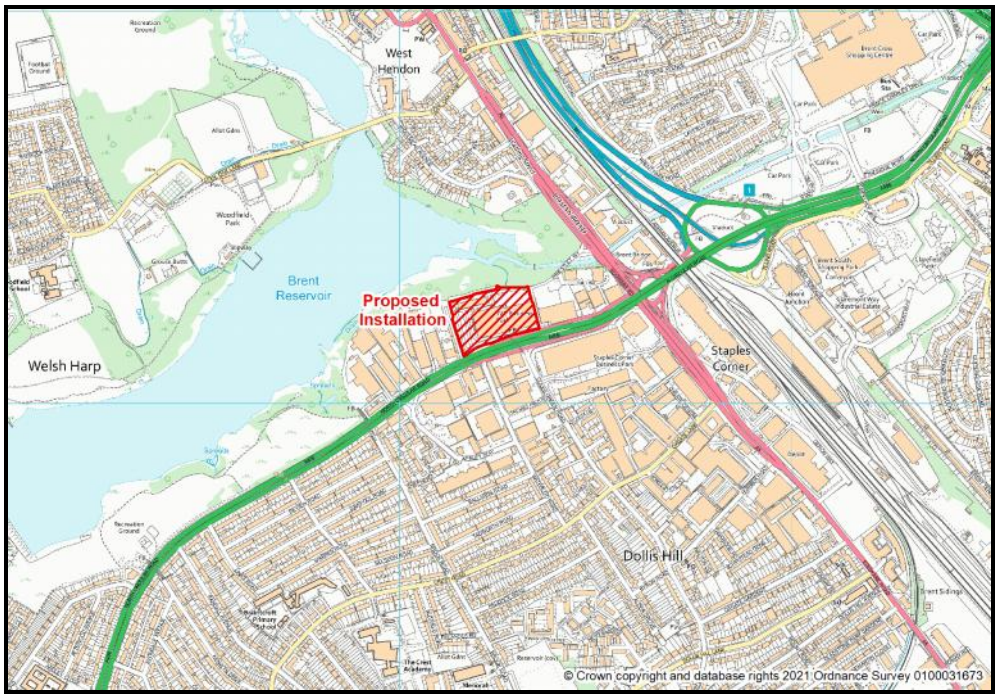
PDCG

BRENT DATA CENTRE, JVC HOUSE

AIR QUALITY ASSESSMENT



June 2021

Report Reference: C73-P05-R01

Independent Air Quality & Odour Specialists

CONTENTS

1 INTRODUCTION

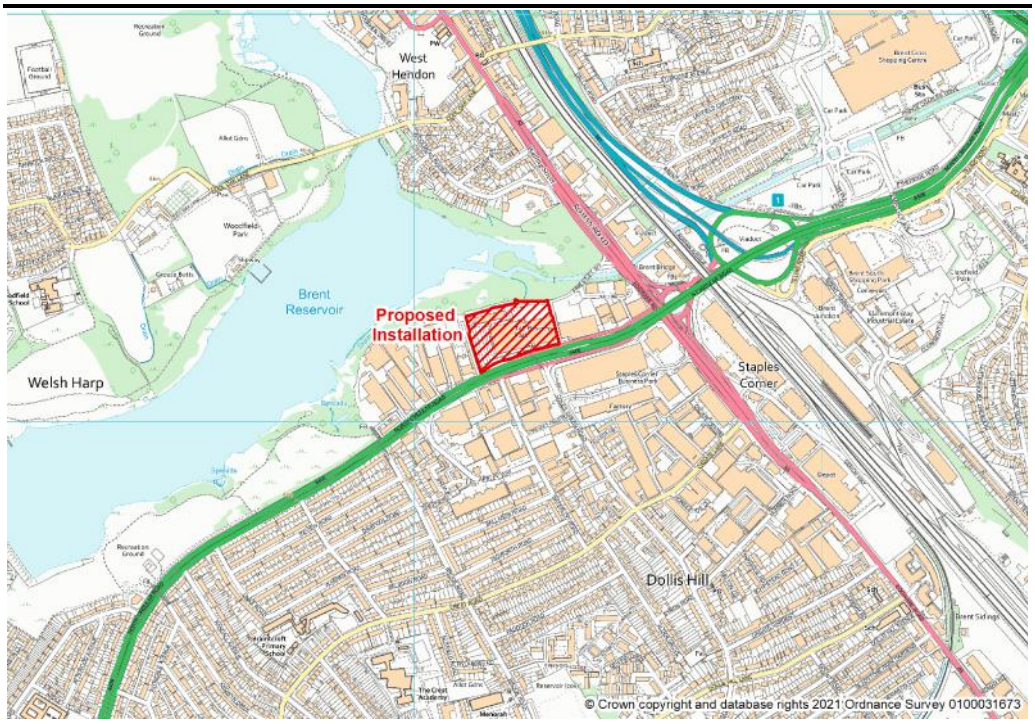
1.1 PURPOSE OF THE ASSESSMENT

Gair Consulting Ltd has been commissioned by PDCG to provide an air quality assessment of emissions to atmosphere from a data centre within the London Borough of Brent. The purpose of the assessment is to support the Environmental Permit Application (EPR/QP3706LH) for the installation. The Data Centre will be equipped with sixteen standby generators fired on diesel to provide power to the data centre in the event of an emergency outage. The generators will be installed in two phases of eight generators each.

In addition to operating in the event of an interruption to the power supply, the generators will also operate for testing and for maintenance and servicing purposes. Therefore, there is also a schedule of planned testing.

Although the installation is located within the London Borough of Brent, the London Borough of Barnet is located approximately 230 m to the east of the installation boundary. The location of the Data Centre is presented in *Figure 1.1*. The site is located to the north of the North Circular Road (A406). Brent Reservoir is located to the north of the site.

FIGURE 1.1 LOCATION OF THE DATA CENTRE



1.2 SCOPE OF THE ASSESSMENT

Operational impacts associated with the combustion sources have been assessed using a dispersion model to predict the impact at ground level utilising five years of meteorological data from London Heathrow Airport (2016 to 2020).

This assessment has considered the impact on human health and sensitive habitat sites. It has been undertaken in accordance with guidance provided by the Environment Agency in its Data Centre FAQ Headline Approach (Draft Version 10.0, June 2018).

1.3 STRUCTURE OF THE REPORT

The remainder of this report is presented as follows:

- *Section 2* presents an assessment of baseline conditions for the location.
- *Section 3* provides a description of the assessment methodology and a quantification of emissions to atmosphere during the operation of the installation.
- *Section 4* presents an assessment of the operational impact of emissions on human health and local air quality.
- *Section 5* presents an assessment of the operational impact of emissions on sensitive habitat sites.
- *Section 6* summarises the air quality assessment and provides recommendations for further work, where necessary.

2 BASELINE CONDITIONS

2.1 INTRODUCTION

This section of the report defines the baseline environment for the assessment and provides the following:

- a discussion of appropriate ambient air quality assessment criteria;
- a review of background monitoring data for the local area;
- a description of local conditions that will affect the dispersion and dilution of emissions arising from the installation.

In relation to impacts on humans, the pollutants of interest emitted from the installation are primarily those associated with diesel combustion. These are:

- oxides of nitrogen (NO_x), the sum of nitric oxide (NO) and nitrogen dioxide (NO_2), expressed as nitrogen dioxide;
- particulate matter (PM_{10} and $PM_{2.5}$);
- gaseous and vaporous organic substances, expressed as total organic carbon (VOCs) or total organic carbon (TOC);
- sulphur dioxide (SO_2); and
- carbon monoxide (CO).

2.2 ASSESSMENT CRITERIA

Air quality standards for the pollutants considered for the assessment are summarised in *Table 2.1*.

TABLE 2.1 AIR QUALITY OBJECTIVES AND LIMIT VALUES

Pollutant	Averaging Period	EAL/AQO ($\mu g\ m^{-3}$)	Comments
Nitrogen dioxide (NO_2)	Annual mean	40	UK AQO and EU limit value
	1-hour mean	200	UK AQO and EU limit value, not to be exceeded more than 18 times per annum, equivalent to the 99.8th percentile of 1-hour means
Fine particles (as PM_{10})	Annual mean	40	UK AQO and EU limit value
	24-hour mean	50	UK AQO and EU limit value, not to be exceeded more than 35 times per annum, equivalent to the 90.4th percentile of 24-hour means
Fine particles (as $PM_{2.5}$)	Annual mean	25	EU limit value

TABLE 2.1 AIR QUALITY OBJECTIVES AND LIMIT VALUES

Pollutant	Averaging Period	EAL/AQO ($\mu g\ m^{-3}$)	Comments
Sulphur dioxide (SO_2)	24-hour mean	125	UK AQO and EU Limit Value, not to be exceeded more than 3 times per annum, equivalent to the 99.2nd percentile of 24-hour means
	1-hour mean	350	UK AQO and EU Limit Value, not to be exceeded more than 24 times per annum, equivalent to the 99.7th percentile of 1-hour means
	15-minute mean	266	UK AQO, not to be exceeded more than 35 times per annum, equivalent to the 99.9th percentile of 15-minute means
Carbon monoxide (CO)	8-hour mean	10,000	UK AQO and EU limit value
	1-hour mean	30,000	Environment Agency EAL (a)
TOC (as benzene)	Annual mean	5	AQO and EU limit value
	1-hour mean	195	Environment Agency EAL (a)
(a) Environment Agency Environmental Assessment Level (EAL) as provided in their risk assessment guidance (formerly H1)			

2.3 LOCAL CONDITIONS

2.3.1 The Dispersion and Dilution of Emissions

For meteorological data to be suitable for dispersion modelling purposes a number of meteorological parameters need to be measured, on an hourly basis. These parameters include wind speed, wind direction, cloud cover and temperature. There are only a limited number of sites where the required meteorological measurements are made. In the UK, all of these sites are quality controlled by the Met Office.

The most important climatological parameters governing the atmospheric dispersion of pollutants are as follows:

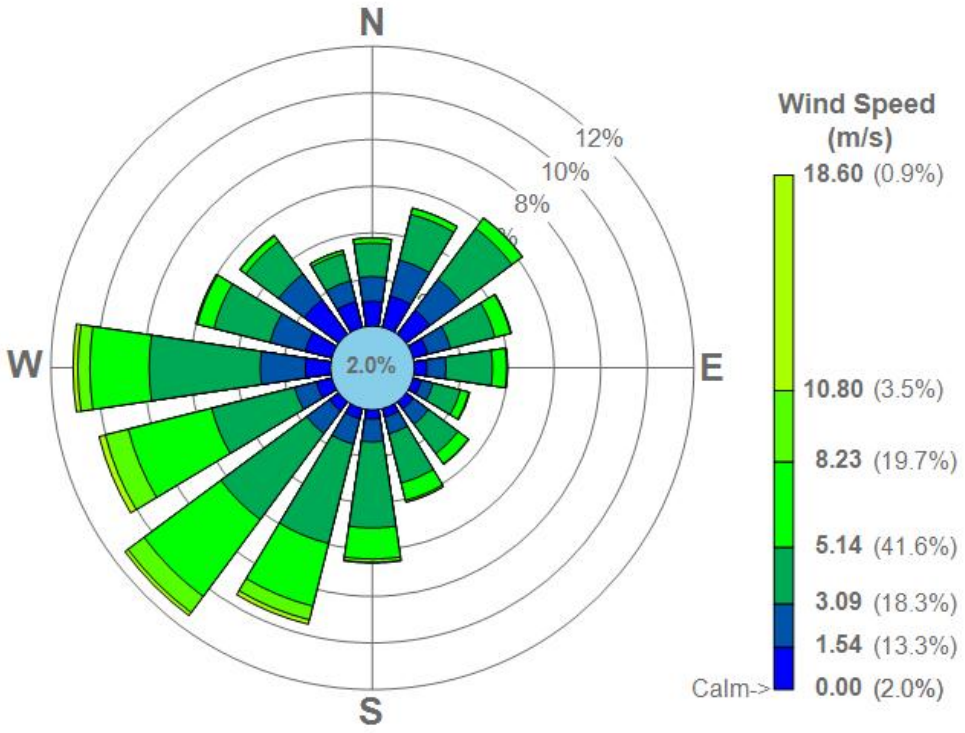
- **Wind direction** determines the broad transport of the emission and the sector of the compass into which the emission is dispersed.
- **Wind speed** will affect low-level emissions by increasing the initial dilution of pollutants in the emission whereas for high-level emissions, such as from a stack, higher winds will bring the plume to ground sooner than otherwise would be the case.
- **Atmospheric stability** is a measure of the turbulence, particularly of the vertical motions present.

2.3.2 Local Wind Climate for the Location

Met Office observing stations are limited and the nearest observing station to the installation site with full data suitable for dispersion modelling is located at London Heathrow Airport approximately 18 km to the southwest of the site.

Five years of meteorological data for the London Heathrow Airport observing station have been obtained (2016 to 2020) and a wind rose for the five years is presented in *Figure 2.1*.

FIGURE 2.1 WIND ROSE FOR LONDON HEATHROW AIRPORT (2016 TO 2020)



The predominant wind direction is from the southwest (11.4%). Calm winds occur for around 2.0% of the time.

2.3.3 Topography

The presence of elevated terrain can significantly affect the dispersion of pollutants in a number of ways. For stack emissions, the presence of elevated terrain reduces the distance between the plume centre line and the ground level, thereby increasing ground level concentrations. Elevated terrain can also increase turbulence and, hence, plume mixing with the effect of increasing concentrations near to an elevated source and reducing concentrations further away.

The site is located in an area of relatively flat terrain. However, information relating to the topography of the area surrounding the facility has been used in the dispersion modelling to assess the impact of terrain features on the dispersion of emissions.

2.4 BACKGROUND AIR QUALITY

2.4.1 Local Authority Review and Assessment

Local authorities are required to periodically review and assess the current and future quality of air in their areas. Where it is determined that an air quality objective is not likely to be met within the relevant time period, the authority must designate an Air Quality Management Area (AQMA) and produce a local action plan.

The review and assessment of air quality for the local area is carried out by the London Borough of Brent (LBoB). The London Borough of Brent has declared large parts of the borough as an AQMA. The declaration was based on the risk of exceeding the annual mean objective for nitrogen dioxide and 24-hour mean objective for PM_{10}. The installation site is located within the AQMA. The London Borough of Barnet has declared the whole borough an AQMA. The declaration in 2001 was also based on the risk of exceeding the annual mean objective for nitrogen dioxide and 24-hour mean objective for PM_{10}. However, this was extended in 2010 to include the hourly mean objective for NO_2 due to exceedances at a bus station and some high streets.

2.4.2 Ambient Air Quality Monitoring

Monitoring of ambient pollutant concentrations is carried out by LBoB at four automatic continuous monitoring locations within the borough. Three of these are located at roadside locations and the fourth at an industrial location. These all monitor NO_2 and PM_{10}. One of these (BT4) also measures $PM_{2.5}$ and ozone (O_3) and another (BT8) measures $PM_{2.5}$. Details of the monitoring sites are presented in *Table 2.3*. The nearest monitoring site to the installation is BT5 approximately 2 km to the south. BT4 is located 2.3 km to the south and BT6 and BT8 are located further south. The location of the two nearest monitoring sites is provided in *Figure 2.2*.

The London Borough of Barnet also undertakes automatic monitoring at two locations, as detailed in *Table 2.3*. Monitoring of NO_2 and PM_{10} is carried out at both locations. The urban background site (ABN2) is located approximately 3 km to the northeast of the installation. The other (ABN1) is located in excess of 5 km from the installation. The location of the urban background site is indicated in *Figure 2.2*.

TABLE 2.3 DETAILS OF AUTOMATIC CONTINUOUS MONITORING SITES

Location	Site Type	Pollutants	Distance to Relevant Exposure	Distance to Kerb of Nearest Road
BT4. Ikea	Roadside	NO_2, PM_{10}, $PM_{2.5}$, O_3	38 m	2 m
BT5. Neasden Lane	Industrial	NO_2, PM_{10}	35 m	4 m
BT6. John Keble Primary School	Roadside	NO_2, PM_{10}	10 m	2 m
BT8. Ark Franklin Primary Academy	Roadside	NO_2, PM_{10}, $PM_{2.5}$	10 m	2 m
ABN1. Tally Ho	Kerbside	NO_2, PM_{10}	5 m	3 m
ABN2. Chalgrove School	Urban background	NO_2, PM_{10}	0 m	N/A

FIGURE 2.2 LOCATION OF THE NEARBY AUTOMATIC CONTINUOUS MONITORING SITES

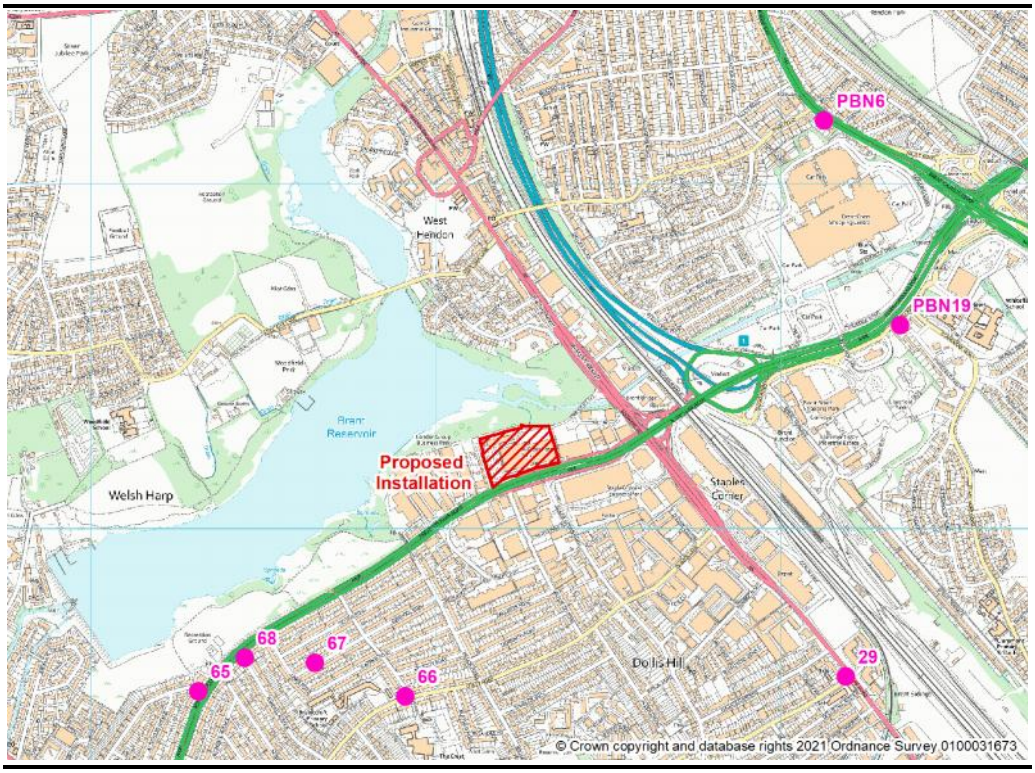
In addition, LBoB undertook non-automatic monitoring of NO_2 at forty-five locations in 2019. London Borough of Barnet also undertook non-automatic monitoring of NO_2 at fifteen sites in 2019. Monitoring sites within 1.5 km of the installation site are described in *Table 2.4* and the locations are presented in *Figure 2.3*.

TABLE 2.4 DETAILS OF NITROGEN DIOXIDE DIFFUSION TUBE MONITORING SITES

Location	Site Type	Distance to Relevant Exposure	Distance to Kerb of Nearest Road
29. Dollis Hill Lane/Cricklewood	Roadside	12 m	1 m
65. Aybone Roade/North Circular Road	Roadside	7 m	1 m
66. Heather Road/Tanfield Avenue	Roadside	12 m	1 m
67. Dawpool Road	Roadside	5 m	1 m
68. Randall Avenue/ North Circular Road	Roadside	5 m	1 m
PBN6. Hendon Way	Roadside	10 m	1.0 m
PBN19. Dyson Court, Tilling Road	Roadside	0 m	2.5 m

A summary of pollutant concentrations measured within the two boroughs are presented in the respective 2019 Annual Status Report which provides monitoring data for 2019.

FIGURE 2.3 LOCATION OF THE DIFFUSION TUBE MONITORING SITES CLOSE TO THE INSTALLATION SITE



2.4.3 Nitrogen Dioxide (NO_2)

A summary of annual mean concentrations of NO_2 measured by the monitoring sites identified from 2017 to 2019 is presented in *Table 2.5*.

TABLE 2.5 ANNUAL MEAN CONCENTRATIONS OF NO_2 (µg m^{-3})

Site	Type (a)	2017	2018	2019
BT4. Ikea	R	72	71	63
BT5. Neasden Lane	I	45	38	38
ABN2. Chalgrove School	UB	29	27	25
29. Dollis Hill Lane/Cricklewood	R	55.6	- (b)	35.3
65. Aybone Road/North Circular Road	R	- (b)	- (b)	35.9
66. Heather Road/Tanfield Avenue	R	- (b)	- (b)	34.6
67. Dawpool Road	R	- (b)	- (b)	33.4
68. Randall Avenue/ North Circular Road	R	- (b)	- (b)	37.6
PBN6. Hendon Way	R	49.5	41.4	37.5
PBN19. Dyson Court, Tilling Road	R	49.1	47.2	41.6

(a) Key: R = Roadside, K = Kerbside, UB = Urban Background, UC = Urban Centre, I = Industrial

(b) Not available

It should be noted that the majority of monitoring sites are roadside sites and will not represent relevant public exposure to annual mean concentrations. Highest concentrations were measured at BT4 but this monitoring site is located 38 m from relevant public exposure (refer *Table 2.3*). At the urban background site, which is representative of public exposure, measured concentrations as the three-year mean were 67.5% of the annual mean air quality objective (AQO) of 40 µg m^{-3} for NO_2.

The number of hourly mean concentrations exceeding the short-term air quality objective for NO_2 (200 µg m^{-3}, 18 exceedances allowed per annum) are presented in *Table 2.6*. For 2018 and 2019, the number of exceedances were well below the 18 allowed.

TABLE 2.6 NUMBER OF EXCEEDANCES OF THE HOURLY AIR QUALITY OBJECTIVE FOR NO_2

Site	Type (a)	2017	2018	2019
BT4. Ikea	R	33	1	7
BT5. Neasden Lane	I	17	1	2
ABN2. Chalgrove School	UB	1	0	0

For comparison, ambient background concentrations of NO_2 for 2021 have been obtained from the Defra UK Background Air Pollution Maps [1]. These 1 km grid resolution maps are derived from a complex modelling exercise that takes into account emissions inventories and measurements of ambient air pollution from both automated and non-automated sites.

