans	Annual mean	fg/m³	-	33.00	0.36	-	33.36	-	0.36	-	33.36	-
PCBs	Annual mean	ng/m³	200	0.12	0.02	0.01%	0.14	0.1%	0.02	0.01%	0.14	0.1%
	Hourly mean	ng/m³	6000	0.24	0.92	0.02%	1.16	0.02%	0.92	0.02%	1.16	0.02%

Table AC.2: Results Summary – MDF 2 Drier Offline												
Pollutant	Quantity	Units	AQAL	Bg	Point of Maximum Impact				Maximum Impact outside Installation Boundary			
					PC		PEC		PC		PEC	
					Conc.	As % of AQAL	Conc.	As % of AQAL	Conc.	As % of AQAL	Conc.	As % of AQAL
Nitrogen dioxide – Likely Case	Annual mean	µg/m^3	40	11.10	5.59	14.0%	16.69	41.7%	3.68	9.2%	14.78	36.9%
	99.79th %ile of hourly means	µg/m^3	200	22.20	23.51	11.8%	45.71	22.9%	22.03	11.0%	44.23	22.1%
Nitrogen dioxide – Worse Case	Annual mean	µg/m^3	40	11.10	9.35	23.4%	20.45	51.1%	7.45	18.6%	18.55	46.4%
	99.79th %ile of hourly means	µg/m^3	200	22.20	53.25	26.6%	75.45	37.7%	53.25	26.6%	75.45	37.7%
Carbon monoxide	8 hour running mean	µg/m^3	10,000	446.00	3.71	0.04%	449.71	4.5%	3.62	0.04%	449.62	4.5%
Sulphur dioxide	99.18th %ile of daily means	µg/m^3	125	6.80	14.32	11.5%	21.12	16.9%	14.32	11.5%	21.12	16.9%
	99.73rd %ile of hourly means	µg/m^3	350	6.80	34.98	10.0%	41.78	11.9%	34.98	10.0%	41.78	11.9%
	99.9th %ile of 15 min. means	µg/m^3	266	6.80	42.35	15.9%	49.15	18.5%	41.24	15.5%	48.04	18.1%

Table AC.3: Results Summary – MDF 1 and 2 Driers Offline												
Pollutant	Quantity	Units	AQAL	Bg	Point of Maximum Impact				Maximum Impact outside Installation Boundary			
					PC		PEC		PC		PEC	
					Conc.	As % of AQAL	Conc.	As % of AQAL	Conc.	As % of AQAL	Conc.	As % of AQAL
Nitrogen dioxide – Likely Case	Annual mean	µg/m³	40	11.10	31.24	78.1%	42.34	105.8%	9.33	23.3%	20.43	51.1%
	99.79th %ile of hourly means	µg/m³	200	22.20	90.49	45.2%	112.69	56.3%	67.68	33.8%	89.88	44.9%
Nitrogen dioxide – Worse Case	Annual mean	µg/m³	40	11.10	32.03	80.1%	43.13	107.8%	12.21	30.5%	23.31	58.3%
	99.79th %ile of hourly means	µg/m³	200	22.20	90.49	45.2%	112.69	56.3%	73.47	36.7%	95.67	47.8%
Particulates (PM_{10})	Annual mean	µg/m³	40	14.50	3.72	9.3%	18.22	45.6%	3.19	8.0%	17.69	44.2%
	90.4th %ile of daily means	µg/m³	50	29.00	10.51	21.0%	39.51	79.0%	9.03	18.1%	38.03	76.1%
Particulates ($PM_{2.5}$)	Annual mean	µg/m³	25	10.10	3.72	14.9%	13.82	55.3%	3.19	12.8%	13.29	53.2%
Carbon monoxide	8 hour running mean	µg/m³	10,000	446.00	245.56	2.5%	691.56	6.9%	245.56	2.5%	691.56	6.9%
Sulphur dioxide	99.18th %ile of daily means	µg/m³	125	6.80	39.38	31.5%	46.18	36.9%	39.38	31.5%	46.18	36.9%
	99.73rd %ile of hourly means	µg/m³	350	6.80	76.39	21.8%	83.19	23.8%	76.39	21.8%	83.19	23.8%
	99.9th %ile of 15 min. means	µg/m³	266	6.80	82.30	30.9%	89.10	33.5%	82.30	30.9%	89.10	33.5%
Hydrogen chloride	Hourly mean	µg/m³	750	1.42	1.82	0.2%	3.24	0.4%	1.72	0.2%	3.14	0.4%
Hydrogen fluoride	Annual mean	µg/m³	16	2.35	0.01	0.03%	2.36	14.7%	0.01	0.03%	2.36	14.7%
	Hourly mean	µg/m³	160	4.70	0.36	0.22%	5.06	3.2%	0.34	0.21%	5.04	3.1%