1 https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2018

For the nine grid squares surrounding the installation site, the mapped 2021 background NO_2 concentrations varied between 19.7 µg m^{-3} and 27.6 µg m^{-3} with a mean of 23.7 µg m^{-3}. These are consistent with measured concentrations at the urban background monitoring site.

2.4.4 Fine Particles (PM_{10} and $PM_{2.5}$)

A summary of measured concentrations of PM_{10} at the three continuous monitoring sites for 2017 to 2019 is presented in *Table 2.7* and the number of exceedances (35 allowed) of the 24-hour mean AQO are provided in *Table 2.8*.

TABLE 2.7 ANNUAL MEAN CONCENTRATIONS OF PM_{10} (µg m^{-3})

Site	Type (a)	2017	2018	2019
BT4. Ikea	R	33	32	30
BT5. Neasden Lane	I	30	28	26
ABN2. Chalgrove School	UB	18	17	17

TABLE 2.8 NUMBER OF EXCEEDANCES OF THE 24-HOUR MEAN PM_{10} AIR QUALITY OBJECTIVE

Site	Type (a)	2017	2018	2019
BT4. Ikea	R	41	37	29
BT5. Neasden Lane	I	29	22	15
ABN2. Chalgrove School	UB	4 (29) (a)	1	3
(a) Where data capture is less than 75%, value in parentheses is the 90.4th percentile of 24-hour means				

Measured annual mean concentrations at all sites are well below the AQO of 40 µg m^{-3} for all years. The number of exceedances of the 24-hour objective of 50 µg m^{-3} exceeded the 35 allowed in 2017 and 2018 at the BT4 monitoring site.

A summary of measured concentrations of $PM_{2.5}$ at the BT4 Ikea monitoring site for 2017 to 2019 is presented in *Table 2.9*. Measured concentrations for all years are below the annual mean AQO of 25 µg m^{-3}.

TABLE 2.9 MEASURED ANNUAL MEAN $PM_{2.5}$ CONCENTRATIONS

Monitoring Site	2017	2018	2019
BT4. Ikea	21.4	20.0	20.7

For comparison, ambient background concentrations of PM_{10} and $PM_{2.5}$ for 2021 have been obtained from the Defra UK Background Air Pollution Maps.

For the nine grid squares surrounding the installation site, the mapped 2021 background PM_{10} concentrations vary between 16.2 µg m^{-3} and 18.5 µg m^{-3}

with a mean of 17.6 μg m^{-3}. This is consistent with measured concentrations at the urban background monitoring site.

For the nine grid squares surrounding the installation site, the mapped 2021 background $PM_{2.5}$ concentrations vary between 10.8 μg m^{-3} and 12.2 μg m^{-3} with a mean of 11.7 μg m^{-3}.

2.4.5 Sulphur Dioxide (SO_2)

Continuous monitoring of SO_2 concentrations within the local area is not available. The Defra mapped background SO_2 concentrations for the area have been obtained for 2001 and are 6.9 μg m^{-3} as a maximum. Concentrations of SO_2 are presented for 2001, which is the most recent mapped data available.

2.4.6 Carbon Monoxide (CO)

The LBoB do not undertake routine monitoring of carbon monoxide within the area. The Defra mapped background CO concentrations for the area surrounding the site indicate that the maximum annual mean concentration of 0.507 mg m^{-3} (507 μg m^{-3}) would be appropriate. As for SO_2, these are provided for 2001, which is the most recent mapped data available and represents a worst-case for the area. Applying a year adjustment factor of 0.446 for 2021 gives an annual mean of 226 μg m^{-3}.

2.4.7 Total Organic Carbon (TOC) as Benzene

No monitoring for benzene is carried out within the local area. Therefore, a background concentration has been obtained from the Defra background map for 2010 (latest mapped data for benzene). The estimated background benzene concentration for the location is derived as 0.74 μg m^{-3} as the maximum. This is 15% of the annual mean objective concentration of 5 μg m^{-3}.

2.4.8 Background Concentrations for Comparison with Concentrations Predicted by Detailed Dispersion Modelling

A summary of the annual mean background concentrations that have been used in the assessment is presented in *Table 2.10*.

TABLE 2.10 SUMMARY OF BACKGROUND CONCENTRATIONS FOR THE ASSESSMENT

Pollutant	Averaging Period	Concentration
Nitrogen Dioxide (NO_2)	Annual	27.6 µg m^{-3}
	1-Hour	55.2 µg m^{-3} (a)
Oxides of Nitrogen (NOx)	Annual	35.0 µg m^{-3}
	24-Hour	41.3 µg m^{-3} (a)(b)
Particles (PM_{10})	Annual	18.5 µg m^{-3}
	24-Hour	21.8 µg m^{-3} (a)(b)
Particles ($PM_{2.5}$)	Annual	12.2 µg m^{-3}
Sulphur Dioxide (SO_2)	Annual	6.9 µg m^{-3}
	24-Hour	8.1 µg m^{-3} (a)(b)
	1-Hour	13.8 µg m^{-3} (a)
	15-Minute	18.5 µg m^{-3} (a)(c)
Carbon Monoxide (CO)	Annual	226 µg m^{-3}
	8-Hour	316 µg m^{-3} (a)(d)
	1-Hour	452 µg m^{-3} (a)
Total Organic Carbon (as Benzene)	Annual	0.74 µg m^{-3}
	1-Hour	1.5 µg m^{-3}

(a) 1-hour mean background concentration estimated by multiplying the annual mean by a factor of 2 in accordance with the Risk Assessment Guidance.

(b) 24-hour mean background concentration estimated by multiplying the 1-hour mean by a factor of 0.59 in accordance with the Risk Assessment Guidance.

(c) 15-minute mean background concentration estimated by multiplying the 1-hour mean by a factor of 1.34 in accordance with the Risk Assessment Guidance.

(d) 8-hour mean background concentration estimated by multiplying the 1-hour mean by a factor of 0.70 in accordance with the Risk Assessment Guidance.

3 ASSESSMENT METHODOLOGY FOR OPERATIONAL IMPACTS

3.1 INTRODUCTION

Emissions to air from the installation have been modelled using the US AERMOD (US EPA Version 19191) and a five-year meteorological data set from London Heathrow Airport (2016 to 2020).

3.2 SENSITIVE RECEPTORS

3.2.1 Human Health

In addition to presenting the maximum predicted concentrations within the modelling domain, a number of discrete sensitive receptors have been included in the model. The locations of the sensitive receptors considered for this assessment are provided in *Table 3.1* and presented in *Figure 3.1*. These include residential properties as well as adjacent warehousing and retail units.

FIGURE 3.1 LOCATION OF SENSITIVE RECEPTORS CONSIDERED FOR THE ASSESSMENT

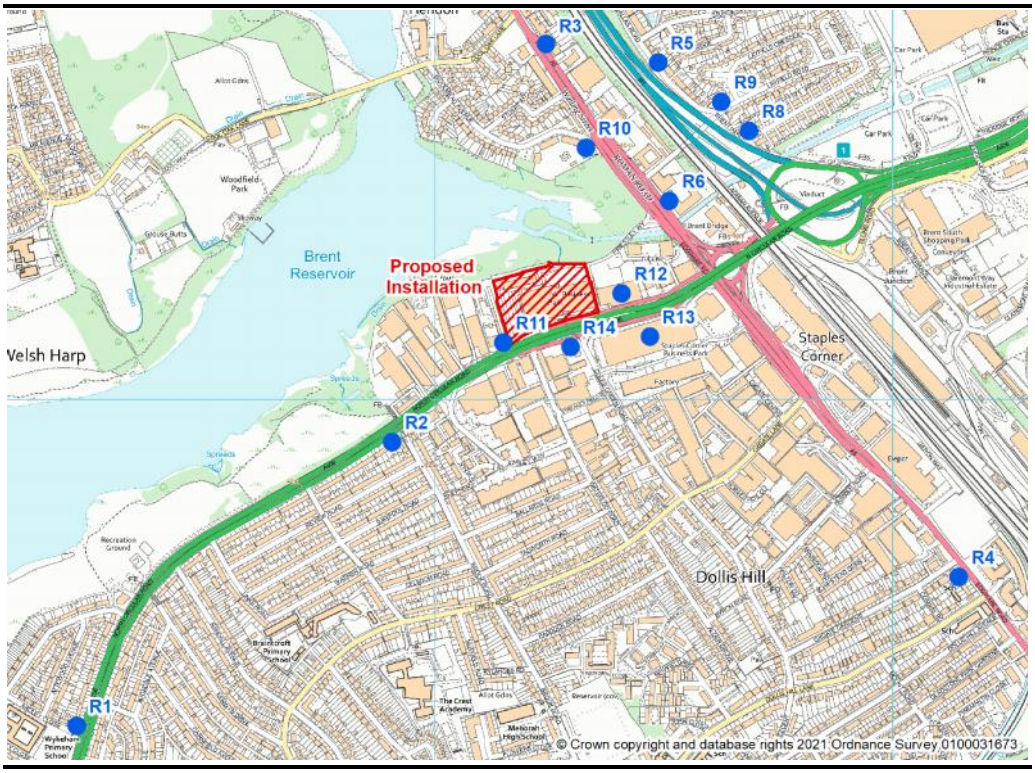


TABLE 3.1 DESCRIPTION OF SENSITIVE RECEPTORS

Ref.	Receptor	Receptor Type	Grid Reference	
R1	Ardley Close	Residential/School	521219	186289
R2	North Circular Road	Residential	521908	186906
R3	A5	Residential	522244	187776
R4	Edgeware Road	Residential	523145	186613
R5	Dallas Road	Residential	522488	187736
R6	Travel Lodge	Leisure	522512	187433
R8	Brent Park Road	Residential	522687	187586
R9	Layfield Road	Residential	522626	187650
R10	Woolmead Avenue	Residential	522331	187549
R11	Commercial/Industrial	Commercial/Industrial	522150	187124
R12	Builders Warehouse	Commercial/Industrial	522409	187231
R13	Self-Storage Warehouse	Commercial/Industrial	522470	187137
R14	Retail	Retail	522297	187114

3.2.2 Habitat Sites

Introduction

The Environment Agency's Risk Assessment Guidance states that the impact of emissions to air on vegetation and ecosystems should be assessed for the following habitat sites within 10 km of the source:

- Special Areas of Conservation (SACs) and candidate SACs (cSACs) designated under the EC Habitats Directive [2];
- Special Protection Areas (SPAs) and potential SPAs designated under the EC Birds Directive [3]; and
- Ramsar Sites designated under the Convention on Wetlands of International Importance [4].

Within 2 km of the source:

- Sites of Special Scientific Interest (SSSI) established by the 1981 Wildlife and Countryside Act;
- National Nature Reserves (NNR);
- Local Nature Reserves (LNR);

2 Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora

3 Council Directive 79/409/EEC on the conservation of wild birds

4 The Convention of Wetlands of International Importance especially as Waterfowl Habitat (Ramsar, Iran,1971)

- Local Wildlife Sites (LWS); and
- Ancient Woodland (AW).

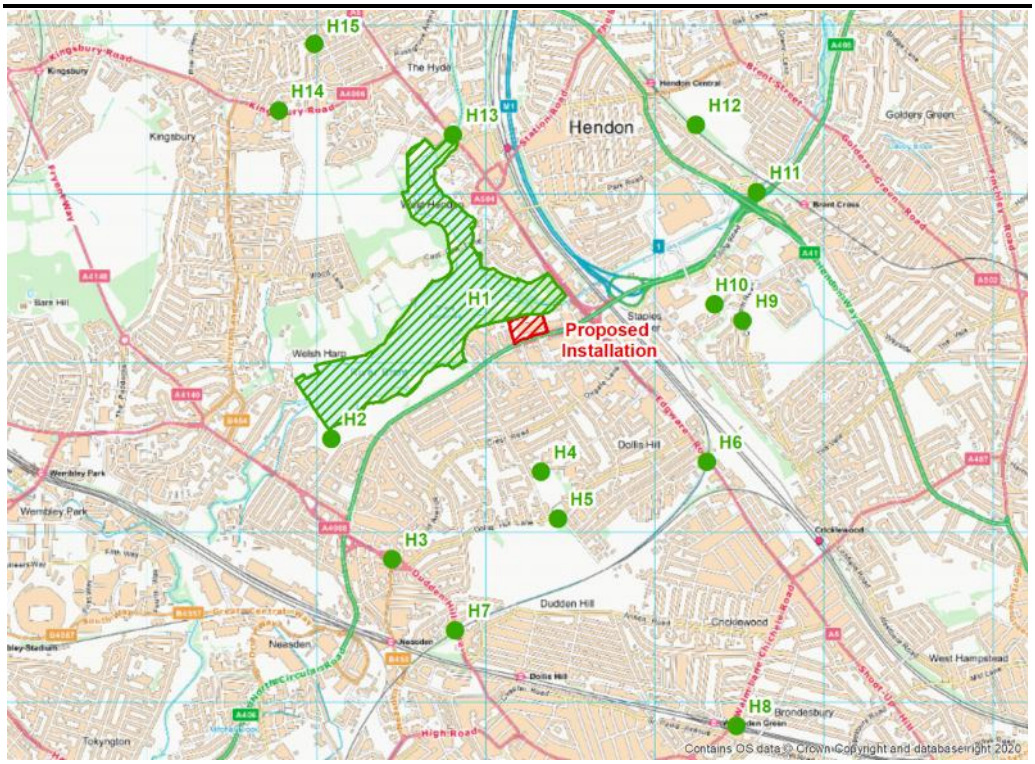
SACs and SPAs are included in an EU-wide network of protected sites called Natura 2000 [5]. The EC Habitats Directive and Wild Birds Directive have been transposed into UK law by the Habitats Regulations [6].

Sensitive Habitats

Within 2 km of the installation site there is one SSSI (Brent Reservoir) and numerous LWS. There are no European habitat sites within 10 km of the installation. A habitat screening report has been provided by the Environment Agency and is provided in *Annex A*. The Brent Reservoir SSSI is immediately north of the site and it also forms the Brent Reservoir/Welsh Harp LNR. Given the size and extent of this habitat, this has been modelled as a polygon receptor and the maximum predicted concentration anywhere within the habitat has been predicted.

The location of the habitats and assumed area of the Brent Reservoir SSSI/LNR habitat site is provided in *Figure 5.1*. A summary of the habitat sites included in the assessment is provided in *Table 5.1*.

FIGURE 5.1 LOCATION OF HABITATS WITHIN 2 KM OF THE INSTALLATION



5 www.natura.org

6 The Conservation (Natural Habitats, &c.) Regulations 1994. The Conservation (Natural Habitats, &c.) (Amendment) Regulations 1997 (Statutory Instrument 1997 No. 3055), The Conservation (Natural Habitats, &c.) (Amendment) (England) Regulations 2000 (Statutory Instrument 2000 No. 192)

TABLE 5.1 DESCRIPTION OF HABITATS CONSIDERED FOR THE AIR QUALITY ASSESSMENT

Ref.	Name	Location	
		Direction from Site	Distance (km)
H1	Brent Reservoir SSSI/LNR	Adjacent to site to the north	
H2	Local Wildlife Site	SW	1.2
H3	Local Wildlife Site	SSW	1.4
H4	Local Wildlife Site	S	0.8
H5	Local Wildlife Site	S	1.0
H6	Local Wildlife Site	SE	1.2
H7	Local Wildlife Site	S	1.7
H8	Local Wildlife Site	SE	2.6
H9	Local Wildlife Site	E	1.2
H10	Local Wildlife Site	E	1.0
H11	Local Wildlife Site	NE	1.5
H12	Local Wildlife Site	NE	1.5
H13	Local Wildlife Site	N	1.2
H14	Local Wildlife Site	NW	1.8
H15	Local Wildlife Site	NW	2.0

LWS H8 is greater than 2 km from the site but is included as it is part of the Metropolitan line between Kilburn and Neasden LWS.

3.3 DISPERSION MODELLING OF EMISSIONS

3.3.1 The Dispersion Model

The potential impact of emissions from the installation has been assessed using a dispersion model to predict airborne ground level concentrations of pollutants emitted from the generator stacks.

The operational impacts from the emission sources have been assessed using the US EPA AERMOD dispersion Model (US EPA Version 19191). AERMOD allows for the modelling of dispersion under convective meteorological conditions using a skewed Gaussian concentration distribution. It is able to simulate the effects of terrain and building downwash simultaneously. It can also calculate concentrations for direct comparison with air quality standards or guidelines. It can also be used to identify the number of exceedances of a specified concentration which is particularly useful for assessing impacts on short-term concentrations. It is used extensively in the UK for assessing the air quality impacts of industrial and other polluting processes.

3.3.2 Building Downwash

Structures associated with the installation or nearby buildings may affect the dispersion of emissions from the stack. The roof of the building is relatively complex with associated plant (chillers etc.) location at roof level. The roof peak height is 14.1 m and the chiller gantry is at a height of 15.4 m. Furthermore, there are acoustic louvres around the edge of the buildings to a height of 20.0 m, but these are relative open structures and have been excluded as downwash structures. The plenums where the exhaust vents into are at a height of 17.5 m. There is a five-storey office building to the north of the site at an approximate height of 22.4 m, but this has been excluded as it will be demolished.

Details of the building structures that have been included in the dispersion model to allow for building downwash effects are presented in *Table 3.2*. It should be noted that these are the measurements assumed to represent the various buildings for the dispersion modelling rather than the actual dimensions of the buildings.

TABLE 3.2 BUILDINGS INCLUDED IN THE DISPERSION MODEL

Building	Height (m)	X Length (m)	Y Width (m)	Angle (°)
Main building	15.4	150	60	166
Plenums	17.5	45	5	166

3.3.3 Grid Size

In addition to assessing the impact of emissions on the 14 discrete receptors identified in *Section 3.2*, the maximum predicted off-site concentration is also determined. Predicted concentrations are calculated across a 3 km by 3 km grid with a 50 m grid resolution and a smaller nested grid of 1 km by 1 km with a grid resolution of 50 m giving an overall grid resolution of 25 m.

3.3.4 Significance Criteria

Human Health

The Environment Agency's Risk Assessment Guidance specifies criteria to enable the potential significance of an impact to be determined [7]. For the process contribution (PC), the impact is deemed not significant if the annual mean PC is less than 1% of the environmental assessment level (EAL) and the short-term PC is less than 10% of the EAL. If either of these criteria is exceeded, they are potentially significant and it is then necessary to consider

7 https://www.gov.uk/guidance/risk-assessments-for-your-environmental-permit

the total predicted environmental concentration (PEC, which is the PC plus the ambient background concentration).

For the annual mean, if the PEC is below 70% of the assessment criterion, then it is considered unlikely that an exceedance of the limit will occur and there should be no adverse impact. For short term concentrations, more detailed assessments are required where the short-term PC is greater than 20% of the short-term standard minus twice the long-term background concentration.

Habitat Sites

The Environment Agency's risk assessment guidance [7] specifies criteria to enable the potential significance of an impact to be determined. For the process contribution (PC), the impact is deemed not significant if the annual mean PC is less than 1% of the critical level (or air quality objective) and the short-term PC is less than 10% of the critical level (or air quality objective). If either of these criteria is exceeded, they are not necessarily significant however, it is then necessary to consider the total predicted environmental concentration or deposition (PC plus the background contribution) as discussed above.

For local wildlife sites (SINCs, SLINC's, NNRs, LNRs and ancient woodland), a process contribution (PC) is considered not significant if:

- the long term PC < 100% of the long-term critical level;
- the short term PC < 100% of the short-term critical level.

3.4 EMISSION SOURCES

3.4.1 Emission Scenarios

Testing and Maintenance of Generators

There are sixteen generators proposed for the installation. It is understood that these will be commissioned in two phases with the first phase comprising eight generators. For the assessment, it is assumed that both phases will be operational. Operation of the generators will occur during testing and maintenance and in the event of an outage of power at the facility.

It is understood that the following testing (and maintenance) regimes will take place:

- Every month (for ten months) each generator will be tested for thirty minutes. This test is designed to test start signals and generator run up and would be at no or very low load. Each generator would be tested separately to minimise short-term impacts on local air quality.

- Every six months each generator will be tested for four hours and will be at or near 100% load. Again, generators would be tested separately to minimise the short-term impact on local air quality. It is noted that this level of testing is a contractual requirement and cannot be altered.

Therefore, the generators would operate for 80 hours per annum at reduced load and 128 hours per annum at full load during testing and maintenance.

Operation During an Event

The generators would also run during an interruption to the power supply. It is proposed that the facility would be connected to the Elstree 132kV substation. Over the past ten years there have been only three outages at Elstree with a maximum duration of 1.9 minutes. Therefore, it is considered very unlikely that the generators would run for extended periods during an event. However, the facility is contracted to provide support for up to 48 hours. The Environment Agency's FAQ suggests that it is assumed that an event occurs for a period of 72 hours per annum (h/a). Therefore, screening of impacts is carried out assuming 72 h/a. Where impacts cannot be screened out as not significant or air quality objective likely to be met, 48 h/a and 3 h/a [8] event durations are also considered.

During an event, all sixteen generators would operate and as four generators would provide the power requirements of three generators, each generator is assumed to operate at 75% load.

3.4.2 Summary of Operational Hours and Loads

A summary of the operational hours and loads is provided in *Table 3.3*. This also provides the assumed hours for assessing long-term (annual mean) and short-term (15-minute, hourly, 8-hourly and 24-hourly mean) concentrations.

3.4.3 Installation Stack Emission Parameters

There will be sixteen generators with emissions from two generators into a single plenum. Emissions for a single generator and two generators combined are presented in *Table 3.4* for 100% load. Emissions data for different loadings are provided in *Annex B*. The generators would be installed in two phases of eight generators each. However, the assessment assumes as a worst-case that all sixteen generators are installed and are operational.

8 Assumes that the generators would operate for an hour (for each of the three very short outages that occurred over ten years) on the basis that the supply is potentially unstable.