Table AC.3: Results Summary – MDF 1 and 2 Driers Offline												
Pollutant	Quantity	Units	AQAL	Bg	Point of Maximum Impact				Maximum Impact outside Installation Boundary			
					PC		PEC		PC		PEC	
					Conc.	As % of AQAL	Conc.	As % of AQAL	Conc.	As % of AQAL	Conc.	As % of AQAL
Mercury	Annual mean	ng/m^3	250	1.27	0.09	0.04%	1.36	0.5%	0.09	0.04%	1.36	0.5%
	Hourly mean	ng/m^3	7500	2.54	6.05	0.08%	8.59	0.11%	5.72	0.08%	8.26	0.11%
Cadmium	Annual mean	ng/m^3	5	0.09	0.09	1.8%	0.18	3.6%	0.09	1.8%	0.18	3.6%
	Hourly mean	ng/m^3	-	0.18	6.05	-	6.23	-	5.72	-	5.90	-
Dioxins and Furans	Annual mean	fg/m^3	-	33.00	0.18	-	33.18	-	0.18	-	33.18	-
PCBs	Annual mean	ng/m^3	200	0.12	0.01	0.004%	0.13	0.1%	0.01	0.004%	0.13	0.1%
	Hourly mean	ng/m^3	6000	0.24	0.61	0.01%	0.84	0.014%	0.61	0.01%	0.84	0.014%

Table AC.4: Results Summary – K7 and K8 Biomass Plants Offline												
Pollutant	Quantity	Units	AQAL	Bg	Point of Maximum Impact				Maximum Impact outside Installation Boundary			
					PC		PEC		PC		PEC	
					Conc.	As % of AQAL	Conc.	As % of AQAL	Conc.	As % of AQAL	Conc.	As % of AQAL
Nitrogen dioxide – Likely Case	Annual mean	µg/m^3	40	11.10	7.32	18.3%	18.42	46.1%	4.46	11.2%	15.56	38.9%
	99.79th %ile of hourly means	µg/m^3	200	22.20	87.23	43.6%	109.43	54.7%	79.57	39.8%	101.77	50.9%
Nitrogen dioxide – Worse Case	Annual mean	µg/m^3	40	11.10	10.25	25.6%	21.35	53.4%	9.10	22.8%	20.20	50.5%
	99.79th %ile of hourly means	µg/m^3	200	22.20	100.38	50.2%	122.58	61.3%	93.31	46.7%	115.51	57.8%

Appendix D – Ecological Results Tables

Table AD.1: Ecological Results - Annual Mean NOx					
Receptor	**Bg**	**PC (as % of CL)**		**PEC (as % of CL)**	
		Normal	**MDF 2 Offline**	**Normal**	**MDF 2 Offline**
Likely Emissions					
River Dee and Bala Lake	16.6	5.1%	4.1%	60.5%	59.5%
Johnstown Newt Sites	17.3	0.7%	0.6%	58.3%	58.2%
Berwyn and South Clwyd Mountains	11.7	0.7%	0.6%	39.7%	39.6%
Berwyn	7.9	0.5%	0.4%	27.0%	26.8%
Chirk Castle	11.5	7.6%	7.6%	46.0%	46.0%
Nant-y-Belan and Prynela Woods	11.5	2.8%	2.3%	41.2%	40.7%
Pentri Wood	11.3	1.3%	1.0%	38.9%	38.6%