TABLE 3.3 OPERATIONAL HOURS AND LOADS

Parameter	Monthly Testing	Six Monthly Testing	Event
Number of tests per annum	10	2	-
Number of generators operation per test/event	16 consecutively	16 consecutively	16 simultaneous
Operational load	10%	100%	75%
Operational hours for annual mean (h/a)	80 (a)	128 (b)	72, 48 or 3 (c)
Operational hours for 24-hour means (h/a)	4,380 (d)(e)	4,380 (d)(e)	8760
Operational hours for 8-hour, 1-hour and 15-minute means (h/a)	8,760	8,760	8,760

(a) 16 generators operating for 30 minutes a month for 10 months (16*10*30/60)

(b) 16 generators operating for 4 hours a month for 2 months (16*2*4)

(c) 72 hours as suggested by the Environment Agency FAQ, 48 hours as the contracted hours and 3 hours as indicated by outages at Elstree over the last 10 years

(d) Testing will only take place between 08:00 and 20:00

(e) Assumption adopted for screening purposes only, where impacts are potentially significant variable emission parameters are used

TABLE 3.4 SUMMARY OF THE EMISSIONS PARAMETERS FOR DISPERSION MODELLING AT 100% LOAD

Parameter	Single Generator	Combined Two Generators
Number of sources	16	8
Stack height (m)	17.5	17.5
Temperature of emission (^oC)	482	482
Actual flow rate ($m^3\ s^{-1}$)	11.8	23.6
Emission velocity at stack exit ($m\ s^{-1}$)	41.7	41.7
Oxygen content of exhaust (%v/v dry)	10.6	10.6
Moisture content of exhaust (%v/v)	6.7	6.7
Normalised flow rate ($Nm^3\ s^{-1}$) (a)	2,362	2,362
Flue/effective stack diameter (m)	0.6	0.84

(a) Reference conditions of 273K, 1 atmosphere, dry and 5% oxygen

Emissions data provided in *Annex B*, has been provided by AVK, the providers of the generating units. Information on pollutant emissions is provided as a concentration ($mg\ Nm^{-3}$) and as mass per kilowatt-hour generated (g/kWh). At higher loads, the mass emission rates ($g\ s^{-1}$) calculated are consistent for both methods but vary at lower loads. Therefore, as a worst-case the highest mass emission rate is used for each pollutant and each load.

TABLE 3.5 POLLUTANT EMISSION CONCENTRATIONS FOR DISPERSION MODELLING

Pollutant	Emission rate per Generator for Monthly Tests (g s^{-1})	Emission rate per Generator for Six Monthly Tests (g s^{-1})	Emission rate per Generator for an Event (g s^{-1})
NOx	0.84	6.08	4.06
Particles	0.0046	0.0184	0.0207
SO_2	0.00037	0.00276	0.00207
CO	0.26	0.28	0.28
TOC	0.066	0.046	0.048

4 PREDICTED OPERATIONAL IMPACT ON HUMAN HEALTH

4.1 INTRODUCTION

The predicted impact of emissions to air from the installation are presented. Initial modelling was carried out for five years of meteorological data (2016 to 2020). Maximum annual mean concentrations occurred for the 2020 meteorological data and were 115% compared to the average for the five years. For the maximum hourly mean, highest concentrations were also predicted for 2020 and were 2% higher than the average for the five years.

For testing where generators are modelled individually, initial modelling considered the eight locations for the dual-flue vents to determine the worst-case location based on maximum annual mean and hourly mean concentrations. Concentrations for the eight locations varied between 93% and 120% of the average for all eight generators. The worst-case location was used for detailed modelling and concentrations are representative of a worst-case.

It is proposed that the two vents will discharge into a plenum (5 m by 5m) shared by two generators. The plenum is used to contain the generator exhausts and the cooling air exhausts. Initial modelling of the mixed exhaust, which resulted in a significantly lower temperature and a lower efflux velocity compared to the generator exhaust, generally resulted in lower predicted off-site concentrations compared to the generator exhaust alone. This was likely due to dilution of the pollutants with the cooling air. Therefore, as a worst-case it is assumed that the generator stacks exhaust at the top of the plenum rather than mixing with the cooling air within the plenum before discharge. Modelling of emissions assuming the exhausts vent into the plenum are provided in *Annex C*.

More detailed modelling of emissions for the various scenarios were carried out using the 2020 meteorological data and for the generator location giving rise to highest concentrations.

4.2 DETAILED DISPERSION MODELLING RESULTS – MONTHLY TESTS

4.2.1 Introduction

Detailed dispersion modelling for the ten monthly tests is provided. It is assumed that each generator is tested for 30 minutes once per month (for ten months of the year). The generators are assumed to be operating at 10% load.

4.2.2 Nitrogen Dioxide

Predicted annual mean and hourly mean ground level concentrations of NO_2 arising as a result of emissions from the installation are presented in *Table 4.1*. Maximum predicted concentrations are provided along with predicted concentrations for the discrete receptors. The significance of the impacts are assessed in accordance with Environment Agency guidance.

TABLE 4.1 MAXIMUM PREDICTED NO_2 CONCENTRATIONS FOR THE MONTHLY (10 PER ANNUM) TESTING (µg m^{-3})

Receptor/Parameter	Annual Mean		99.8th Percentile of 1-hour Means	
	PC (µg m^{-3})	%age AQO	PC (µg m^{-3})	%age AQO
Maximum off-site	0.19	0.5%	96.1	48.1%
Maximum Receptor	0.024	0.1%	26.0	13.0%
Maximum Residential	0.020	0.1%	20.0	10.0%
R1. Ardley Close	0.001	0.0%	2.2	1.1%
R2. North Circular Road	0.006	0.0%	9.0	4.5%
R3. A5	0.007	0.0%	11.1	5.6%
R4. Edgeware Road	0.001	0.0%	3.4	1.7%
R5. Dallas Road	0.009	0.0%	11.7	5.9%
R6. Travel Lodge	0.023	0.1%	15.7	7.9%
R8. Brent Park Road	0.008	0.0%	8.5	4.2%
R9. Layfield Road	0.009	0.0%	9.9	4.9%
R10. Woolmead Avenue	0.020	0.1%	20.0	10.0%
R11. Commercial/Industrial	0.020	0.1%	19.2	9.6%
R12. Builders Warehouse	0.024	0.1%	21.9	11.0%
R13 Self Storage WH	0.016	0.0%	20.2	10.1%
R14 Retail	0.016	0.0%	26.0	13.0%
Maximum receptor (PC) (a)	0.024 (0.1%)		26.0 (13.0%)	
Assumed background	27.6		55.2	
Total concentration (PEC) (a)	27.6 (69.1%)		81.2 (40.6%)	
Air Quality Standard	40		200	
Significance	*Not significant*		*AQO likely to be met*	
(a) Values in parentheses are the percentages of the air quality standard				

Guidance issued by the Environment Agency's Air Quality Assessment and Modelling Unit (AQMAU) [9] indicates that an initial screening approach would be to assume that 100% of annual average and 50% of peak hourly average concentrations of NO_x are in the form of NO_2. For a more detailed worst-case

9 Conversion Ratios for NO_x and NO_2, Air Quality Modelling and Assessment Unit of the Environment Agency (undated)

assessment such as this, the guidance recommends a conversion rate of 70% and 35% for annual and hourly concentrations, respectively. Therefore, for the purposes of the assessment it is assumed that 70% of the NO_x is NO_2 for annual means and 35% for hourly mean predictions.

Maximum predicted annual mean concentrations occur to the northeast of the installation at the boundary of the site. The maximum predicted is 0.19 µg m^{-3} and is 0.5% of the AQO of 40 µg m^{-3}.

The maximum (100th percentile) off-site NO_2 concentration is also predicted to occur to the northeast of the site. The maximum hourly concentration is 112.1 µg m^{-3} as the PC (167.3 µg m^{-3} as the PEC) is well below the limit value of 200 µg m^{-3}. Therefore, it is very unlikely that the AQO would be exceeded given that 18 exceedances are allowed per annum.

Predicted concentrations at sensitive receptors are substantially lower. Therefore, it is concluded that the impact of emissions during the testing (10 one monthly tests) would be not significant.

4.2.3 PM_{10}

Predicted ground level concentrations of PM_{10} arising as a result of the installation emissions are presented in *Table 4.2*. This assumes that all particles emitted by the installation are less than 10 µm in diameter. Maximum predicted concentrations are provided as well as predicted concentrations at discrete receptors. The significance of the impacts are assessed in accordance with the Environment Agency guidance.

TABLE 4.2 MAXIMUM PREDICTED PM_{10} CONCENTRATIONS FOR THE MONTHLY (10 PER ANNUM) TESTING (µg m^{-3})

Receptor/Parameter	Annual Mean		90.4th Percentile of 24-hour Means	
	PC (µg m^{-3})	%age AQO	PC (µg m^{-3})	%age AQO
Maximum off-site	0.0015	<0.1%	0.20	0.4%
Maximum Receptor	0.00019	<0.1%	0.031	0.1%
Maximum Residential	0.00016	<0.1%	0.025	0.1%
R1. Ardley Close	0.00001	<0.1%	0.002	<0.1%
R2. North Circular Road	0.00004	<0.1%	0.009	<0.1%
R3. A5	0.00005	<0.1%	0.009	<0.1%
R4. Edgeware Road	0.00001	<0.1%	0.002	<0.1%
R5. Dallas Road	0.00007	<0.1%	0.011	<0.1%
R6. Travel Lodge	0.00018	<0.1%	0.026	0.1%
R8. Brent Park Road	0.00007	<0.1%	0.009	<0.1%
R9. Layfield Road	0.00007	<0.1%	0.010	<0.1%
R10. Woolmead Avenue	0.00016	<0.1%	0.025	0.1%

TABLE 4.2 MAXIMUM PREDICTED PM_{10} CONCENTRATIONS FOR THE MONTHLY (10 PER ANNUM) TESTING (µg m^{-3})

R11. Commercial/Industrial	0.00016	<0.1%	0.031	0.1%
R12. Builders Warehouse	0.00019	<0.1%	0.030	0.1%
R13 Self Storage WH	0.00012	<0.1%	0.022	<0.1%
R14 Retail	0.00013	<0.1%	0.024	<0.1%
Maximum receptor (PC) (a)	0.00019 (<0.1%)		0.031 (0.1%)	
Assumed background	18.5		21.8	
Total concentration (PEC) (a)	18.5 (46.2%)		21.8 (43.6%)	
Air Quality Standard	40		50	
Significance	*Not significant*		*Not significant*	
(a) Values in parentheses are the percentages of the air quality standard				

Predicted concentrations even as the maximum anywhere within the model domain are very small compared to the relevant AQO and it is concluded that the impact would be not significant.

4.2.4 $PM_{2.5}$

Assuming as a worst-case, that all particles are within the $PM_{2.5}$ fraction, predicted annual mean $PM_{2.5}$ concentrations would be the same as predicted for PM_{10} in *Table 4.2*.

The maximum predicted off-site concentration (0.0015 µg m^{-3}) is less than 0.1% of the AQO. Therefore, it is concluded that emissions of $PM_{2.5}$ from the installation would be not significant.

4.2.5 Sulphur Dioxide

Predicted ground level concentrations of SO_2 arising as a result of emissions from the installation are presented in *Table 4.3*. Maximum predicted concentrations are provided, and the significance of the impact is assessed according to the Environment Agency guidance.

Maximum predicted concentrations (100^{th} percentiles) anywhere within the model domain are as follows:

- 0.027 µg m^{-3} (<0.1%) of the 24-hour mean AQO for SO_2;
- 0.15 µg m^{-3} (<0.1%) of the 1-hour mean AQO for SO_2; and
- 0.19 µg m^{-3} (0.1%) of the 15-minute mean AQO for SO_2.

The predicted short-term SO_2 concentrations are all 10% or less of the relevant AQO. Therefore, according to the Environment Agency guidance the impact of SO_2 emissions from the installation would be assessed as not significant.

TABLE 4.3 MAXIMUM PREDICTED SO_2 CONCENTRATIONS FOR THE MONTHLY (10 PER ANNUM) TESTING (µg m^{-3})

Receptor/Parameter	99.2nd Percentile of 24-hour Means		99.7th Percentile of 1-hour means		99.9th Percentile of 15-minute Means	
	PC (µg m^{-3})	%age AQO	PC (µg m^{-3})	%age AQO	PC (µg m^{-3})	%age AQO
Maximum off-site	0.023	<0.1%	0.12	<0.1%	0.17	0.1%
Maximum Receptor	0.0058	<0.1%	0.032	<0.1%	0.047	<0.1%
Maximum Residential	0.0041	<0.1%	0.024	<0.1%	0.038	<0.1%
R1. Ardley Close	0.0003	<0.1%	0.003	<0.1%	0.005	<0.1%
R2. North Circular Road	0.0014	<0.1%	0.011	<0.1%	0.016	<0.1%
R3. A5	0.0014	<0.1%	0.013	<0.1%	0.023	<0.1%
R4. Edgeware Road	0.0005	<0.1%	0.004	<0.1%	0.006	<0.1%
R5. Dallas Road	0.0017	<0.1%	0.014	<0.1%	0.023	<0.1%
R6. Travel Lodge	0.0036	<0.1%	0.020	<0.1%	0.028	<0.1%
R8. Brent Park Road	0.0012	<0.1%	0.010	<0.1%	0.015	<0.1%
R9. Layfield Road	0.0015	<0.1%	0.012	<0.1%	0.018	<0.1%
R10. Woolmead Avenue	0.0041	<0.1%	0.024	<0.1%	0.038	<0.1%
R11. Commercial/ Industrial	0.0056	<0.1%	0.024	<0.1%	0.034	<0.1%
R12. Builders Warehouse	0.0050	<0.1%	0.027	<0.1%	0.038	<0.1%
R13 Self Storage WH	0.0040	<0.1%	0.025	<0.1%	0.037	<0.1%
R14 Retail	0.0058	<0.1%	0.032	<0.1%	0.047	<0.1%
Maximum receptor (PC) (a)	0.0058 (<0.1%)		0.032 (<0.1%)		0.047 (<0.1%)	
Assumed background	8.1		13.8		18.5	
Total concentration (PEC) (a)	8.1 (6.5%)		13.8 (3.9%)		18.5 (7.0%)	
Air Quality Standard	125		350		266	
Significance	*Not significant*		*Not significant*		*Not significant*	
(a) Values in parentheses are the percentages of the air quality standard						

4.2.6 Carbon Monoxide

Predicted ground level concentrations of CO arising as a result of emissions from the installation are presented in *Table 4.4*. Maximum predicted concentrations are provided, and the significance of the impact is assessed according to the Environment Agency guidance.

TABLE 4.4 MAXIMUM PREDICTED CO CONCENTRATIONS FOR THE MONTHLY (10 PER ANNUM) TESTING (µg m^{-3})

Receptor/Parameter	Maximum 8-Hour Mean		Maximum 1-Hour Mean	
	PC (µg m^{-3})	%age AQO	PC (µg m^{-3})	%age AQO
Maximum off-site	68.5	0.7%	99.1	0.3%
Maximum Receptor	17.7	0.2%	26.7	0.1%
Maximum Residential	11.0	0.1%	24.7	0.1%
R1. Ardley Close	1.4	0.0%	2.6	0.0%
R2. North Circular Road	5.0	0.1%	9.1	0.0%
R3. A5	4.7	0.0%	15.8	0.1%
R4. Edgeware Road	1.5	0.0%	3.4	0.0%
R5. Dallas Road	6.1	0.1%	13.3	0.0%
R6. Travel Lodge	9.3	0.1%	15.5	0.1%
R8. Brent Park Road	3.7	0.0%	9.7	0.0%
R9. Layfield Road	4.6	0.0%	10.4	0.0%
R10. Woolmead Avenue	11.0	0.1%	24.7	0.1%
R11. Commercial/ Industrial	13.3	0.1%	23.1	0.1%
R12. Builders Warehouse	15.4	0.2%	21.5	0.1%
R13 Self Storage WH	12.1	0.1%	21.3	0.1%
R14 Retail	17.7	0.2%	26.7	0.1%
Maximum receptor (PC) (a)	17.7 (0.2%)		26.7 (0.1%)	
Assumed background	316		452	
Total concentration (PEC) (a)	334 (3.3%)		479 (1.6%)	
Air Quality Standard	10,000		30,000	
Significance	*Not significant*		*Not significant*	
(a) Values in parentheses are the percentages of the air quality standard				

Predicted ground level CO concentrations are well within the relevant air quality objective. At worst, the maximum off-site 8-hour mean is 0.7% of the AQO, which would be assessed as not significant. The 1-hour mean is 0.3% of the AQO and would also be assessed as not significant.

4.2.7 Total Organic Carbon

Predicted annual mean concentrations of TOC (as benzene) arising as a result of emissions from the installation are presented in *Table 4.5*.

TABLE 4.5 MAXIMUM PREDICTED CONCENTRATIONS OF BENZENE FOR THE MONTHLY (10 PER ANNUM) TESTING (μg m^{-3})

Receptor/Parameter	Annual Mean		Maximum 1-Hour Mean	
	PC (μg m^{-3})	%age AQO	PC (μg m^{-3})	%age AQO
Maximum off-site	0.021	0.4%	25.2	12.9%
Maximum Receptor	0.0027	0.1%	6.8	3.5%
Maximum Residential	0.0023	<0.1%	6.3	3.2%
R1. Ardley Close	0.0001	<0.1%	0.7	0.3%
R2. North Circular Road	0.0006	<0.1%	2.3	1.2%
R3. A5	0.0007	<0.1%	4.0	2.1%
R4. Edgeware Road	0.0002	<0.1%	0.9	0.4%
R5. Dallas Road	0.0010	<0.1%	3.4	1.7%
R6. Travel Lodge	0.0026	0.1%	3.9	2.0%
R8. Brent Park Road	0.0009	<0.1%	2.5	1.3%
R9. Layfield Road	0.0010	<0.1%	2.6	1.4%
R10. Woolmead Avenue	0.0023	<0.1%	6.3	3.2%
R11. Commercial/ Industrial	0.0023	<0.1%	5.9	3.0%
R12. Builders Warehouse	0.0027	0.1%	5.5	2.8%
R13 Self Storage WH	0.0018	<0.1%	5.4	2.8%
R14 Retail	0.0018	<0.1%	6.8	3.5%
Maximum receptor (PC) (a)	0.0027 (0.1%)		6.8 (3.5%)	
Assumed background	0.74		1.5	
Total concentration (PEC) (a)	0.74 (14.8%)		8.3 (4.3%)	
Air Quality Standard	5		195	
Significance	*Not significant*		*Not significant*	
(a) Values in parentheses are the percentages of the air quality standard				

Maximum predicted ground level TOC (assuming all benzene as a worst case) concentrations are well within the annual mean AQO. The maximum off-site concentration is 0.4% of the long-term objective and would be not significant according to the Environment Agency guidance. Predicted maximum hourly mean concentrations are less than 10% of the short term AQS at sensitive receptors and would be assessed as not significant. The maximum anywhere off-site exceeds 10% of the environmental assessment level (EAL) but the PEC is well below the EAL. Therefore, it is concluded that emissions of TOC would be not significant.

4.3 DETAILED DISPERSION MODELLING RESULTS – SIX MONTHLY TESTS

4.3.1 Introduction

Detailed dispersion modelling for the two six-monthly tests is provided. It is assumed that each generator is tested for four hours for two months of the

year. The generators are assumed to be operating at 100% load and would be tested individually.

4.3.2 Nitrogen Dioxide

Predicted annual and hourly mean ground level concentrations of NO_2 arising as a result of emissions from the installation are presented in *Table 4.6*. Maximum predicted concentrations are provided along with predicted concentrations for the discrete receptors.

TABLE 4.6 MAXIMUM PREDICTED NO_2 CONCENTRATIONS FOR THE SIX-MONTHLY (TWO PER ANNUM) TESTING (µg m^{-3})

Receptor/Parameter	Annual Mean		99.8th Percentile of 1-hour Means	
	PC (µg m^{-3})	%age AQO	PC (µg m^{-3})	%age AQO
Maximum off-site	0.46	1.1%	161.0	80.5%
Maximum Receptor	0.11	0.3%	42.3	21.1%
Maximum Residential	0.071	0.2%	36.7	18.4%
R1. Ardley Close	0.006	0.0%	5.1	2.6%
R2. North Circular Road	0.022	0.1%	17.3	8.6%
R3. A5	0.032	0.1%	20.8	10.4%
R4. Edgeware Road	0.005	0.0%	6.1	3.0%
R5. Dallas Road	0.051	0.1%	19.3	9.6%
R6. Travel Lodge	0.11	0.3%	32.2	16.1%
R8. Brent Park Road	0.055	0.1%	16.5	8.3%
R9. Layfield Road	0.056	0.1%	17.3	8.6%
R10. Woolmead Avenue	0.071	0.2%	36.7	18.4%
R11. Commercial/Industrial	0.057	0.1%	39.2	19.6%
R12. Builders Warehouse	0.054	0.1%	40.6	20.3%
R13 Self Storage WH	0.027	0.1%	37.8	18.9%
R14 Retail	0.024	0.1%	42.3	21.1%
Maximum receptor (PC) (a)	0.11 (0.3%)		42.3 (21.1%)	
Assumed background	27.6		55.2	
Total concentration (PEC) (a)	27.7 (69.3%)		97.5 (48.8%)	
Air Quality Standard	40		200	
Significance	*Not significant*		*AQO likely to be met*	
(a) Values in parentheses are the percentages of the air quality standard				

Maximum predicted annual mean concentrations occur to the northeast of the installation at the boundary of the site. The maximum predicted annual mean concentration is 0.46 µg m^{-3} and is 1.1% of the AQO of 40 µg m^{-3}. At all sensitive receptors the PC is less than 1% of the AQO and the impact would be assessed as not significant.

The maximum (100th percentile) off-site NO_2 concentration is also predicted to occur to the northeast of the site. The maximum hourly concentration is 262.3 µg m^{-3} as the PC (317.5 µg m^{-3} as the PEC) and is above the limit value of 200 µg m^{-3}. Therefore, combined with the PEC there is the potential for the AQO to be exceeded. An assessment of the risk of exceedance is provided in *Section 4.5.3*.

Predicted concentrations at sensitive receptors are substantially lower than the maximum off-site concentration (69.2 µg m^{-3} as the 100th percentile) and it is unlikely that the limit of 200 µg m^{-3} would be exceeded at these locations.

4.3.3 PM_{10}

Predicted ground level concentrations of PM_{10} arising as a result of the installation emissions are presented in *Table 4.7*.