Table AD.2: Ecological Results - Daily Mean NOx					
Receptor	**Bg**	**PC (as % of CL)**		**PEC (as % of CL)**	
		Normal	**MDF 2 Offline**	**Normal**	**MDF 2 Offline**
Likely Emissions					
River Dee and Bala Lake	16.6	25.9%	21.8%	**81.3%**	**77.2%**
Johnstown Newt Sites	17.3	2.6%	2.1%	60.2%	59.7%
Berwyn and South Clwyd Mountains	11.7	3.8%	2.8%	42.8%	41.9%
Berwyn	7.9	2.6%	2.1%	29.1%	28.5%
Chirk Castle	11.5	43.1%	46.1%	**81.5%**	**84.5%**
Nant-y-Belan and Prynela Woods	11.5	8.1%	6.4%	46.5%	44.8%
Pentri Wood	11.3	13.6%	10.3%	51.2%	47.9%

Table AD.3: Ecological Results - Annual Mean SO2					
Receptor	Bg	PC (as % of CL)		PEC (as % of CL)	
		Normal	MDF 2 Offline	Normal	MDF 2 Offline
River Dee and Bala Lake	1.6	2.0%	2.8%	10.2%	11.0%
Johnstown Newt Sites	2.2	0.3%	0.3%	11.1%	11.2%
Berwyn and South Clwyd Mountains	1.6	0.2%	0.3%	8.2%	8.3%
Berwyn	1.3	0.2%	0.2%	6.8%	6.9%
Chirk Castle	1.6	2.1%	4.4%	10.3%	12.6%
Nant-y-Belan and Prynela Woods	1.8	0.9%	1.2%	10.1%	10.4%
Pentri Wood	1.6	0.5%	0.6%	8.7%	8.8%

Table AD.4: Ecological Results – HF				
Receptor	Max Weekly PC (as % of CL)		Max Daily PC (as % of CL)	
	Normal	MDF 2 Offline	Normal	MDF 2 Offline
River Dee and Bala Lake	3.0%	3.0%	0.8%	0.8%
Johnstown Newt Sites	0.2%	0.2%	0.1%	0.1%
Berwyn and South Clwyd Mountains	0.3%	0.3%	0.1%	0.1%
Berwyn	0.3%	0.3%	0.1%	0.1%
Chirk Castle	5.4%	5.4%	1.3%	1.3%
Nant-y-Belan and Prynela Woods	0.7%	0.7%	0.2%	0.2%
Pentri Wood	1.2%	1.2%	0.3%	0.3%

Table AD.5: Ecological Results – For Deposition Analysis			
Receptor	**Annual Mean PC - µg/m³**		
	NOx – Likely Emissions	**SO2**	**HCl**
Normal Operations			
River Dee and Bala Lake	1.54	0.40	0.013
Johnstown Newt Sites	0.22	0.05	0.001
Berwyn and South Clwyd Mountains	0.21	0.05	0.001
Berwyn	0.16	0.04	0.001
Chirk Castle	2.27	0.42	0.021
Nant-y-Belan and Prynela Woods	0.83	0.18	0.006
Pentri Wood	0.38	0.09	0.003
MDF 2 Offline			
River Dee and Bala Lake	1.22	0.56	0.013
Johnstown Newt Sites	0.17	0.06	0.001
Berwyn and South Clwyd Mountains	0.17	0.06	0.001
Berwyn	0.12	0.04	0.001
Chirk Castle	2.27	0.88	0.021
Nant-y-Belan and Prynela Woods	0.69	0.24	0.006
Pentri Wood	0.30	0.13	0.003