TABLE 4.7 MAXIMUM PREDICTED PM_{10} CONCENTRATIONS FOR THE SIX-MONTHLY (TWO PER ANNUM) TESTING (µg m^{-3})

Receptor/Parameter	Annual Mean		90.4th Percentile of 24-hour Means	
	PC (µg m^{-3})	%age AQO	PC (µg m^{-3})	%age AQO
Maximum off-site	0.0020	<0.1%	0.22	0.4%
Maximum Receptor	0.00046	<0.1%	0.043	0.1%
Maximum Residential	0.00031	<0.1%	0.033	0.1%
R1. Ardley Close	0.00003	<0.1%	0.003	<0.1%
R2. North Circular Road	0.00010	<0.1%	0.013	<0.1%
R3. A5	0.00014	<0.1%	0.016	<0.1%
R4. Edgeware Road	0.00002	<0.1%	0.002	<0.1%
R5. Dallas Road	0.00022	<0.1%	0.022	<0.1%
R6. Travel Lodge	0.00046	<0.1%	0.043	0.1%
R8. Brent Park Road	0.00024	<0.1%	0.021	<0.1%
R9. Layfield Road	0.00024	<0.1%	0.026	0.1%
R10. Woolmead Avenue	0.00031	<0.1%	0.033	0.1%
R11. Commercial/Industrial	0.00024	<0.1%	0.029	0.1%
R12. Builders Warehouse	0.00023	<0.1%	0.025	0.1%
R13 Self Storage WH	0.00012	<0.1%	0.010	<0.1%
R14 Retail	0.00010	<0.1%	0.008	<0.1%
Maximum receptor (PC) (a)	0.00046 (<0.1%)		0.043 (0.1%)	
Assumed background	18.5		21.8	
Total concentration (PEC) (a)	18.5 (46.2%)		21.8 (43.6%)	
Air Quality Standard	40		50	
Significance	*Not significant*		*Not significant*	
(a) Values in parentheses are the percentages of the air quality standard				

Predicted concentrations even as the maximum anywhere within the model domain are very small compared to the relevant AQO and it is concluded that the impact would be not significant.

4.3.4 $PM_{2.5}$

Assuming as a worst-case, that all particles are within the $PM_{2.5}$ fraction, predicted annual mean $PM_{2.5}$ concentrations would be the same as predicted for PM_{10} in *Table 4.7*.

The maximum predicted off-site concentration (0.0020 µg m^{-3}) is less than 0.1% of the AQO. Therefore, it is concluded that emissions of $PM_{2.5}$ from the installation would be not significant.

4.3.5 Sulphur Dioxide

Predicted ground level concentrations of SO_2 arising as a result of emissions from the installation are presented in *Table 4.8*. Maximum predicted concentrations are provided, and the significance of the impact is assessed according to the Environment Agency guidance.

Maximum predicted concentrations (100^{th} percentiles) anywhere within the model domain are as follows:

- 0.087 µg m^{-3} (0.1%) of the 24-hour mean AQO for SO_2;
- 0.34 µg m^{-3} (0.1%) of the 1-hour mean AQO for SO_2; and
- 0.47 µg m^{-3} (0.2%) of the 15-minute mean AQO for SO_2.

The predicted short-term SO_2 concentrations are all 10% or less of the relevant AQO, therefore according to the Environment Agency guidance the impact of SO_2 emissions from the installation would be assessed as not significant.

TABLE 4.8 MAXIMUM PREDICTED SO_2 CONCENTRATIONS FOR THE SIX-MONTHLY (TWO PER ANNUM) TESTING (µg m^{-3})

Receptor/Parameter	99.2nd Percentile of 24-hour Means		99.7th Percentile of 1-hour means		99.9th Percentile of 15-minute Means	
	PC (µg m^{-3})	%age AQO	PC (µg m^{-3})	%age AQO	PC (µg m^{-3})	%age AQO
Maximum off-site	0.066	0.1%	0.21	0.1%	0.33	0.1%
Maximum Receptor	0.014	<0.1%	0.053	<0.1%	0.094	<0.1%
Maximum Residential	0.0099	<0.1%	0.047	<0.1%	0.068	<0.1%
R1. Ardley Close	0.0012	<0.1%	0.0067	<0.1%	0.0095	<0.1%
R2. North Circular Road	0.0054	<0.1%	0.023	<0.1%	0.032	<0.1%
R3. A5	0.0054	<0.1%	0.027	<0.1%	0.038	<0.1%
R4. Edgeware Road	0.0013	<0.1%	0.0073	<0.1%	0.012	<0.1%
R5. Dallas Road	0.0059	<0.1%	0.025	<0.1%	0.034	<0.1%
R6. Travel Lodge	0.014	<0.1%	0.042	<0.1%	0.058	<0.1%
R8. Brent Park Road	0.0059	<0.1%	0.022	<0.1%	0.030	<0.1%
R9. Layfield Road	0.0056	<0.1%	0.023	<0.1%	0.031	<0.1%
R10. Woolmead Avenue	0.0099	<0.1%	0.047	<0.1%	0.068	<0.1%
R11. Commercial/ Industrial	0.011	<0.1%	0.051	<0.1%	0.072	<0.1%
R12. Builders Warehouse	0.0097	<0.1%	0.053	<0.1%	0.094	<0.1%
R13 Self Storage WH	0.0080	<0.1%	0.047	<0.1%	0.077	<0.1%
R14 Retail	0.0075	<0.1%	0.051	<0.1%	0.090	<0.1%
Maximum receptor (PC) (a)	0.014 (<0.1%)		0.053 (<0.1%)		0.094 (<0.1%)	
Assumed background	8.1		13.8		18.5	
Total concentration (PEC) (a)	8.1 (6.5%)		13.9 (4.0%)		18.6 (7.0%)	
Air Quality Standard	125		350		266	
Significance	*Not significant*		*Not significant*		*Not significant*	
(b) Values in parentheses are the percentages of the air quality standard						

4.3.6 Carbon Monoxide

Predicted ground level concentrations of CO arising as a result of emissions from the installation are presented in *Table 4.9*. Maximum predicted concentrations are provided, and the significance of the impact is assessed according to the Environment Agency guidance.

TABLE 4.9 MAXIMUM PREDICTED CO CONCENTRATIONS FOR THE SIX-MONTHLY (TWO PER ANNUM) TESTING (µg m^{-3})

Receptor/Parameter	Maximum 8-Hour Mean		Maximum 1-Hour Mean	
	PC (µg m^{-3})	%age AQO	PC (µg m^{-3})	%age AQO
Maximum off-site	20.1	0.2%	34.5	0.1%
Maximum Receptor	4.9	<0.1%	9.1	<0.1%
Maximum Residential	4.1	<0.1%	5.3	<0.1%
R1. Ardley Close	0.5	<0.1%	0.8	<0.1%
R2. North Circular Road	1.9	<0.1%	2.4	<0.1%
R3. A5	2.1	<0.1%	2.9	<0.1%
R4. Edgeware Road	0.7	<0.1%	1.1	<0.1%
R5. Dallas Road	2.0	<0.1%	2.7	<0.1%
R6. Travel Lodge	3.8	<0.1%	4.5	<0.1%
R8. Brent Park Road	1.6	<0.1%	2.2	<0.1%
R9. Layfield Road	1.6	<0.1%	2.4	<0.1%
R10. Woolmead Avenue	4.1	<0.1%	5.3	<0.1%
R11. Commercial/ Industrial	4.6	<0.1%	6.1	<0.1%
R12. Builders Warehouse	4.5	<0.1%	9.1	<0.1%
R13 Self Storage WH	4.9	<0.1%	6.3	<0.1%
R14 Retail	4.2	<0.1%	8.1	<0.1%
Maximum receptor (PC) (a)	4.9 (<0.1%)		9.1 (<0.1%)	
Assumed background	316		452	
Total concentration (PEC) (a)	321 (3.2%)		461 (1.5%)	
Air Quality Standard	10,000		30,000	
Significance	*Not significant*		*Not significant*	
(b) Values in parentheses are the percentages of the air quality standard				

Predicted ground level CO concentrations are well within the relevant air quality objective. At worst, the maximum off-site 8-hour mean is 0.2% of the AQO, which would be assessed as not significant. The maximum 1-hour mean is 0.1% of the AQO and would also be assessed as not significant.

4.3.7 Total Organic Carbon

Predicted annual mean concentrations of TOC (as benzene) arising as a result of emissions from the installation are presented in *Table 4.10*.

TABLE 4.10 MAXIMUM PREDICTED CONCENTRATIONS OF BENZENE FOR THE SIX-MONTHLY (TWO PER ANNUM) TESTING (μg m^{-3})

Receptor/Parameter	Annual Mean		Maximum 1-Hour Mean	
	PC (μg m^{-3})	%age AQO	PC (μg m^{-3})	%age AQO
Maximum off-site	0.0049	0.1%	5.7	2.9%
Maximum Receptor	0.0012	<0.1%	1.5	0.8%
Maximum Residential	0.0008	<0.1%	0.87	0.4%
R1. Ardley Close	0.0001	<0.1%	0.13	0.1%
R2. North Circular Road	0.0002	<0.1%	0.40	0.2%
R3. A5	0.0003	<0.1%	0.47	0.2%
R4. Edgeware Road	0.0001	<0.1%	0.18	0.1%
R5. Dallas Road	0.0005	<0.1%	0.44	0.2%
R6. Travel Lodge	0.0012	<0.1%	0.73	0.4%
R8. Brent Park Road	0.0006	<0.1%	0.37	0.2%
R9. Layfield Road	0.0006	<0.1%	0.39	0.2%
R10. Woolmead Avenue	0.0008	<0.1%	0.87	0.4%
R11. Commercial/ Industrial	0.0006	<0.1%	1.0	0.5%
R12. Builders Warehouse	0.0006	<0.1%	1.5	0.8%
R13 Self Storage WH	0.0003	<0.1%	1.0	0.5%
R14 Retail	0.0003	<0.1%	1.3	0.7%
Maximum receptor (PC) (a)	0.0012 (<0.1%)		1.5 (0.8%)	
Assumed background	0.74		1.5	
Total concentration (PEC) (a)	0.74 (14.8%)		3.0 (1.5%)	
Air Quality Standard	5		195	
Significance	*Not significant*		*Not significant*	
(b) Values in parentheses are the percentages of the air quality standard				

Maximum predicted ground level TOC (assuming all benzene as a worst case) concentrations are well within the annual mean AQO. The maximum off-site concentration is 0.1% of the long-term objective and would be not significant according to the Environment Agency guidance. Predicted maximum hourly mean concentrations are less than 10% of the short term AQS at sensitive receptors and would be assessed as not significant.

4.4 DETAILED DISPERSION MODELLING RESULTS – 72 HOUR EVENT

4.4.1 Introduction

Detailed dispersion modelling assuming that there is an event where all engines operate for 72 hours is provided. It is assumed that each generator is operating at 75% load.

4.4.2 Nitrogen Dioxide

Predicted annual and hourly mean ground level concentrations of NO_2 arising as a result of emissions from the installation are presented in *Table 4.11*. Maximum predicted concentrations are provided along with predicted concentrations for the discrete receptors.

TABLE 4.11 MAXIMUM PREDICTED NO_2 CONCENTRATIONS FOR A 72 HOUR EVENT

Receptor/Parameter	Annual Mean		99.8th Percentile of 1-hour Means	
	PC (µg m^{-3})	%age AQO	PC (µg m^{-3})	%age AQO
Maximum off-site	2.1	5.3%	1266.8	633.4%
Maximum Receptor	0.55	1.4%	370.4	185.2%
Maximum Residential	0.32	0.8%	312.9	156.4%
R1. Ardley Close	0.030	0.1%	46.6	23.3%
R2. North Circular Road	0.10	0.2%	142.5	71.3%
R3. A5	0.14	0.4%	167.6	83.8%
R4. Edgeware Road	0.024	0.1%	56.6	28.3%
R5. Dallas Road	0.24	0.6%	159.3	79.6%
R6. Travel Lodge	0.55	1.4%	307.0	153.5%
R8. Brent Park Road	0.29	0.7%	156.2	78.1%
R9. Layfield Road	0.29	0.7%	153.1	76.5%
R10. Woolmead Avenue	0.32	0.8%	312.9	156.4%
R11. Commercial/Industrial	0.25	0.6%	356.0	178.0%
R12. Builders Warehouse	0.21	0.5%	370.4	185.2%
R13 Self Storage WH	0.13	0.3%	333.4	166.7%
R14 Retail	0.093	0.2%	269.5	134.7%
Maximum receptor (PC) (a)	0.55 (1.4%)		370.4 (185.2%)	
Assumed background	27.6		55.2	
Total concentration (PEC) (a)	28.2 (70.5%)		425.6 (212.8%)	
Air Quality Standard	40		200	
Significance	*Potentially significant*		*Potentially significant*	
(b) Values in parentheses are the percentages of the air quality standard				

The maximum predicted annual mean concentration is 2.1 µg m^{-3} and is 5.3% of the AQO of 40 µg m^{-3}. At all sensitive receptors where there is relevant public exposure (e.g. residential properties), the PC is less than 1% of the AQO and the impact would be assessed as not significant.

Predicted hourly mean concentrations are relatively high as it is assumed that all 16 generators operate continuously such that the worst-case meteorological conditions can be assessed. The maximum (100th percentile) concentration is 1,591 µg m^{-3} as the PC (1,646 µg m^{-3} as the PEC) and is well above the limit value of 200 µg m^{-3}. Therefore, combined with the PEC there is the potential

for the AQO to be exceeded. An assessment of the risk of exceedance is provided in *Section 4.5.4*.

Predicted concentrations at sensitive receptors are substantially lower than the maximum off-site concentration (527 µg m^{-3} as the 100th percentile). However, there is the potential to exceed the limit of 200 µg m^{-3} at some receptor locations.

For the maximum predicted, the 200 µg m^{-3} short-term limit for NO_2 could be exceeded with two generators operating and at sensitive receptors with six generators operating.

4.4.3 PM_{10}

Predicted ground level concentrations of PM_{10} arising as a result of the installation emissions are presented in *Table 4.12*.

TABLE 4.12 MAXIMUM PREDICTED PM_{10} CONCENTRATIONS FOR A 72 HOUR EVENT

Receptor/Parameter	Annual Mean		90.4th Percentile of 24-hour Means	
	PC (µg m^{-3})	%age AQO	PC (µg m^{-3})	%age AQO
Maximum off-site	0.015	<0.1%	6.0	12.1%
Maximum Receptor	0.0040	<0.1%	1.4	2.8%
Maximum Residential	0.0023	<0.1%	0.92	1.8%
R1. Ardley Close	0.00022	<0.1%	0.077	0.2%
R2. North Circular Road	0.00073	<0.1%	0.30	0.6%
R3. A5	0.0010	<0.1%	0.41	0.8%
R4. Edgeware Road	0.00018	<0.1%	0.061	0.1%
R5. Dallas Road	0.0018	<0.1%	0.67	1.3%
R6. Travel Lodge	0.0040	<0.1%	1.4	2.8%
R8. Brent Park Road	0.0021	<0.1%	0.71	1.4%
R9. Layfield Road	0.0021	<0.1%	0.79	1.6%
R10. Woolmead Avenue	0.0023	<0.1%	0.92	1.8%
R11. Commercial/Industrial	0.0018	<0.1%	0.68	1.4%
R12. Builders Warehouse	0.0015	<0.1%	0.58	1.2%
R13 Self Storage WH	0.00093	<0.1%	0.27	0.5%
R14 Retail	0.00068	<0.1%	0.18	0.4%
Maximum receptor (PC) (a)	0.0040 (<0.1%)		1.4 (2.8%)	
Assumed background	18.5		21.8	
Total concentration (PEC) (a)	18.5 (46.2%)		23.2 (46.4%)	
Air Quality Standard	40		50	
Significance	*Not significant*		*Not significant*	
(a) Values in parentheses are the percentages of the air quality standard				

Predicted concentrations even as the maximum anywhere within the model domain are small compared to the relevant AQO and it is concluded that the impact would be not significant. The maximum 24-hour mean (100th percentile) concentration is predicted as 14.4 µg m^{-3} (28.7%). Therefore, given the worst-case assumptions adopted for short-term impacts (e.g. continuous operation), it is concluded that it is unlikely that the 24-hour mean AQO would be exceeded.

4.4.4 $PM_{2.5}$

Assuming as a worst-case, that all particles are within the $PM_{2.5}$ fraction, predicted annual mean $PM_{2.5}$ concentrations would be the same as predicted for PM_{10} in *Table 4.12*.

The maximum predicted off-site concentration (0.015 µg m^{-3}) is 0.1% of the AQO. Therefore, it is concluded that emissions of $PM_{2.5}$ from the installation would be not significant.

4.4.5 Sulphur Dioxide

Predicted ground level concentrations of SO_2 arising as a result of emissions from the installation are presented in *Table 4.13*. Maximum predicted concentrations are provided, and the significance of the impact is assessed according to the Environment Agency guidance.

Maximum predicted concentrations (100th percentiles) anywhere within the model domain are as follows:

- 1.5 µg m^{-3} (1.2%) of the 24-hour mean AQO for SO_2;
- 2.4 µg m^{-3} (0.7%) of the 1-hour mean AQO for SO_2; and
- 3.2 µg m^{-3} (1.2%) of the 15-minute mean AQO for SO_2.

The predicted short-term SO_2 concentrations are all 10% or less of the relevant AQO, therefore according to the Environment Agency guidance the impact of SO_2 emissions from the installation would be assessed as not significant.

TABLE 4.13 MAXIMUM PREDICTED SO_2 CONCENTRATIONS FOR A 72 HOUR EVENT

Receptor/Parameter	99.2nd Percentile of 24-hour Means		99.7th Percentile of 1-hour means		99.9th Percentile of 15-minute Means	
	PC ($\mu g\ m^{-3}$)	%age AQO	PC ($\mu g\ m^{-3}$)	%age AQO	PC ($\mu g\ m^{-3}$)	%age AQO
Maximum off-site	1.2	1.0%	1.8	0.5%	2.6	1.0%
Maximum Receptor	0.29	0.2%	0.53	0.2%	0.78	0.3%
Maximum Residential	0.19	0.2%	0.45	0.1%	0.63	0.2%
R1. Ardley Close	0.027	0.0%	0.065	0.0%	0.10	0.0%
R2. North Circular Road	0.10	0.1%	0.18	0.1%	0.29	0.1%
R3. A5	0.10	0.1%	0.24	0.1%	0.33	0.1%
R4. Edgeware Road	0.027	0.0%	0.076	0.0%	0.12	0.0%
R5. Dallas Road	0.12	0.1%	0.23	0.1%	0.32	0.1%
R6. Travel Lodge	0.29	0.2%	0.44	0.1%	0.61	0.2%
R8. Brent Park Road	0.13	0.1%	0.22	0.1%	0.31	0.1%
R9. Layfield Road	0.12	0.1%	0.22	0.1%	0.30	0.1%
R10. Woolmead Avenue	0.19	0.2%	0.45	0.1%	0.63	0.2%
R11. Commercial/ Industrial	0.20	0.2%	0.51	0.1%	0.74	0.3%
R12. Builders Warehouse	0.16	0.1%	0.53	0.2%	0.78	0.3%
R13 Self Storage WH	0.15	0.1%	0.46	0.1%	0.77	0.3%
R14 Retail	0.11	0.1%	0.38	0.1%	0.69	0.3%
Maximum receptor (PC) (a)	0.29 (0.2%)		0.53 (0.2%)		0.78 (0.3%)	
Assumed background	8.1		13.8		18.5	
Total concentration (PEC) (a)	8.4 (6.7%)		14.3 (4.1%)		19.3 (7.2%)	
Air Quality Standard	125		350		266	
Significance	*Not significant*		*Not significant*		*Not significant*	
(a) Values in parentheses are the percentages of the air quality standard						

4.4.6 Carbon Monoxide

Predicted ground level concentrations of CO arising as a result of emissions from the installation are presented in *Table 4.14*. Maximum predicted concentrations are provided, and the significance of the impact is assessed according to the Environment Agency guidance.

TABLE 4.14 MAXIMUM PREDICTED CO CONCENTRATIONS FOR A 72 HOUR EVENT

Receptor/Parameter	Maximum 8-Hour Mean		Maximum 1-Hour Mean	
	PC (µg m^{-3})	%age AQO	PC (µg m^{-3})	%age AQO
Maximum off-site	239.3	2.4%	313.5	1.0%
Maximum Receptor	70.7	0.7%	103.9	0.3%
Maximum Residential	54.5	0.5%	67.3	0.2%
R1. Ardley Close	7.1	0.1%	10.3	0.0%
R2. North Circular Road	25.0	0.3%	30.8	0.1%
R3. A5	27.9	0.3%	35.0	0.1%
R4. Edgeware Road	9.9	0.1%	15.2	0.1%
R5. Dallas Road	25.8	0.3%	32.6	0.1%
R6. Travel Lodge	53.9	0.5%	63.6	0.2%
R8. Brent Park Road	23.4	0.2%	32.2	0.1%
R9. Layfield Road	23.2	0.2%	31.9	0.1%
R10. Woolmead Avenue	54.5	0.5%	67.3	0.2%
R11. Commercial/ Industrial	59.9	0.6%	77.3	0.3%
R12. Builders Warehouse	55.0	0.6%	103.9	0.3%
R13 Self Storage WH	70.7	0.7%	89.7	0.3%
R14 Retail	42.6	0.4%	97.0	0.3%
Maximum receptor (PC) (a)	70.7 (0.7%)		103.9 (0.3%)	
Assumed background	316		452	
Total concentration (PEC) (a)	387 (3.9%)		556 (1.9%)	
Air Quality Standard	10,000		30,000	
Significance	*Not significant*		*Not significant*	
(a) Values in parentheses are the percentages of the air quality standard				

Predicted ground level CO concentrations are well within the relevant air quality objective. At worst, the maximum off-site 8-hour mean is 2.4% of the AQO, which would be assessed as not significant. The maximum 1-hour mean is 1.0% of the AQO and would also be assessed as not significant.

4.4.7 Total Organic Carbon

Predicted annual mean concentrations of TOC (as benzene) arising as a result of emissions from the installation are presented in *Table 4.15*.

TABLE 4.15 MAXIMUM PREDICTED CONCENTRATIONS OF BENZENE FOR A 72 HOUR EVENT

Receptor/Parameter	Annual Mean		Maximum 1-Hour Mean	
	PC (µg m^{-3})	%age AQO	PC (µg m^{-3})	%age AQO
Maximum off-site	0.036	0.7%	54.0	27.7%
Maximum Receptor	0.0093	0.2%	17.9	9.2%
Maximum Residential	0.0054	0.1%	11.6	5.9%
R1. Ardley Close	0.0005	<0.1%	1.8	0.9%
R2. North Circular Road	0.0017	<0.1%	5.3	2.7%
R3. A5	0.0024	<0.1%	6.0	3.1%
R4. Edgeware Road	0.0004	<0.1%	2.6	1.3%
R5. Dallas Road	0.0041	0.1%	5.6	2.9%
R6. Travel Lodge	0.0093	0.2%	11.0	5.6%
R8. Brent Park Road	0.0049	0.1%	5.5	2.8%
R9. Layfield Road	0.0049	0.1%	5.5	2.8%
R10. Woolmead Avenue	0.0054	0.1%	11.6	5.9%
R11. Commercial/ Industrial	0.0042	0.1%	13.3	6.8%
R12. Builders Warehouse	0.0035	0.1%	17.9	9.2%
R13 Self Storage WH	0.0022	<0.1%	15.4	7.9%
R14 Retail	0.0016	<0.1%	16.7	8.6%
Maximum receptor (PC) (a)	0.0093 (0.2%)		17.9 (9.2%)	
Assumed background	0.74		1.5	
Total concentration (PEC) (a)	0.75 (15.0%)		19.4 (9.9%)	
Air Quality Standard	5		195	
Significance	*Not significant*		*Not significant*	
(a) Values in parentheses are the percentages of the air quality standard				

Maximum predicted ground level TOC (assuming all benzene as a worst case) concentrations are well within the annual mean AQO. The maximum off-site concentration is 0.7% of the long-term objective and would be not significant according to the Environment Agency guidance. Predicted maximum hourly mean concentrations are less than 10% of the short term AQS at sensitive receptors and would be assessed as not significant.

4.5 EXCEEDANCE RISK FOR SHORT-TERM NO_2 CONCENTRATIONS

4.5.1 Introduction

The impact of the installation on long-term and short-term PM_{10}, $PM_{2.5}$, SO_2, CO and benzene can be screened out from further assessment.

For short-term NO_2, there is a risk of exceeding the hourly mean AQO for the two six-monthly tests as the maximum predicted anywhere within the model

domain and for a 72-hour event for the maximum predicted and at sensitive receptor locations.

4.5.2 Methodology for Assessing the Risk of Exceedance

The methodology for assessing the risk of exceedance of the air quality objectives uses a hypergeometric probability distribution (HPD) method. The HPD is a statistical analysis which determines the probability that the limit value would be exceeded for emissions from facilities where emissions occur for only a limited number of hours per year but where modelling continuous operation indicates that an exceedance of the air quality standard would occur. Generally, it is used for short-term operating reserve (STOR) power stations or data centre facilities and for emissions of NO_x. Details of the methodology are provided by the Environment Agency [10]

The analysis provides a probability that for the 8,760 hours modelled that 19 hours exceed the limit of 200 $\mu g\, m^{-3}$ (18 exceedances are allowed) and, consequently, an exceedance of the air quality objective where:

- probabilities of 1% or less indicates exceedances are highly unlikely;
- a probability of less than 5% indicates exceedances are unlikely;
- probabilities of 5% or greater indicate that there is potential for an exceedance and may not be acceptable.

The method requires the number of exceedances of the hourly limit of 200 $\mu g\, m^{-3}$ for the modelled year to be determined. Where an event or operation occurs for four hours or more, the probability is multiplied by a factor of 2.5 since over a continuous four-hour period the wind direction may be similar and thereby the risk of exceedance increases for a downwind receptor.

The number of exceedances at each receptor are determined taking into account the background concentration of 55.2 $\mu g\, m^{-3}$ (i.e. the number of PC's in excess of 144.8 $\mu g\, m^{-3}$, 200 – 55.2 $\mu g\, m^{-3}$).

4.5.3 Four Hour Tests (Six-monthly)

For the two four-hour tests carried out six-monthly, the predicted maximum number of exceedances occurs at the boundary of the site at 61 exceedances. Using the HPD methodology, this will provide a risk of exceedance 0.0% if total testing occurs for 128 hours per annum (16 generators, twice a year for four hours). Therefore, the probability of exceeding the short-term AQO for NO_2 would be highly unlikely. As the testing occurs over a period of four hours, the factor of 2.5 has been applied.

10 Specified generators: air dispersion modelling example short term statistical analysis (Environment Agency)

4.5.4 Event

For an interruption to the power supply event, a number of durations for the event have been considered (72 hours, 48 hours and 3 hours). If the event occurred for only 3 hours and 18 allowable exceedances may occur, then there would be no risk of exceeding the AQO. A summary of the probability of exceeding the AQO, taking into account background concentrations, for the three scenarios is provided in *Table 4.16*. As the 72-hour and 48-hour events may occur over a period of four hours or more, the factor of 2.5 is applied.

TABLE 4.16 PROBABILITY OF EXCEEDING THE SHORT-TERM AIR QUALITY OBJECTIVE FOR NO_2 DURING AN EVENT

Receptor/Parameter	Probability		
	72-hour Event	48-hour Event	3-hour Event
Maximum off-site	159.7%	12.2%	0.0%
R1. Ardley Close	0.0%	0.0%	0.0%
R2. North Circular Road	0.0%	0.0%	0.0%
R3. A5	0.0%	0.0%	0.0%
R4. Edgeware Road	0.0%	0.0%	0.0%
R5. Dallas Road	0.0%	0.0%	0.0%
R6. Travel Lodge	0.0%	0.0%	0.0%
R8. Brent Park Road	0.0%	0.0%	0.0%
R9. Layfield Road	0.0%	0.0%	0.0%
R10. Woolmead Avenue	0.0%	0.0%	0.0%
R11. Commercial/ Industrial	0.0%	0.0%	0.0%
R12. Builders Warehouse	0.0%	0.0%	0.0%
R13 Self Storage WH	0.0%	0.0%	0.0%
R14 Retail	0.0%	0.0%	0.0%

For all sensitive receptors, the probability of exceeding the AQO is 0.0% and it is highly unlikely that the AQO would be exceeded. For the 72-hour event, there is a high probability (159.7%) that the AQO would be exceeded. For the 48-hour event this is reduced to 12.2%. However, maximum predicted concentrations are very localised. Contour plots of the 1% (pink) and 5% (red) probabilities are provided in *Figure 4.1* for the 72-hour event and *Figure 4.2* for the 48-hour event.

For the 72-hour event, above 5% probability is confined to the site, a small area of the SSSI to the north and the adjacent warehouse. For the 48-hour event, probabilities above 5% are lost in the contour smoothing and probabilities above 1% are confined to the site and a small area of the warehousing. Therefore, it is concluded that the impact on local air quality of an event of 48 or 72 hours would be not significant.

FIGURE 4.1 PROBABILITY OF EXCEEDING THE SHORT-TERM NO_2 AQO – 72 HOUR EVENT

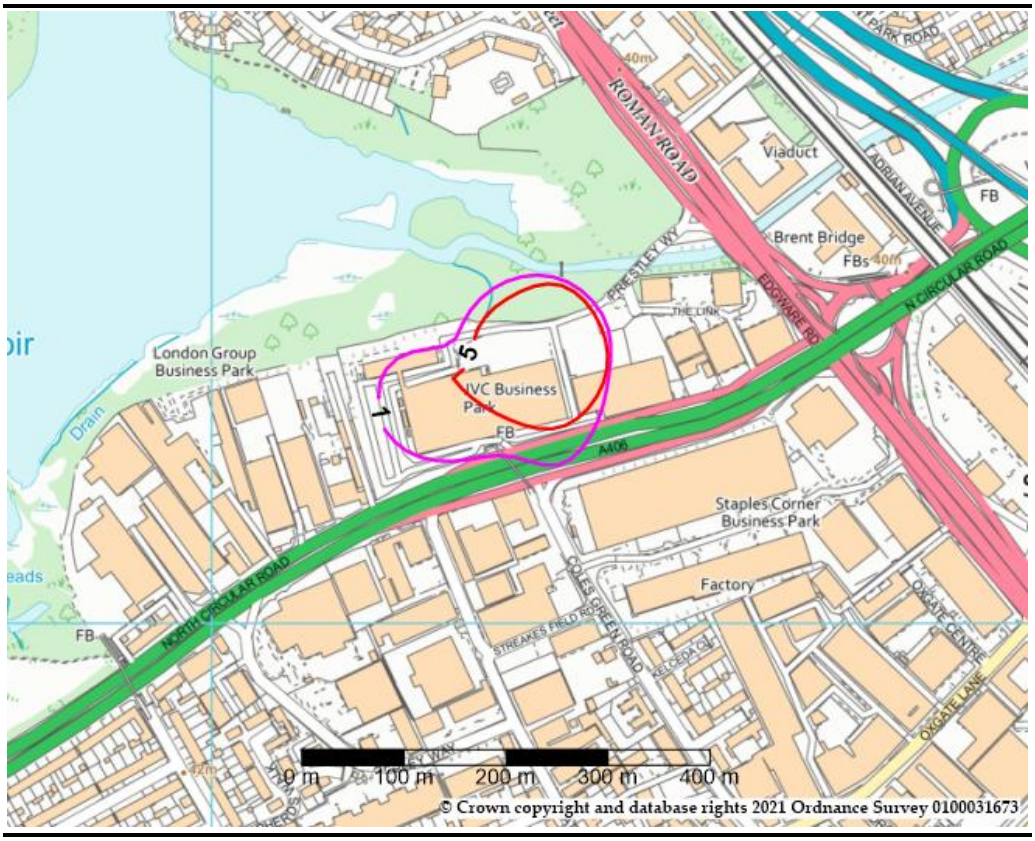
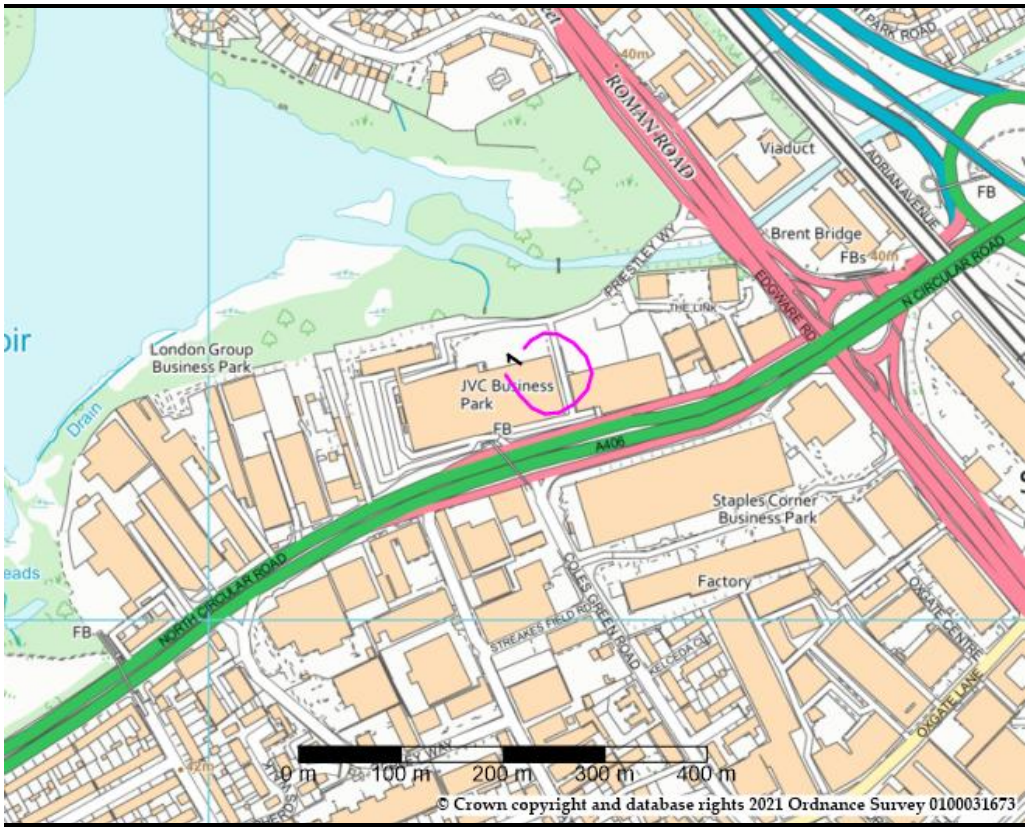


FIGURE 4.2 PROBABILITY OF EXCEEDING THE SHORT-TERM NO_2 AQO – 48 HOUR EVENT



4.6 CUMULATIVE IMPACTS

The two types of testing and an event would not occur at the same time. Therefore, the cumulative assessment has considered annual mean concentrations only. Predicted annual mean concentrations of NO_2, PM_{10}/$PM_{2.5}$ and benzene are presented in *Table 4.17*, *Table 4.18* and *Table 4.19*, respectively. This assumes that the event occurs for 72 hours per annum.

TABLE 4.17 CUMULATIVE ANNUAL MEAN NO_2 CONCENTRATIONS – TESTING PLUS 72 HOUR EVENT

Receptor/Parameter	Annual Mean	
	PC (µg m^{-3})	%age AQO
Maximum off-site	2.8	6.9%
Maximum Receptor	0.68	1.7%
Maximum Residential	0.41	1.0%
R1. Ardley Close	0.04	0.1%
R2. North Circular Road	0.13	0.3%
R3. A5	0.18	0.5%
R4. Edgeware Road	0.03	0.1%
R5. Dallas Road	0.30	0.8%
R6. Travel Lodge	0.68	1.7%
R8. Brent Park Road	0.35	0.9%
R9. Layfield Road	0.36	0.9%
R10. Woolmead Avenue	0.41	1.0%
R11. Commercial/Industrial	0.32	0.8%
R12. Builders Warehouse	0.29	0.7%
R13 Self Storage WH	0.17	0.4%
R14 Retail	0.13	0.3%
Maximum receptor (PC) (a)	0.68 (1.7%)	
Assumed background	27.6	
Total concentration (PEC) (a)	28.3 (70.7%)	
Air Quality Standard	40	
Significance	*Potentially significant*	
(a) Values in parentheses are the percentages of the air quality standard		

Even for this worst-case assumption of a 72-hour event, the PEC at sensitive receptors is just above 70%. However, at residential receptors where there would be relevant public exposure, the PC is 1.0% of the AQO and the PEC is 70.0%.

TABLE 4.18 CUMULATIVE ANNUAL MEAN PM_{10} AND $PM_{2.5}$ CONCENTRATIONS – TESTING PLUS 72 HOUR EVENT

Receptor/Parameter	Annual Mean		
	PC (µg m^{-3})	PM_{10} %age AQO	$PM_{2.5}$ %age AQO
Maximum off-site	0.019	<0.1%	0.1%
Maximum Receptor	0.0047	<0.1%	<0.1%
Maximum Residential	0.0028	<0.1%	<0.1%
R1. Ardley Close	0.0003	<0.1%	<0.1%
R2. North Circular Road	0.0009	<0.1%	<0.1%
R3. A5	0.0012	<0.1%	<0.1%
R4. Edgeware Road	0.0002	<0.1%	<0.1%
R5. Dallas Road	0.0021	<0.1%	<0.1%
R6. Travel Lodge	0.0046	<0.1%	<0.1%
R8. Brent Park Road	0.0024	<0.1%	<0.1%
R9. Layfield Road	0.0024	<0.1%	<0.1%
R10. Woolmead Avenue	0.0028	<0.1%	<0.1%
R11. Commercial/Industrial	0.0022	<0.1%	<0.1%
R12. Builders Warehouse	0.0019	<0.1%	<0.1%
R13 Self Storage WH	0.0012	<0.1%	<0.1%
R14 Retail	0.0009	<0.1%	<0.1%
Maximum receptor (PC) (a)		0.0047 (<0.1%)	0.0047 (0.1%)
Assumed background		18.5	12.2
Total concentration (PEC) (a)		18.5 (46.2%)	12.2 (48.8%)
Air Quality Standard		40	25
Significance		*Not significant*	*Not significant*
(a) Values in parentheses are the percentages of the air quality standard			

Predicted concentrations of PM_{10} and $PM_{2.5}$ are well below 1% of the respective AQO at all receptor locations. Therefore, cumulative impacts are assessed as not significant.

TABLE 4.17 CUMULATIVE ANNUAL MEAN BENZENE CONCENTRATIONS – TESTING PLUS 72 HOUR EVENT

Receptor/Parameter	Annual Mean	
	PC (μg m^{-3})	%age AQO
Maximum off-site	0.021	0.4%
Maximum Receptor	0.0027	0.1%
Maximum Residential	0.0023	0.0%
R1. Ardley Close	0.0001	0.0%
R2. North Circular Road	0.0006	0.0%
R3. A5	0.0007	0.0%
R4. Edgeware Road	0.0002	0.0%
R5. Dallas Road	0.0010	0.0%
R6. Travel Lodge	0.0026	0.1%
R8. Brent Park Road	0.0009	0.0%
R9. Layfield Road	0.0010	0.0%
R10. Woolmead Avenue	0.0023	0.0%
R11. Commercial/Industrial	0.0023	0.0%
R12. Builders Warehouse	0.0027	0.1%
R13 Self Storage WH	0.0018	0.0%
R14 Retail	0.0018	0.0%
Maximum receptor (PC) (a)	0.0027 (0.1%)	
Assumed background	0.74	
Total concentration (PEC) (a)	0.74 (14.8%)	
Air Quality Standard	5	
Significance	*Not significant*	
(a) Values in parentheses are the percentages of the air quality standard		

Predicted concentrations of benzene are well below 1% of the respective AQO at all receptor locations. Therefore, cumulative impacts are assessed as not significant.

5 PREDICTED OPERATIONAL IMPACT ON HABITAT SITES

5.1 CRITICAL LEVELS AND CRITICAL LOADS

5.1.1 Introduction

There are many impacts on ecosystems associated with elevated levels of atmospheric nitrogen and its deposition to sensitive habitats. The most important of these are [11]:

- short-term direct effects of nitrogen gases and aerosols on individual species;
- soil mediated effects;
- increased susceptibility to secondary stress factors, such as drought or frost; and
- changes in (competitive) relationships between species, resulting in loss of biodiversity.

In order to provide benchmark levels, below which significant harmful effects to the environment do not occur, critical levels and critical loads have been developed referring to gaseous airborne concentrations of pollutants and deposition of pollution to land and water, respectively.

5.1.2 Critical Levels

Critical levels are thresholds of airborne pollutant concentrations above which damage may be sustained to sensitive plants and animals. High concentrations of pollutants in ambient air directly cause harm to leaves and needles of forests and other plant communities.

The 2008 Air Quality Directive set limit values for the protection of vegetation and ecosystems and these have been adopted by the Air Quality Strategy, but are not currently set in Regulations. The current critical levels, limit values and objectives are summarised in *Table 5.1*.

11 Air Quality Guidelines for Europe, Second Edition, WHO Regional publications European Series No. 91, Chapter 11: Effects of nitrogen-containing air pollutants: critical levels, Chapter 14 : Effects of airborne nitrogen pollutants on vegetation: critical loads (2000)

TABLE 5.1 CRITICAL LEVELS, LIMIT VALUES AND OBJECTIVES FOR THE PROTECTION OF VEGETATION AND ECOSYSTEMS

	Description	Averaging Period	Concentration («g m^3)
Nitrogen Oxides			
EU Directive on Ambient Air Quality / 2010 Air Quality Standards Regulations	Critical Level / Limit Value	Annual mean	30
Environment Agency Risk Assessment Guidance	Critical Level	Daily mean	75
Sulphur Dioxide			
Environment Agency Risk Assessment Guidance	Critical Level for ecosystems dominated by lichens and bryophytes	Annual mean	10
	Critical Level for all other ecosystems	Annual mean	20

5.1.3 Critical Loads

Introduction

Critical loads refer to the threshold beyond which deposition of pollutants to water or land results in measurable damage to vegetation and habitats. This takes the form of either gravitational settling of particulate matter (dry deposition) or wet deposition, where atmospheric pollutants dissolve in water vapour and then precipitate to the ground (e.g. as rain, snow, fog etc.).

The issue for ecosystems is the risk that the deposition rate of acid (acidification) or nutrient nitrogen (eutrophication) may be in excess of the amount that the ecosystem can tolerate. The point at which this occurs is the 'critical load'.

Eutrophication

Critical loads for nutrient nitrogen are determined largely on the basis of the species or habitat type affected. Critical loads have been determined for a number of habitat types at the European level and reflect the way different plants have adapted to differing availabilities of nutrient. Those in nutrient deficient environments, e.g. coastal sand dunes, will be less tolerant of excess nitrogen from aerial deposition.

Critical loads for eutrophication at sensitive habitat receptors can be obtained from the Air Pollution Information System (APIS) [12]. Critical loads are only available for SSSI and European sites. No information is provided for the

12 www.apis.co.uk

Brent Reservoir SSSI but APIS states that the sensitive habitats comprise lowland open water and their margins. APIS further states that there are no critical loads for the assigned feature and specific advice should be sought. However, it should be noted that the SSSI is designated for breeding birds rather than for specific habitats.

As no critical loads are provided for the SSSI or the numerous LWS, for the purposes of the assessment it is assumed that the sensitive habitat comprises neutral grassland. This habitat has a critical load for nutrient nitrogen deposition of 20 – 30 kg N $ha^{-1}a^{-1}$.

Acidification

For acidic deposition, the critical load of a habitat site is determined mostly by the underlying geology and soils. Alkaline soils have an innate capacity for neutralising acidic deposition, whereas acidic soils do not. The level of acidification depends on the donation of hydrogen ions to the soil arising primarily from deposition of:

- sulphur dioxide, which reacts with water to produce sulphuric acid;
- nitrogen oxides and ammonia, which react with water to produce nitric acid; and
- acid gases such as hydrogen chloride.

The critical load of acidification is defined by a critical load function which describes the relationship between the relative contributions of sulphur (S) and nitrogen (N) to the total acidification. The critical load function is defined by the following parameters:

- CLmaxS, the maximum critical load of acidity for S, assuming there is no N deposition;
- CLminN, is the critical load of acidity due to nitrogen removal processes in the soil only (i.e. independent of deposition); and
- CLmaxN, is the maximum critical load of acidity for N, assuming there is no S deposition.

As there is no information available for the SSSI or the various LWS it is assumed that the sensitive habitats comprise neutral (calcareous) grassland. The critical load for this habitat is as follows:

- CLmaxS of 4.0 keq $ha^{-1}a^{-1}$;
- CLminN of 1.071 keq $ha^{-1}a^{-1}$; and
- CLmaxN of 5.071 keq $ha^{-1}a^{-1}$.

5.2 BACKGROUND DEPOSITION FLUXES AND AIRBORNE CONCENTRATIONS

Information on background nutrient nitrogen deposition, acidification and airborne concentrations of NO_x and SO_2 have been obtained from information provided by the Centre for Ecology and Hydrology (CEH) and available from the Air Pollution Information System (APIS) website and the Defra background maps.

APIS is able to provide an indication of background nutrient nitrogen deposition and acidification by geographical location and habitat type. The estimates are made from 5 km resolution mapped data, which are derived from a combination of modelling studies and measured deposition and acidification rates [13]. There is an inherent level of uncertainty resulting from this process, particularly in areas with significant emissions sources. However, in the absence of local measurements, the APIS data provides a useful benchmark for comparison with deposition and acidification rates predicted by the dispersion model. More detailed mapping is available for NOx and SO_2 based on a 1 km grid resolution. A summary of the background fluxes provided by APIS for habitat sites selected for the assessment is presented in *Table 5.2*.