Table AD.6: Ecological Results – N Deposition									
Receptor	CL Class	kgN/ha/yr			Deposition Velocity	Min CL		Max CL	
		Min CL	Max CL	Bg		PC as % of min CL	PEC as % of min CL	PC as % of max CL	PEC as % of max CL
Normal Operations									
River Dee and Bala Lake	No designated features sensitive	-	-	-	Grassland	-	-	-	-
Johnstown Newt Sites	No comparable habitat with established Critical Loads	-	-	-	Grassland	-	-	-	-
Berwyn and South Clwyd Mountains	Blanket Bogs	5	10	21.7	Grassland	0.4%	434.4%	0.2%	217.2%
Berwyn	Red Kite	10	20	35.14	Woodland	0.3%	351.7%	0.2%	175.9%
	Hen Harrier	10	20	23.94	Grassland	0.2%	239.6%	0.1%	119.8%
Chirk Castle	Broadleaved woodlands	10	20	34.02	Woodland	4.6%	344.8%	2.3%	172.4%
	Neutral grassland	20	30	22.26	Grassland	1.1%	112.4%	0.8%	75.0%
Nant-y-Belan and Prynela Woods	Broadleaved woodlands	10	20	36.68	Woodland	1.7%	368.5%	0.8%	184.2%
Pentri Wood	Broadleaved woodlands	10	20	34.02	Woodland	0.8%	341.0%	0.4%	170.5%
MDF 2 Offline									
River Dee and Bala Lake	No designated features sensitive	-	-	-	Grassland	-	-	-	-
Johnstown Newt Sites	No comparable habitat with established Critical Loads	-	-	-	Grassland	-	-	-	-
Berwyn and South Clwyd Mountains	Blanket Bogs	5	10	21.7	Grassland	0.3%	434.3%	0.2%	217.2%
Berwyn	Red Kite	10	20	35.14	Woodland	0.2%	351.6%	0.1%	175.8%
	Hen Harrier	10	20	23.94	Grassland	0.1%	239.5%	0.1%	119.8%
Chirk Castle	Broadleaved woodlands	10	20	34.02	Woodland	4.6%	344.8%	2.3%	172.4%
	Neutral grassland	20	30	22.26	Grassland	1.1%	112.4%	0.8%	75.0%
Nant-y-Belan and Prynela Woods	Broadleaved woodlands	10	20	36.68	Woodland	1.4%	368.2%	0.7%	184.1%
Pentri Wood	Broadleaved woodlands	10	20	34.02	Woodland	0.6%	340.8%	0.3%	170.4%