TABLE 5.2 BACKGROUND DEPOSITION FLUXES AND AIRBORNE CONCENTRATIONS

Ref.	Name	NOx ($\mu g\ m^{-3}$)	SO_2 ($\mu g\ m^{-3}$)	Nutrient Nitrogen ($kg\ N\ ha^{-1}a^{-1}$)	Acidification (N:S) ($keq\ ha^{-1}a^{-1}$)
H1	Brent Reservoir SSSI/LNR	35.0	1.4	11.6	0.83:0.18
H2	Local Wildlife Site	48.1	1.4	11.6	0.83:0.18
H3	Local Wildlife Site	51.4	1.6	11.6	0.83:0.18
H4	Local Wildlife Site	41.8	1.6	11.6	0.83:0.18
H5	Local Wildlife Site	41.8	1.6	11.6	0.83:0.18
H6	Local Wildlife Site	41.0	1.6	11.6	0.83:0.18
H7	Local Wildlife Site	51.4	1.6	11.6	0.83:0.18
H8	Local Wildlife Site	41.5	1.8	11.6	0.83:0.18
H9	Local Wildlife Site	53.3	1.6	11.6	0.83:0.18
H10	Local Wildlife Site	53.3	1.6	11.6	0.83:0.18
H11	Local Wildlife Site	46.4	1.6	11.6	0.83:0.18
H12	Local Wildlife Site	46.4	1.6	11.6	0.83:0.18
H13	Local Wildlife Site	36.9	1.6	11.6	0.83:0.18
H14	Local Wildlife Site	46.2	1.6	11.6	0.83:0.18
H15	Local Wildlife Site	46.2	1.6	11.6	0.83:0.18

13 Transboundary Air Pollution: Acidification, Eutrophication, and Ground Level Ozone in the UK, NEGTAP, EPG 1/3/153, 2001

5.3 CALCULATION OF ACID AND NUTRIENT NITROGEN DEPOSITION

The deposition of acid and nutrient nitrogen is not directly modelled but is derived from the concentration predicted at each sensitive ecological receptor for each pollutant of interest. The derivation is based upon Environment Agency guidance (AQTAG06) [14] and uses the conversion factors set out in *Table 5.3*. The factors take into account the difference in deposition velocity and mechanisms experienced in woodlands, and grasslands and other non-arboreal areas. For HCl, half of the acidification is assigned as nitrogen and half as sulphur.

TABLE 5.3 FACTORS FOR CONVERSION OF ANNUAL MEAN CONCENTRATIONS TO NUTRIENT NITROGEN AND ACID DEPOSITION

Pollutant	Deposition Velocity – Grasslands ($m\ s^{-1}$)	Deposition Velocity – Woodlands ($m\ s^{-1}$)	Conversion Factor ($\mu g\ m^{-2}\ s^{-1}$ to kg N $ha^{-1}\ year^{-1}$)	Conversion Factor ($\mu g\ m^{-2}\ s^{-1}$ to keq $ha^{-1}\ year^{-1}$)
SO_2	0.012	0.024	-	9.84
NO_x as NO_2	0.0015	0.003	96	6.84

5.4 PREDICTED IMPACT OF EMISSIONS ON HABITAT SITES – MONTHLY TESTING

5.4.1 Airborne Concentrations of NO_x and SO_2

Introduction

Predicted concentrations are compared to the relevant critical levels. For the Brent SSSI, the predicted concentration is the maximum predicted anywhere within the habitat site.

As testing will only be carried out during the day, variable emission rates have been used with generators on between 08:00 and 20:00 and off during the rest of the time.

NO_x

There are two critical levels for NO_x based on the annual mean and 24-hour mean concentrations. Predicted concentrations for the SSSI and LWS are presented in *Table 5.4*.

14 AQTAG06 – Technical Guidance on Detailed Modelling Approach for an Appropriate Assessment for Emissions to Air, Environment Agency, Updated Version (March 2014)

TABLE 5.4 MAXIMUM PREDICTED AIRBORNE NO_X CONCENTRATIONS AT HABITAT SITES FOR MONTHLY TESTING

Habitat	Annual Mean PC NO_x ($\mu g\ m^{-3}$)	Annual Mean NOx as %age of Critical Level	24-Hour Mean PC NO_x ($\mu g\ m^{-3}$)	24-Hour Mean NOx as %age of Critical Level
H1. Brent Reservoir SSSI/LNR	0.094	0.3%	26.1	34.8%
H2. Local Wildlife Site	0.001	<0.1%	0.8	1.1%
H3. Local Wildlife Site	0.001	<0.1%	0.8	1.1%
H4. Local Wildlife Site	0.001	<0.1%	1.9	2.6%
H5. Local Wildlife Site	0.001	<0.1%	0.9	1.2%
H6. Local Wildlife Site	0.001	<0.1%	1.4	1.9%
H7. Local Wildlife Site	0.000	<0.1%	0.7	1.0%
H8. Local Wildlife Site	0.000	<0.1%	0.5	0.7%
H9. Local Wildlife Site	0.002	<0.1%	1.3	1.7%
H10. Local Wildlife Site	0.002	<0.1%	1.0	1.3%
H11. Local Wildlife Site	0.001	<0.1%	1.1	1.5%
H12. Local Wildlife Site	0.001	<0.1%	0.5	0.7%
H13. Local Wildlife Site	0.001	<0.1%	0.6	0.7%
H14. Local Wildlife Site	0.000	<0.1%	0.3	0.4%
H15. Local Wildlife Site	0.000	<0.1%	0.3	0.4%
Critical Level	*30*		*75*	

For NO_x, predicted annual mean concentrations at all habitat receptors are less than 1% of the critical level of 30 $\mu g\ m^{-3}$ and would be assessed as not significant.

The 24-hour mean concentrations are also less than 10% of the short-term critical level of 75 $\mu g\ m^{-3}$ for all of the LWS and would be assessed as not significant.

For the Brent Reservoir SSSI, the maximum contribution from the installation is 34.8% of the critical level. Annual mean NOx concentrations are estimated as 35 $\mu g\ m^{-3}$ and the derived 24-hour mean concentrations would be 41.3 $\mu g\ m^{-3}$ (refer *Table 2.10*). Combined with background concentrations, the PEC would be 67.4 $\mu g\ m^{-3}$ and there is no predicted exceedance of the 24-hour mean critical level. It should also be noted that these represent worst-case

conditions with testing assumed to be carried out every day of the year to take account of worst-case meteorological conditions.

SO_2

There are two critical levels for SO_2 depending on the presence or not of lichens and bryophytes. Predicted annual mean SO_2 concentrations as a result of monthly testing at all habitats is less than 0.001 µg m^{-3} and less than 0.01% of the most stringent critical level of 10 µg m^{-3}. Therefore, the impact of SO_2 emissions on local habitats from the monthly testing would be not significant.

5.4.2 Acidification

Deposition of sulphur and nitrogen compounds cause acidification, and both have been taken into account in assessing the acidification impacts of the installation on the habitat sites. The critical load for acidification is defined by three quantities CLmaxS, CLmaxN and CLminN. The critical load function tool provided by APIS has been used to assess the likelihood of exceedance of the critical load based on the nitrogen and sulphur PCs and PECs. A summary of the predicted PC deposition fluxes is provided in *Table 5.5*.

TABLE 5.5 MAXIMUM PREDICTED SULPHUR AND NITROGEN PCS FOR MONTHLY TESTING

Habitat	PC N (keq $ha^{-1}a^{-1}$)	PC S (keq $ha^{-1}a^{-1}$)	PC as %age of Critical Load
H1. Brent Reservoir SSSI/LNR	0.0010	<0.0001	<0.1%
H2. LWS	<0.0001	<0.0001	<0.1%
H3. LWS	<0.0001	<0.0001	<0.1%
H4. LWS	<0.0001	<0.0001	<0.1%
H5. LWS	<0.0001	<0.0001	<0.1%
H6. LWS	<0.0001	<0.0001	<0.1%
H7. LWS	<0.0001	<0.0001	<0.1%
H8. LWS	<0.0001	<0.0001	<0.1%
H9. LWS	<0.0001	<0.0001	<0.1%
H10. LWS	<0.0001	<0.0001	<0.1%
H11. LWS	<0.0001	<0.0001	<0.1%
H12. LWS	<0.0001	<0.0001	<0.1%
H13. LWS	<0.0001	<0.0001	<0.1%
H14. LWS	<0.0001	<0.0001	<0.1%
H15. LWS	<0.0001	<0.0001	<0.1%

For the monthly testing, the predicted contribution of the installation to acidification is less than 1% of the critical load at all habitats and the impact would be assessed as not significant.

5.4.3 Nutrient Nitrogen Deposition

Predicted nutrient nitrogen deposition for the habitat sites is presented in *Table 5.6*. The PC and PEC as a percentage of the lower critical load (20 kg N $ha^{-1}a^{-1}$) is also provided.

TABLE 5.6 MAXIMUM PREDICTED NUTRIENT NITROGEN DEPOSITION AT HABITAT SITES FOR MONTHLY TESTING

Habitat	PC (kg N $ha^{-1}a^{-1}$)	PC as %age of CL	PEC as a %age of CL
H1. Brent Reservoir SSSI/LNR	0.014	0.1%	58.1%
H2. LWS	0.0001	<0.1%	58.0%
H3. LWS	0.0001	<0.1%	58.0%
H4. LWS	0.0002	<0.1%	58.0%
H5. LWS	0.0001	<0.1%	58.0%
H6. LWS	0.0002	<0.1%	58.0%
H7. LWS	0.0001	<0.1%	58.0%
H8. LWS	0.0001	<0.1%	58.0%
H9. LWS	0.0002	<0.1%	58.0%
H10. LWS	0.0003	<0.1%	58.0%
H11. LWS	0.0002	<0.1%	58.0%
H12. LWS	0.0002	<0.1%	58.0%
H13. LWS	0.0001	<0.1%	58.0%
H14. LWS	0.0000	<0.1%	58.0%
H15. LWS	0.0000	<0.1%	58.0%

For the monthly testing, the predicted contribution of the installation to nutrient nitrogen deposition is less than 1% of the critical load at all habitats and the impact would be assessed as not significant.

5.5 PREDICTED IMPACT OF EMISSIONS ON HABITAT SITES – SIX-MONTH TESTING

5.5.1 Airborne Concentrations of NO_x and SO_2

NO_x

Predicted NO_x concentrations for the SSSI and LWS are presented in *Table 5.7* for the four-hour six-monthly testing regime. This assumes that two generators are tested each day.

TABLE 5.7 MAXIMUM PREDICTED AIRBORNE NO_x CONCENTRATIONS AT HABITAT SITES FOR SIX MONTH TESTING

Habitat	Annual Mean PC NO_x ($\mu g\ m^{-3}$)	Annual Mean NOx as %age of Critical Level	24-Hour Mean PC NO_x ($\mu g\ m^{-3}$)	24-Hour Mean NOx as %age of Critical Level
H1. Brent Reservoir SSSI/LNR	0.30	1.0%	55.1	73.5%
H2. Local Wildlife Site	0.005	<0.1%	1.4	1.8%
H3. Local Wildlife Site	0.004	<0.1%	1.5	2.0%
H4. Local Wildlife Site	0.006	<0.1%	2.9	3.8%
H5. Local Wildlife Site	0.003	<0.1%	1.6	2.1%
H6. Local Wildlife Site	0.006	<0.1%	1.8	2.4%
H7. Local Wildlife Site	0.003	<0.1%	1.2	1.6%
H8. Local Wildlife Site	0.002	<0.1%	1.0	1.3%
H9. Local Wildlife Site	0.012	<0.1%	2.4	3.2%
H10. Local Wildlife Site	0.018	0.1%	3.2	4.3%
H11. Local Wildlife Site	0.010	<0.1%	1.6	2.1%
H12. Local Wildlife Site	0.010	<0.1%	1.9	2.6%
H13. Local Wildlife Site	0.006	<0.1%	1.7	2.3%
H14. Local Wildlife Site	0.002	<0.1%	0.7	1.0%
H15. Local Wildlife Site	0.002	<0.1%	0.8	1.1%
Critical Level	*30*		*75*	

For NO_x, predicted annual mean concentrations at all habitat receptors are less than or equal to 1% of the critical level of 30 $\mu g\ m^{-3}$ and would be assessed as not significant.

The 24-hour mean concentrations are also less than 10% of the short-term critical level of 75 $\mu g\ m^{-3}$ for all of the LWS and would be assessed as not significant.

For the Brent Reservoir SSSI, the maximum contribution from the installation is 73.5% of the critical level. Combined with background concentrations, the PEC would be 96.4 $\mu g\ m^{-3}$ (129% of the critical level) and there is the potential for the 24-hour mean critical level to be exceeded. It should be noted that these represent worst-case conditions with testing carried out every day of the year to take account of worst-case meteorological conditions.

A statistical analysis of the probability of exceedances of the 24-hour mean critical level is provided in *Section 5.7.1*.

SO_2

Predicted annual mean SO_2 concentrations as a result of six-monthly testing at all habitats is less than 0.001 µg m^{-3} and less than 0.01% of the most stringent critical level of 10 µg m^{-3}. Therefore, the impact of SO_2 emissions on local habitats from the six-monthly testing would be not significant.

5.5.2 Acidification

A summary of the predicted PC deposition fluxes for the six-monthly testing is provided in *Table 5.8*.

TABLE 5.8 MAXIMUM PREDICTED SULPHUR AND NITROGEN PCS – SIX MONTHLY TESTING

Habitat	PC N (keq $ha^{-1}a^{-1}$)	PC S (keq $ha^{-1}a^{-1}$)	PC as %age of Critical Load
H1. Brent Reservoir SSSI/LNR	0.0031	<0.0001	0.1%
H2. LWS	0.0001	<0.0001	<0.1%
H3. LWS	<0.0001	<0.0001	<0.1%
H4. LWS	0.0001	<0.0001	<0.1%
H5. LWS	<0.0001	<0.0001	<0.1%
H6. LWS	0.0001	<0.0001	<0.1%
H7. LWS	<0.0001	<0.0001	<0.1%
H8. LWS	<0.0001	<0.0001	<0.1%
H9. LWS	0.0001	<0.0001	<0.1%
H10. LWS	0.0002	<0.0001	<0.1%
H11. LWS	0.0001	<0.0001	<0.1%
H12. LWS	0.0001	<0.0001	<0.1%
H13. LWS	0.0001	<0.0001	<0.1%
H14. LWS	<0.0001	<0.0001	<0.1%
H15. LWS	<0.0001	<0.0001	<0.1%

For the six-monthly testing, the predicted contribution of the installation to acidification is less than 1% of the critical load at all habitats and the impact would be assessed as not significant.

5.5.3 Nutrient Nitrogen Deposition

Predicted nutrient nitrogen deposition for the habitat sites is presented in *Table 5.9*. The PC and PEC as a percentage of the lower critical load (20 kg N $ha^{-1}a^{-1}$) is also provided.

TABLE 5.9 MAXIMUM PREDICTED NUTRIENT NITROGEN DEPOSITION AT HABITAT SITES FOR SIX-MONTHLY TESTING

Habitat	PC (kg N $ha^{-1}a^{-1}$)	PC as %age of CL	PEC as a %age of CL
H1. Brent Reservoir SSSI/LNR	0.043	0.2%	58.2%
H2. LWS	0.0008	<0.1%	58.0%
H3. LWS	0.0005	<0.1%	58.0%
H4. LWS	0.0008	<0.1%	58.0%
H5. LWS	0.0005	<0.1%	58.0%
H6. LWS	0.0008	<0.1%	58.0%
H7. LWS	0.0004	<0.1%	58.0%
H8. LWS	0.0002	<0.1%	58.0%
H9. LWS	0.0017	<0.1%	58.0%
H10. LWS	0.0025	<0.1%	58.0%
H11. LWS	0.0015	<0.1%	58.0%
H12. LWS	0.0014	<0.1%	58.0%
H13. LWS	0.0008	<0.1%	58.0%
H14. LWS	0.0002	<0.1%	58.0%
H15. LWS	0.0002	<0.1%	58.0%

For the six-monthly testing, the predicted contribution of the installation to nutrient nitrogen deposition is less than 1% of the critical load at all habitats and the impact would be assessed as not significant.

5.6 PREDICTED IMPACT OF EMISSIONS ON HABITAT SITES – OUTAGE EVENT

5.6.1 Airborne Concentrations of NO_x and SO_2

NO_x

Predicted concentrations for the SSSI and LWS are presented in *Table 5.10*. This provides a screening assessment for a 72-hour outage where it is assumed that all generators operate for a period of 72 hours. However, for 24-hour mean predictions it is assumed that the generators run continuously 8,760 hours per year to account for the worst-case meteorological conditions.

TABLE 5.10 MAXIMUM PREDICTED AIRBORNE NO_X CONCENTRATIONS AT HABITAT SITES FOR A 72 HOUR EVENT

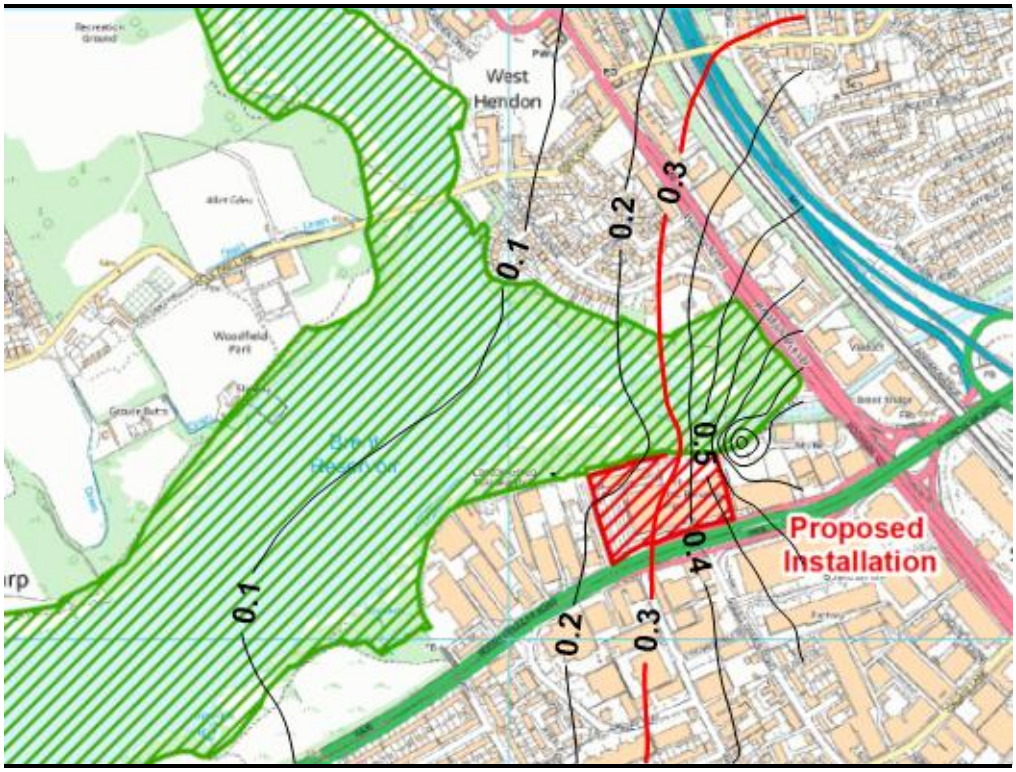
Habitat	Annual Mean PC NO_x ($\mu g\ m^{-3}$)	Annual Mean NOx as %age of Critical Level	24-Hour Mean PC NO_x ($\mu g\ m^{-3}$)	24-Hour Mean NOx as %age of Critical Level
H1. Brent Reservoir SSSI/LNR	1.1	3.6%	1038.5	1384.7%
H2. Local Wildlife Site	0.040	0.1%	64.4	85.9%
H3. Local Wildlife Site	0.035	0.1%	53.3	71.1%
H4. Local Wildlife Site	0.033	0.1%	102.5	136.7%
H5. Local Wildlife Site	0.020	0.1%	53.9	71.9%
H6. Local Wildlife Site	0.027	0.1%	54.3	72.4%
H7. Local Wildlife Site	0.023	0.1%	38.3	51.0%
H8. Local Wildlife Site	0.009	0.0%	22.4	29.9%
H9. Local Wildlife Site	0.077	0.3%	67.7	90.3%
H10. Local Wildlife Site	0.114	0.4%	82.7	110.3%
H11. Local Wildlife Site	0.070	0.2%	42.6	56.8%
H12. Local Wildlife Site	0.080	0.3%	56.5	75.3%
H13. Local Wildlife Site	0.045	0.1%	60.6	80.8%
H14. Local Wildlife Site	0.015	0.0%	44.7	59.5%
H15. Local Wildlife Site	0.017	0.1%	31.0	41.4%
Critical Level	*30*		*75*	

For NO_x, predicted annual mean concentrations at all LWS are less than 1% of the critical level of 30 $\mu g\ m^{-3}$ and would be assessed as not significant. At the Brent Reservoir, annual mean concentrations are 1.1 $\mu g\ m^{-3}$ as the maximum predicted anywhere within the habitat. However, as indicated in the contour in *Figure 5.1*, predicted concentrations are very localised.

The 24-hour mean critical level is exceeded at the Brent Reservoir and a number of the LWS. These represent worst-case conditions with all generators assumed to run continuously 8,760 hours per year to take account of worst-case meteorological conditions.

A statistical analysis of the probability of exceedances of the 24-hour mean critical level at all habitats is provided in *Section 5.7.2*.

FIGURE 5.1 ANNUAL MEAN NO_X CONCENTRATIONS FOR A 72 HOUR EVENT



SO_2

Predicted annual mean SO_2 concentrations as a result of a 72-hour event at all habitats is less than 0.001 µg m^{-3} and less than 0.01% of the most stringent critical level of 10 µg m^{-3}. Therefore, the impact of SO_2 emissions on local habitats from an unplanned outage would be not significant.

5.6.2 Acidification

A summary of the predicted PC deposition fluxes for the 72-hour event is provided in *Table 5.11*.

TABLE 5.11 MAXIMUM PREDICTED SULPHUR AND NITROGEN PCS – 72-HOUR EVENT

Habitat	PC N (keq $ha^{-1}a^{-1}$)	PC S (keq $ha^{-1}a^{-1}$)	PC as %age of Critical Load
H1. Brent Reservoir SSSI/LNR	0.0112	0.0001	0.2%
H2. LWS	0.0004	<0.0001	<0.1%
H3. LWS	0.0004	<0.0001	<0.1%
H4. LWS	0.0003	<0.0001	<0.1%
H5. LWS	0.0002	<0.0001	<0.1%
H6. LWS	0.0003	<0.0001	<0.1%
H7. LWS	0.0002	<0.0001	<0.1%
H8. LWS	0.0001	<0.0001	<0.1%
H9. LWS	0.0008	<0.0001	<0.1%
H10. LWS	0.0012	<0.0001	<0.1%
H11. LWS	0.0007	<0.0001	<0.1%
H12. LWS	0.0008	<0.0001	<0.1%
H13. LWS	0.0005	<0.0001	<0.1%
H14. LWS	0.0002	<0.0001	<0.1%
H15. LWS	0.0002	<0.0001	<0.1%

For an unplanned outage of 72 hours, the predicted contribution of the installation to acidification is less than 1% of the critical load at all habitats and the impact would be assessed as not significant.

5.6.3 Nutrient Nitrogen Deposition

Predicted nutrient nitrogen deposition for the habitat sites is presented in *Table 5.12*. The PC and PEC as a percentage of the lower critical load (20 kg N $ha^{-1}a^{-1}$) is also provided.

TABLE 5.12 MAXIMUM PREDICTED NUTRIENT NITROGEN DEPOSITION AT HABITAT SITES FOR A 72-HOUR EVENT

Habitat	PC (kg N $ha^{-1}a^{-1}$)	PC as %age of CL	PEC as a %age of CL
H1. Brent Reservoir SSSI/LNR	0.16	0.8%	58.8%
H2. LWS	0.0057	<0.1%	58.0%
H3. LWS	0.0051	<0.1%	58.0%
H4. LWS	0.0047	<0.1%	58.0%
H5. LWS	0.0029	<0.1%	58.0%
H6. LWS	0.0039	<0.1%	58.0%
H7. LWS	0.0033	<0.1%	58.0%

TABLE 5.12 MAXIMUM PREDICTED NUTRIENT NITROGEN DEPOSITION AT HABITAT SITES FOR A 72-HOUR EVENT

Habitat	PC (kg N $ha^{-1}a^{-1}$)	PC as %age of CL	PEC as a %age of CL
H8. LWS	0.0013	<0.1%	58.0%
H9. LWS	0.011	0.1%	58.1%
H10. LWS	0.016	0.1%	58.1%
H11. LWS	0.010	0.1%	58.1%
H12. LWS	0.012	0.1%	58.1%
H13. LWS	0.0064	<0.1%	58.0%
H14. LWS	0.0021	<0.1%	58.0%
H15. LWS	0.0024	<0.1%	58.0%

For a 72-hour unplanned outage, the predicted contribution of the installation to nutrient nitrogen deposition is less than 1% of the critical load at all habitats and the impact would be assessed as not significant.

5.7 EXCEEDANCE RISK OF THE 24-HOUR MEAN CRITICAL LEVEL

5.7.1 Six-monthly Testing

Two Tests per Day

For the maximum predicted impact at the Brent Reservoir SSSI, there is a potential risk of exceeding the 24-hour mean NO_x critical level of 75 µg m^{-3}. Therefore, the HPD method described in *Section 4.5.2* has been adapted to determine the probability of one exceedance per year of the 24-hour mean critical level. It is assumed that testing is carried out over 16 days per year (i.e. two tests per day). It is also assumed that testing of the generators is carried out between 09:00 and 17:00. A summary of the probability of exceedance of the critical level of 75 µg m^{-3} is provided in *Table 5.13*. This is the PC and does not take account of the background NO_x concentration.

The probability of exceeding 75 µg m^{-3} at any LWS is 0.0% and highly unlikely to occur. The LWS are screened out from further assessment as the PC is highly unlikely to exceed the critical level.

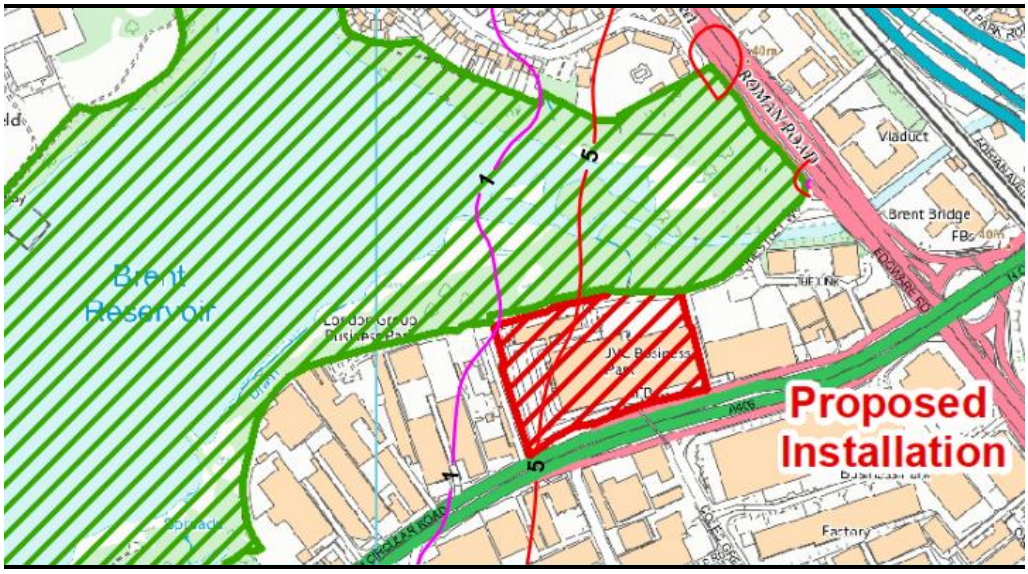
At the SSSI, the background concentration of NO_x is 41.3 µg m^{-3} and the probability of the PEC exceeding 75 µg m^{-3} is 49.6% as the maximum anywhere within the SSSI. This represents a potential exceedance. A contour plot of the probability of the PEC exceeding the critical level across the SSSI is provided in *Figure 5.2*.

There is a potential risk of the PEC exceeding the critical level to the east of the red 5% contour. To the west of the pink 1% contour the risk of exceeding the critical level would be highly unlikely and unlikely between the two contours.

TABLE 5.13 PROBABILITY OF THE PC EXCEEDING THE 24-HOUR MEAN CRITICAL LEVEL FOR NOX – SIX-MONTHLY TESTING

Habitat	Probability	Risk
H1. Brent Reservoir SSSI/LNR	0.0%	Highly unlikely
H2. LWS	0.0%	Highly unlikely
H3. LWS	0.0%	Highly unlikely
H4. LWS	0.0%	Highly unlikely
H5. LWS	0.0%	Highly unlikely
H6. LWS	0.0%	Highly unlikely
H7. LWS	0.0%	Highly unlikely
H8. LWS	0.0%	Highly unlikely
H9. LWS	0.0%	Highly unlikely
H10. LWS	0.0%	Highly unlikely
H11. LWS	0.0%	Highly unlikely
H12. LWS	0.0%	Highly unlikely
H13. LWS	0.0%	Highly unlikely
H14. LWS	0.0%	Highly unlikely
H15. LWS	0.0%	Highly unlikely

FIGURE 5.2 PROBABILITY OF THE PEC EXCEEDING THE 24-HOUR MEAN CRITICAL LEVEL FOR THE SIX-MONTHLY TESTING



One Test per Day

If only one four-hour test was undertaken per day, predicted 24-hour mean concentrations would reduce by around a half. Maximum predicted concentrations at the SSSI would reduce to 27.6 µg m^{-3} (36.8% of the critical level) and the PEC would be 68.9 µg m^{-3} (91.9% of the critical level). Therefore, it would be highly unlikely that the critical level would be exceeded.

5.7.2 Unplanned Outage

A summary of the probability of exceedance of the critical level of 75 µg m^{-3} for a 72-hour outage is provided in *Table 5.14*. This is the PC and does not take account of the background NO_x concentration.

TABLE 5.14 PROBABILITY OF THE PC EXCEEDING THE 24-HOUR MEAN CRITICAL LEVEL FOR NO_x FOR A 72-HOUR EVENT

Habitat	Probability	Risk
H1. Brent Reservoir SSSI/LNR	76.1%	Potential exceedance
H2. LWS	0.0%	Highly unlikely
H3. LWS	0.0%	Highly unlikely
H4. LWS	1.6%	Unlikely
H5. LWS	0.0%	Highly unlikely
H6. LWS	0.0%	Highly unlikely
H7. LWS	0.0%	Highly unlikely
H8. LWS	0.0%	Highly unlikely
H9. LWS	0.0%	Highly unlikely
H10. LWS	4.9%	Unlikely
H11. LWS	0.0%	Highly unlikely
H12. LWS	0.0%	Highly unlikely
H13. LWS	0.0%	Highly unlikely
H14. LWS	0.0%	Highly unlikely
H15. LWS	0.0%	Highly unlikely

For the LWS, the probability of exceeding the 24-hour mean critical level during a 72-hour event is highly unlikely or unlikely and these have been screened from further analysis. For the Brent Reservoir SSSI, there is a high potential for exceedance of the critical level as the maximum predicted anywhere within the habitat site.

A 72-hour event would be an extreme event particularly since outage data from Elstree indicates that there have only been three very small interruptions of less than two minutes in duration over the last ten years. The site is

contracted to provide a service for a continuous period of 48 hours. However, even this is considered to be an extreme operational scenario. Assuming the duration of an event was continuous, the probability of the PC or PEC exceeding the 24-hour mean critical level for NO_x is presented in *Table 5.15* for the following scenarios.

- 72 hours continuous;
- 48 hours continuous;
- 3 hours occurring in one year.

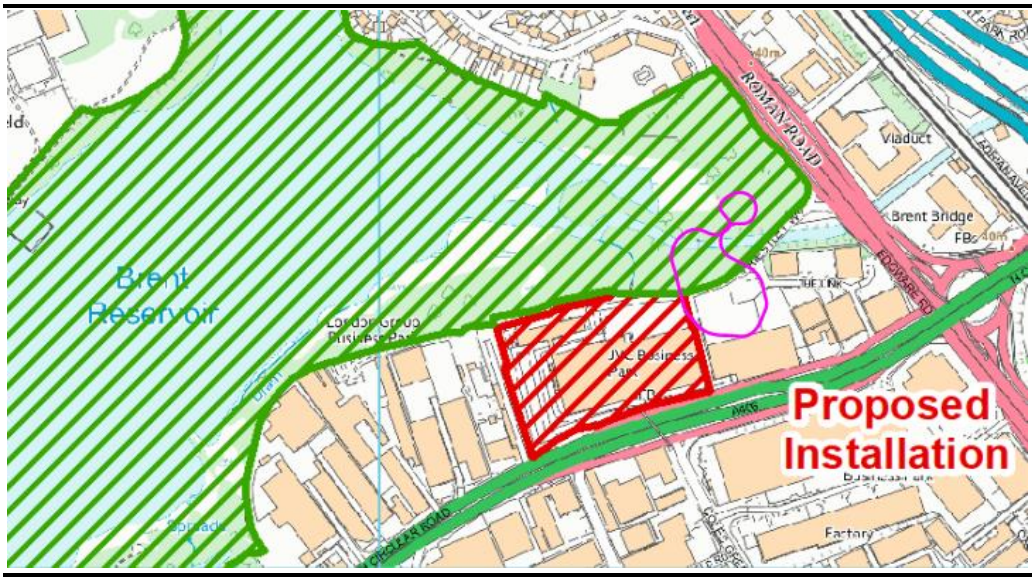
The 3-hour scenario is based on the Elstree data where there have been three outages over a ten-year period. Although the outages are of a very short duration, it is assumed that the generators operate for an hour for each interruption due to the instability of the power supply. It is assumed that the three hours of interruption occur on different days over one year since the three outages at Elstree occurred on different days over a period of ten years.

TABLE 5.15 PROBABILITY OF THE PC AND PEC EXCEEDING THE 24-HOUR MEAN CRITICAL LEVEL AT THE BRENT RESERVOIR SSSI

Event Duration	PC Exceeds 75 µg m^{-3}	PEC Exceeds 75 µg m^{-3}
72 hours continuous	76.1%	85.1%
48 hours continuous	61.4%	71.8%
3 hours in one year	0.0%	2.5%

For the 3 hour/a scenario, the probability of exceeding 75 µg m^{-3} would be 0.0% (highly unlikely) and 2.5% (unlikely) for the PEC exceeding 75 µg m^{-3}. For the PEC, the probability of exceeding 75 µg m^{-3} is provided in *Figure 5.2*.

FIGURE 5.2 PROBABILITY OF THE PEC EXCEEDING THE 24-HOUR MEAN CRITICAL LEVEL FOR A 3 HOURS PER YEAR OUTAGE



For the majority of the habitat the probability of the PEC exceeding the critical level is 1% or less.

5.8 CUMULATIVE IMPACTS

5.8.1 Airborne NOx and SO_2

As for human health, the two types of testing and an event would not occur at the same time. Therefore, the cumulative assessment has considered annual mean concentrations only. Predicted annual mean concentrations of NO_x are presented in *Table 5.16*. Impacts for the LWS were below 0.1% of the critical level for the two testing regimes and the event and have not been considered for the cumulative assessment. Results for NO_x are presented for event durations of 72 hours, 48 hours and 3 hours.

TABLE 5.16 MAXIMUM PREDICTED AIRBORNE NO_x CONCENTRATIONS AT BRENT RESERVOIR SSSI - CUMULATIVE ASSESSMENT

Habitat & Event Duration	Annual Mean PC NO_x ($\mu g\ m^{-3}$)	Annual Mean PC NOx as %age of Critical Level	Annual Mean PEC NOx as %age of Critical Level
H1. Brent Reservoir SSSI/LNR 72 Hour Event	1.5	4.9%	121.6%
H1. Brent Reservoir SSSI/LNR 48 Hour Event	1.1	3.7%	120.4%
H1. Brent Reservoir SSSI/LNR 3 Hour Event	0.44	1.5%	118.1%

The background NO_x concentration at 35.0 $\mu g\ m^{-3}$ represents 116.7% of the critical level. For event durations, the PC is greater than 1% of the critical level and would be assessed as potentially significant.

For SO_2 and an event duration of 72-hours, the predicted maximum impact for both testing regimes and the event at all habitats was less than 0.1% of the critical level and has not been considered for the cumulative assessment.

5.8.2 Acidification

A summary of the predicted PC and PEC acid deposition fluxes for event durations of 72 hours, 48 hours and 3 hours is provided in *Table 5.17*.

TABLE 5.17 MAXIMUM PREDICTED ACIDIFICATION AT BRENT RESERVOIR SSSI – CUMULATIVE ASSESSMENT

Habitat	Annual Mean PC (kg N $ha^{-1}a^{-1}$)	Annual Mean PC as %age of Critical Load	Annual Mean PEC as %age of Critical Load
H1. Brent Reservoir SSSI/LNR 72 Hour Event	0.015	0.3%	20.2%
H1. Brent Reservoir SSSI/LNR 48 Hour Event	0.012	0.2%	20.1%
H1. Brent Reservoir SSSI/LNR 3 Hour Event	0.005	0.1%	20.0%

The predicted acidification flux for all event durations is less than 1% of the critical load and the impact for all would be assessed as not significant.

5.8.3 Nutrient Nitrogen Deposition

A summary of the predicted PC and PEC nutrient nitrogen deposition fluxes for event durations of 72 hours, 48 hours and 3 hours is provided in *Table 5.18*.

TABLE 5.18 MAXIMUM PREDICTED NUTRIENT NITROGEN DEPOSITION AT BRENT RESERVOIR SSSI – CUMULATIVE ASSESSMENT

Habitat	Annual Mean PC (kg N $ha^{-1}a^{-1}$)	Annual Mean PC as %age of Critical Load	Annual Mean PEC as %age of Critical Load
H1. Brent Reservoir SSSI/LNR 72 Hour Event	0.21	1.1%	59.1%
H1. Brent Reservoir SSSI/LNR 48 Hour Event	0.16	0.8%	58.8%
H1. Brent Reservoir SSSI/LNR 3 Hour Event	0.06	0.3%	58.3%

Except for 72 hours, the predicted acidification flux for the event durations is less than 1% of the critical load and the impact for would be assessed as not significant. For 72 hours, the PC is 1.1% of the critical load and the PEC is less than 70% and it is concluded that it is likely the critical load would be met.

5.9 INTERPRETATION OF HABITAT IMPACTS

Emissions from the data centre generators have the potential to affect the Brent Reservoir SSSI. These relate to airborne NO_x only and, in particular, exceedance of the 24-hour mean critical level of 75 $\mu g\ m^{-3}$.

However, the SSSI is designated for its assemblages of breeding birds rather than the habitat itself and any air quality effects are mediated through effects on their supporting habitats. Furthermore, despite elevated annual mean background NO_x concentrations across the SSSI, it has been assessed by

Natural England to be in a favourable condition (i.e. it supports more wetland breeding birds than the target). Furthermore, the habitats (reedbeds, wet woodland) are classified by APIS as relatively insensitive to nutrient nitrogen deposition. It should also be noted that the reservoir and surrounding area are heavily used for recreational purposes (e.g. sailing, windsurfing, kayaking etc.).

It is recommended that the impact of emissions of NO_x on the habitats present should be assessed by an ecologist to support this permit application.

6 SUMMARY AND RECOMMENDATIONS

6.1 SUMMARY

6.1.1 Overview of the Assessment

The air quality assessment for the installation has considered the emissions to air from the data centre generators during planned testing and unplanned interruptions to the power supply. The assessment supports the Environmental Permit application for the installation.

Testing includes monthly testing (10 months) of all generators individually at no or low load (assumed to be 10%) for 30 minutes and six-monthly testing of all generators individually at full load (100%) for four hours. These testing regimes are a contractual requirement and cannot be altered. The unplanned event (interruption to the power supply) would result in all generators operating at 75% load. A number of event durations have been considered including 72 hours based on Environment Agency guidance, 48 hours based on contractual requirements and 3 hours based on the number of outages experienced at Elstree Substation over the last ten years (3 outages of less than 2 minutes each).

Dispersion modelling of emissions from the installation has been undertaken using the US AERMOD (Version 19191) dispersion model and five years of meteorological data from London Heathrow Airport. Results have been presented for the worst-case meteorological year.

Ground level concentrations for substances emitted from the installation are compared to air quality objectives, environmental assessment levels and existing air quality. The following substances have been included in the assessment:

- the oxides of nitrogen (NO_x);
- fine particles (PM_{10} and $PM_{2.5}$);
- sulphur dioxide (SO_2);
- carbon monoxide (CO);
- total organic carbon (TOC) as benzene;

For sensitive habitat sites, which includes the Brent Reservoir SSSI immediately to the north of the installation site, the impact of airborne NO_x and SO_2 have been assessed as well as acidification and nutrient nitrogen deposition. Predicted concentrations and deposition rates have been compared to background information and relevant critical levels and critical loads for the sensitive habitats identified.

6.1.2 Human Health Impacts

For human health impacts, predicted ground level concentrations of PM_{10}, $PM_{2.5}$, SO_2, CO and benzene as result of the tests or a prolonged interruption to the power supply would be assessed as not significant. Annual mean concentrations of NO_2 would also be assessed as not significant. However, there is a risk that the short-term AQO for NO_2 may be exceeded for the four-hour six-monthly testing and during a prolonged interruption to the power supply. This potential exceedance was determined on the assumption that the six-monthly testing and outage event occur continuously 8,760 hours per annum to assess the impact during worst-case meteorological conditions.

A statistical analysis has been used to determine the probability of an exceedance of the short-term AQO for NO_2 based on the number of occurrences of testing and the duration of an event. For the six-monthly testing, the probability of an exceedance was assessed as 0.0% and an exceedance would be highly unlikely. For an event, the probability of exceeding the AQO at any sensitive receptor location was also assessed as highly unlikely at 0.0%.

The cumulative impact of testing and an event on long-term (annual mean) concentrations of NO_2, PM_{10}, $PM_{2.5}$ and benzene indicated that the impacts would be not significant, or it is likely that the air quality objective would be met.

6.1.3 Habitat Impacts

For airborne SO_2, acidification and nutrient nitrogen deposition, the impact of the generators on habitat sites is assessed as not significant for the testing regimes or during an outage event. For annual mean NO_x, the impact would also be assessed as not significant. However, there is a potential risk that the 24-hour mean critical level for NO_x may be exceeded at the Brent Reservoir SSSI during the 4-hour testing (only where two or more tests per day are carried out) and for a prolonged interruption to the supply.

The cumulative impact of testing and an event on long-term (annual mean) concentrations of NO_x, SO_2, acidification and nutrient nitrogen deposition has been provided. For SO_2 and acidification the cumulative impacts would be assessed as not significant. For airborne NO_x, the cumulative annual mean NO_x concentration varies between 1.5% and 4.9% of the critical level and is potentially significant. For nutrient nitrogen deposition, the cumulative deposition rate exceeds 1% of the critical load but the PEC is less than 50%. Therefore, the critical load is unlikely to be exceeded.

Therefore, emissions from the data centre generators have the potential to affect the Brent Reservoir SSSI. However, the SSSI is designated for its assemblages of breeding birds rather than the habitat itself and any air quality effects are mediated through effects on their supporting habitats.

Furthermore, despite elevated annual mean background concentrations of NOx across the SSSI, it has been assessed by Natural England to be in a favourable condition (i.e. it supports more wetland breeding birds than the target). Furthermore, the habitats (reedbeds, wet woodland) are classified by APIS to be relatively insensitive to nutrient nitrogen deposition.

6.2 RECOMMENDATIONS

Given the potential impact of NO_x emissions on the Brent Reservoir SSSI, the following are recommended.

- It is recommended that the impact of emissions of NO_x on the habitats present should be assessed by an ecologist to support this permit application.
- An improvement condition should be included in the permit to assess the feasibility of other fuel options for the generators (e.g. use of hydrotreated vegetable oil) with lower NO_x emissions. The use of NOx reduction techniques such as selected catalytic reduction (SCR) are not considered feasible since the reduction in NO_x would be offset by emissions of ammonia.