Table AD.7: Ecological Results – Acid Deposition – min CL Analysis									
Receptor	CL Class	$kg_{eq}/ha/yr$					Deposition Velocity	Min CL	
		Min N	MaxS	MaxN	Bg N	Bg S		PC as % of min CL	PEC as % of min CL
Normal Operations									
River Dee and Bala Lake	-	-	-	-	-	-	Grassland	-	-
Johnstown Newt Sites	-	-	-	-	-	-	Grassland	-	-
Berwyn and South Clwyd Mountains	Raised and blanket bogs	0.178	0.23	0.551	1.55	0.29	Grassland	1.5%	335.4%
Berwyn	Unmanaged broadleaved and coniferous woodland	0.142	0.654	0.894	2.51	0.45	Woodland	1.4%	332.5%
	Dwarf shrub heath	0.642	0.5	1.142	1.71	0.35	Grassland	0.5%	180.9%
Chirk Castle	Unmanaged broadleaved and coniferous woodland	0.142	1.731	1.873	2.43	0.28	Woodland	8.2%	152.9%
	Calcareous grassland	0.856	4	4.856	1.59	0.24	Grassland	1.5%	39.2%
Nant-y-Belan and Prynela Woods	Unmanaged broadleaved and coniferous woodland	0.357	1.522	1.879	2.62	0.27	Woodland	3.3%	157.1%
Pentri Wood	Unmanaged broadleaved and coniferous woodland	0.142	1.731	1.873	2.43	0.28	Woodland	1.6%	146.3%
MDF 2 Offline									
River Dee and Bala Lake	-	-	-	-	-	-	Grassland	-	-
Johnstown Newt Sites	-	-	-	-	-	-	Grassland	-	-
Berwyn and South Clwyd Mountains	Raised and blanket bogs	0.178	0.23	0.551	1.55	0.29	Grassland	1.6%	335.6%
Berwyn	Unmanaged broadleaved and coniferous woodland	0.142	0.654	0.894	2.51	0.45	Woodland	1.5%	332.6%
	Dwarf shrub heath	0.642	0.5	1.142	1.71	0.35	Grassland	0.6%	181.0%
Chirk Castle	Unmanaged broadleaved and coniferous woodland	0.142	1.731	1.873	2.43	0.28	Woodland	14.0%	158.7%
	Calcareous grassland	0.856	4	4.856	1.59	0.24	Grassland	2.7%	40.4%
Nant-y-Belan and Prynela Woods	Unmanaged broadleaved and coniferous woodland	0.357	1.522	1.879	2.62	0.27	Woodland	3.8%	157.6%
Pentri Wood	Unmanaged broadleaved and coniferous woodland	0.142	1.731	1.873	2.43	0.28	Woodland	2.0%	146.7%

Table AD.8: Ecological Results – Acid Deposition – max CL Analysis									
Receptor	CL Class	$kg_{eq}/ha/yr$					Deposition Velocity	Min CL	
		Min N	MaxS	MaxN	Bg N	Bg S		PC as % of min CL	PEC as % of min CL
Normal Operations									
River Dee and Bala Lake	-	-	-	-	-	-	Grassland	-	-
Johnstown Newt Sites	-	-	-	-	-	-	Grassland	-	-
Berwyn and South Clwyd Mountains	Raised and blanket bogs	0.536	4.18	4.358	1.55	0.29	Grassland	0.2%	42.4%
Berwyn	Unmanaged broadleaved and coniferous woodland	0.5	3.576	3.933	2.51	0.45	Woodland	0.3%	75.6%
	Dwarf shrub heath	1.17	1.76	2.837	1.71	0.35	Grassland	0.2%	72.8%
Chirk Castle	Unmanaged broadleaved and coniferous woodland	-	-	-	2.43	0.28	Woodland	-	-
	Calcareous grassland	-	-	-	1.59	0.24	Grassland	-	-
Nant-y-Belan and Prynela Woods	Unmanaged broadleaved and coniferous woodland	-	-	-	2.62	0.27	Woodland	-	-
Pentri Wood	Unmanaged broadleaved and coniferous woodland	-	-	-	2.43	0.28	Woodland	-	-
MDF 2 Offline									
River Dee and Bala Lake	-	-	-	-	-	-	Grassland	-	-
Johnstown Newt Sites	-	-	-	-	-	-	Grassland	-	-
Berwyn and South Clwyd Mountains	Raised and blanket bogs	0.536	4.18	4.358	1.55	0.29	Grassland	0.2%	42.4%
Berwyn	Unmanaged broadleaved and coniferous woodland	0.5	3.576	3.933	2.51	0.45	Woodland	0.3%	75.6%
	Dwarf shrub heath	1.17	1.76	2.837	1.71	0.35	Grassland	0.2%	72.8%
Chirk Castle	Unmanaged broadleaved and coniferous woodland	-	-	-	2.43	0.28	Woodland	-	-
	Calcareous grassland	-	-	-	1.59	0.24	Grassland	-	-
Nant-y-Belan and Prynela Woods	Unmanaged broadleaved and coniferous woodland	-	-	-	2.62	0.27	Woodland	-	-
Pentri Wood	Unmanaged broadleaved and coniferous woodland	-	-	-	2.43	0.28	Woodland	-	-

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