ANNEX A

LOCAL WILDLIFE SITES

Nature and Heritage Conservation

Screening Report: Bespoke Installation

Reference	**EPR/QP3706LH/A001**
NGR	**TQ 22265 87214**
Buffer (m)	**75**
Date report produced	**19/04/2021**
Number of maps enclosed	**4**

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

Nature and heritage conservation sites	Screening distance (km)	Further information
Sites of Special Scientific Interest (SSSI)	2	Natural England
Brent Reservoir		
Local Nature Reserve (LNR)	2	Natural England
Brent Reservoir / Welsh Harp		
Local Wildlife Sites (LWS)	2	Appropriate Local Record Centre (LRC) Appropriate Wildlife Trust
Silk Stream and Burnt Oak Brook		
Old St Andrew's Churchyard, Kingsbury		
Harp Island		
Brent Reservoir (Welsh Harp)		
Kingsbury Road bank		
Meadow Way Copse		
Hendon Park and Northern Line		

Railway Cutting

Clarefield Park

Clitterhouse Playing Fields

Lower Dollis Brook

Quainton Street Open Space

Dudding Hill Loop between Cricklewood and Harlesden

Grange Roundabout Nature Area

Metropolitan line between Kilburn and Neasden

Gladstone Park

Dollis Hill Reservoir

Protected Habitats	Screening distance (m)	Further Information
Reedbeds	up to 500m	Natural England

Where protected species are present, a licence may be required from Natural England or the Welsh Government to handle the species or undertake the proposed works.

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

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

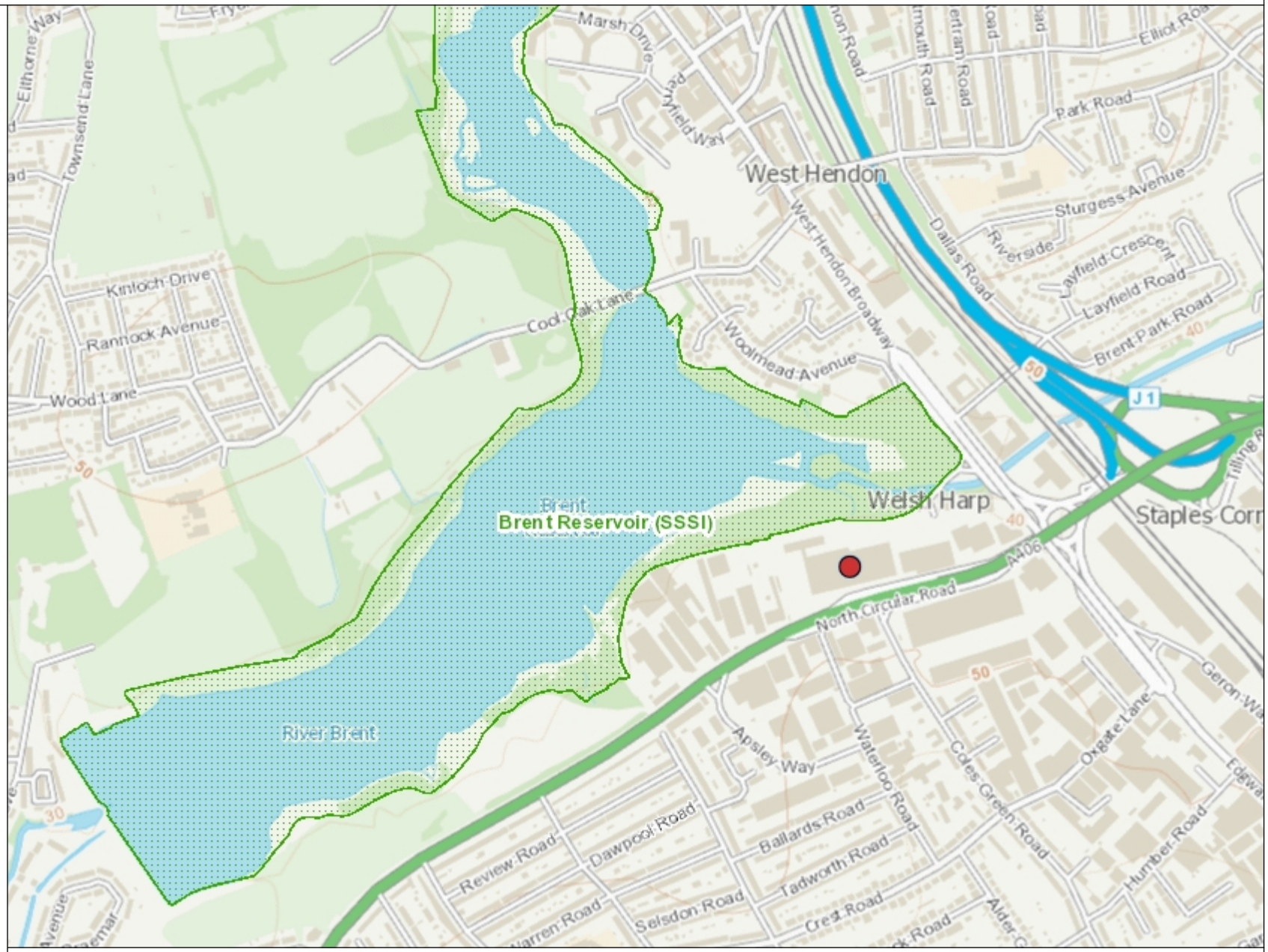
Please note the nature and heritage screening we have conducted as part of this report is subject to change as it is based on data we hold at the time it is generated. We cannot guarantee there will be no changes to our screening data between the date of this report and the submission of the permit application,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

SSSI

Environment Agency

Legend

SSSI (England)



1: 10,000

0 250

Metres

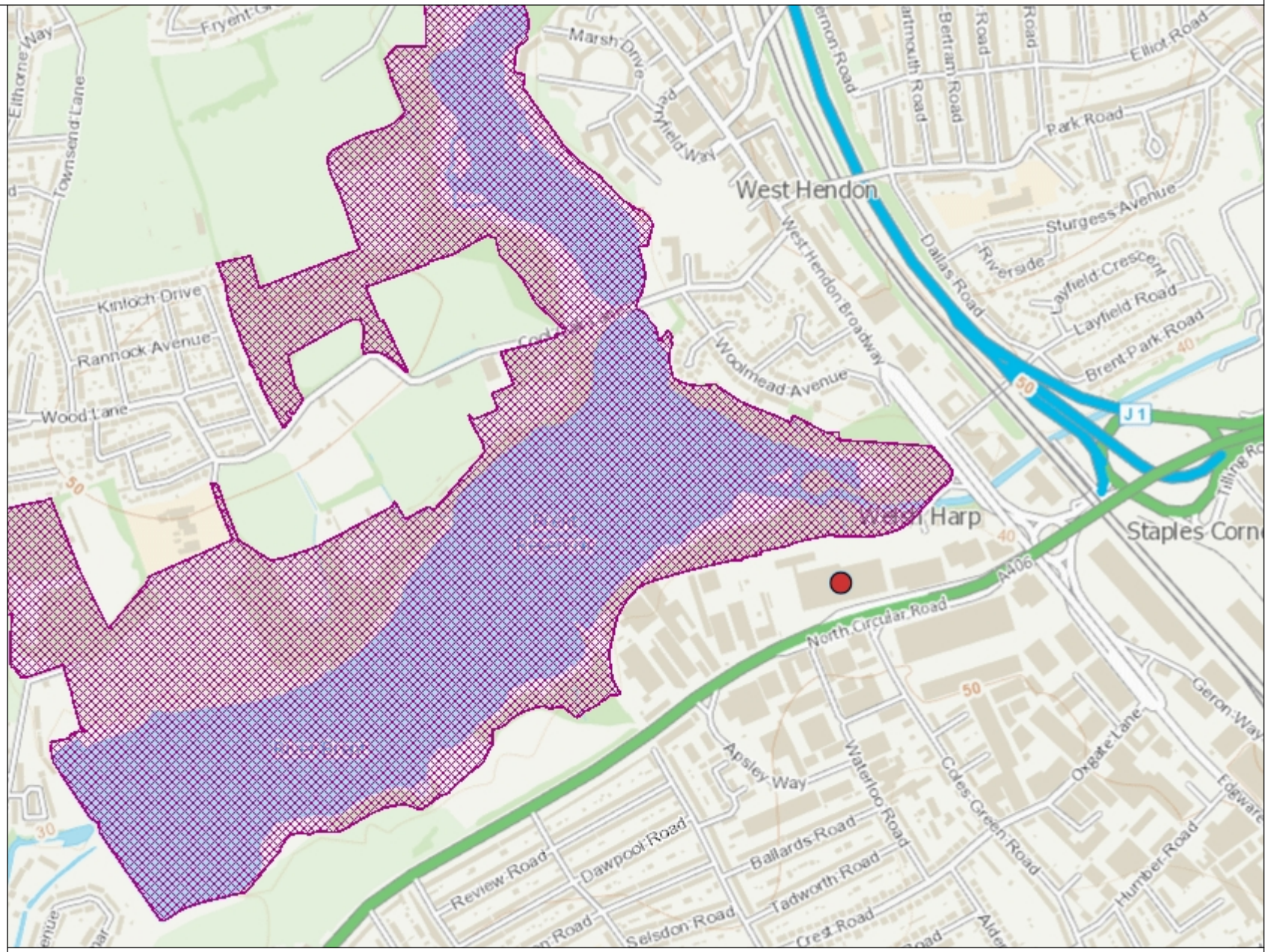
N W E S

Local Nature Reserve

Environment Agency

Legend

LNR (England)



1: 10,000

0 250

Metres

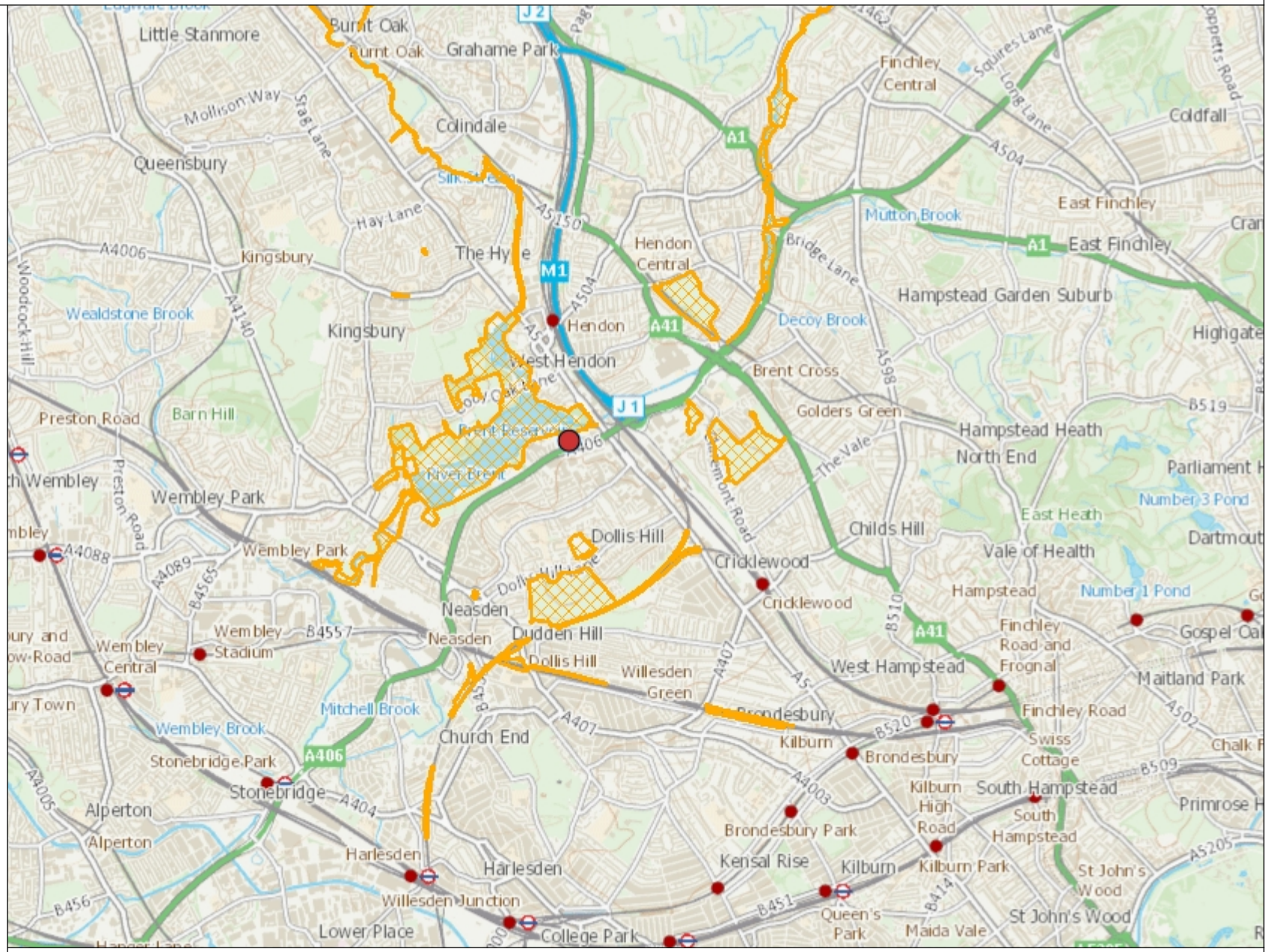
N W E S

Local Wildlife Sites

Environment Agency

Legend

Local Wildlife Sites



1: 50,000

0 1,250

Metres

N W E S

Protected Habitats

Environment Agency

Legend

Protected Habitats screened for Env Permits

1: 10,000

0 250

Metres

N W E S

ANNEX B

EMISSION PARAMETERS

NEA Emissions		**100%**	**75%**	**50%**	**25%**	**10%**
Total capacity	Mwe	3.307	2.48	1.653	0.827	0.331
Temp	oC	482	427	434	403	268
Temp	K	755	700	707	676	541
Mass flow	kg/h	19196	15930	12083	7485	5323
Assumed density	kg/Nm3	1.25	1.25	1.25	1.25	1.25
Normalised flow at 273K	Nm3/s	4.27	3.54	2.69	1.66	1.18
Actual volume	Am3/s	11.8	9.1	7.0	4.1	2.3
Oxygen	% wet	9.9	11.2	11.9	13.1	15.8
Oxygen	% dry	10.6	12.0	12.8	14.0	16.9
Moisture	%	6.7	6.7	6.7	6.7	6.7
Volume flow full 273K, dry		3.98	3.30	2.51	1.55	1.10
Volume flow full ref 5%	Nm3/s	2.58	1.85	1.28	0.67	0.28
NOx at 5%	mg/Nm3	2362	2172	1639	1375	2411
NOx	g/s	6.08	4.01	2.10	0.92	0.66
NOx	g/kWh	6.6	5.9	4.8	4.4	9.1
NOx	g/s	6.06	4.06	2.20	1.01	0.84
Flue diameter	m	0.6	0.6	0.6	0.6	0.6
Flue area	m2	0.28	0.28	0.28	0.28	0.28
Velocity	m/s	41.7	32.1	24.6	14.6	8.3
CO	g/kWh	0.3	0.4	1	1.4	2.8
CO	g/s	0.28	0.28	0.46	0.32	0.26
CO at 5% Calculated	mg/Nm3	107	149	358	480	935
CO at 5% Given	mg/Nm3	111	139	339	445	723
SO2	g/kWh	0.003	0.003	0.003	0.003	0.004
SO2	g/s	0.00276	0.00207	0.00138	0.00069	0.00037
SO2 at 5% Calculated	mg/Nm3	1.1	1.1	1.1	1.0	1.3
SO2 at 5% Given	mg/Nm3	1.0	1.0	1.0	1.0	1.0
HC	g/kWh	0.05	0.07	0.09	0.16	0.72
HC	g/s	0.0459	0.0482	0.0413	0.0368	0.0662
HC at 5% Calculated	mg/Nm3	17.8	26.1	32.2	54.9	240.5
HC at 5% Given	mg/Nm3	19	23	29	50	187
TSP	g/kWh	0.02	0.03	0.1	0.18	0.05
TSP	g/s	0.0184	0.0207	0.0459	0.0414	0.0046
TSP at 5% Calculated	mg/Nm3	7.1	11.2	35.8	61.8	16.7
TSP at 5% Given	mg/Nm3	7	10	33	55	13

Stack Locations	Easting	Northing
G1A and G1B	522291	187252
G2A and G2B	522299	187254
G3A and G3B	522302	187255
G4A and G4B	522310	187257
G5A and G5B	522314	187258
G6A and G6B	522321	187259
G7A and G7B	522325	187260
G8A and G8B	522332	187262

ANNEX C

MODEL RESULTS FOR GENERATORS EXHAUSTING INTO THE PLENUM

INTRODUCTION

It is proposed that the two vents will discharge into a plenum (5 m by 5m) shared by two generators. The plenum is used to contain the generator exhausts and the cooling air exhausts. Initial modelling of the mixed exhaust, which resulted in a significantly lower temperature and a lower efflux velocity compared to the generator exhausts, generally resulted in lower predicted off-site concentrations compared to the generator exhausts alone. This was likely due to dilution of the pollutants with the cooling air. Therefore, as a worst-case it was assumed for the detailed modelling presented in the main report that the generator stacks exhaust at the top of the plenum rather than mixing with the cooling air within the plenum before discharge.

This annex presents the results assuming that the exhaust gases mix with the cooling air within the plenum before discharge to atmosphere at the top of the plenum. It is assumed that full mixing between the cooling air and exhaust gases occurs. Modelling of emissions for the various scenarios has been carried out using the 2020 meteorological data and for the generator location giving rise to highest concentrations.

EMISSION PARAMETERS

Emission parameters for the 1-hour test (single generator at 10% load), 4-hour test (single generator at 100% load) and event (two generators per plenum, sixteen in total at 75% load) are provided in *Annex D*.

PREDICTED OPERATIONAL IMPACT ON HUMAN HEALTH

DETAILED DISPERSION MODELLING RESULTS – MONTHLY TESTS

Detailed dispersion modelling for the ten monthly tests is provided. It is assumed that each generator is tested for 30 minutes once per month (for ten months of the year). The generators are assumed to be operating at 10% load.

Predicted annual mean and hourly mean ground level concentrations of NO_2 arising as a result of emissions from the installation are presented in *Table C1*. Maximum predicted concentrations are provided along with predicted concentrations for the discrete receptors. The significance of the impacts are assessed in accordance with Environment Agency guidance.

TABLE C1 MAXIMUM PREDICTED NO_2 CONCENTRATIONS FOR THE MONTHLY (10 PER ANNUM) TESTING (μg m^{-3}) – DISCHARGE FROM PLENUM

Receptor/Parameter	Annual Mean		99.8th Percentile of 1-hour Means	
	PC (μg m^{-3})	%age AQO	PC (μg m^{-3})	%age AQO
Maximum off-site	0.25	0.6%	131.3	65.7%
Maximum Receptor	0.042	0.1%	22.3	11.2%
Maximum Residential	0.017	0.0%	10.1	5.1%
R1. Ardley Close	0.001	0.0%	2.6	1.3%
R2. North Circular Road	0.005	0.0%	4.8	2.4%
R3. A5	0.006	0.0%	6.6	3.3%
R4. Edgeware Road	0.002	0.0%	3.4	1.7%
R5. Dallas Road	0.008	0.0%	5.8	2.9%
R6. Travel Lodge	0.022	0.1%	9.4	4.7%
R8. Brent Park Road	0.008	0.0%	4.5	2.3%
R9. Layfield Road	0.008	0.0%	5.0	2.5%
R10. Woolmead Avenue	0.017	0.0%	10.1	5.1%
R11. Commercial/Industrial	0.017	0.0%	10.4	5.2%
R12. Builders Warehouse	0.042	0.1%	22.3	11.2%
R13 Self Storage WH	0.014	0.0%	11.8	5.9%
R14 Retail	0.016	0.0%	12.5	6.3%

Maximum predicted annual mean concentrations occur to the northeast of the installation at the boundary of the site. The maximum predicted is 0.25 μg m^{-3} and is 0.6% of the AQO of 40 μg m^{-3}. This is slightly higher than predicted for the generator stacks at the top of the plenum.

The maximum (99.8th percentile) off-site NO_2 concentration is also predicted to occur to the northeast of the site. The maximum hourly concentration is 131.3 μg m^{-3} as the PC (186.5 μg m^{-3} as the PEC) is well below the limit value of 200 μg m^{-3}. Therefore, it is very unlikely that the AQO would be exceeded given that 18 exceedances are allowed per annum. Compared to the discharge via the generator stacks at the top of the plenum, maximum predicted concentrations are higher, but receptor concentrations are generally lower.

DETAILED DISPERSION MODELLING RESULTS – SIX MONTHLY TESTS

Detailed dispersion modelling for the two six-monthly tests is provided. It is assumed that each generator is tested for four hours for two months of the year. The generators are assumed to be operating at 100% load and would be tested individually.

Predicted annual and hourly mean ground level concentrations of NO_2 arising as a result of emissions from the installation are presented in *Table C2*. Maximum predicted concentrations are provided along with predicted concentrations for the discrete receptors.

TABLE C2 MAXIMUM PREDICTED NO_2 CONCENTRATIONS FOR THE SIX-MONTHLY (TWO PER ANNUM) TESTING (µg m^{-3}) - DISCHARGE FROM PLENUM

Receptor/Parameter	Annual Mean		99.8th Percentile of 1-hour Means	
	PC (µg m^{-3})	%age AQO	PC (µg m^{-3})	%age AQO
Maximum off-site	0.48	1.2%	500.6	250.3%
Maximum Receptor	0.086	0.2%	52.2	26.1%
Maximum Residential	0.047	0.1%	24.1	12.1%
R1. Ardley Close	0.004	0.0%	3.8	1.9%
R2. North Circular Road	0.013	0.0%	9.7	4.8%
R3. A5	0.018	0.0%	11.7	5.9%
R4. Edgeware Road	0.003	0.0%	4.8	2.4%
R5. Dallas Road	0.033	0.1%	11.6	5.8%
R6. Travel Lodge	0.086	0.2%	28.7	14.4%
R8. Brent Park Road	0.041	0.1%	11.4	5.7%
R9. Layfield Road	0.041	0.1%	11.6	5.8%
R10. Woolmead Avenue	0.047	0.1%	24.1	12.1%
R11. Commercial/Industrial	0.037	0.1%	25.6	12.8%
R12. Builders Warehouse	0.059	0.1%	52.2	26.1%
R13 Self Storage WH	0.022	0.1%	26.4	13.2%
R14 Retail	0.019	0.0%	14.5	7.2%

Maximum predicted annual mean concentrations occur to the northeast of the installation at the boundary of the site. The maximum predicted annual mean concentration is 0.48 µg m^{-3} and is 1.2% of the AQO of 40 µg m^{-3}. This is comparable to the model predictions with the exhaust at the top of the plenum. However, predicted concentrations at sensitive receptors are lower for discharge and mixing within the plenum.

The maximum (99.8th percentile) off-site NO_2 concentration is also predicted to occur to the northeast of the site. The maximum hourly concentration is 500.6 µg m^{-3} as the PC (555.8 µg m^{-3} as the PEC) and is above the limit value of 200 µg m^{-3}. Therefore, combined with the PEC there is the potential for the AQO to be exceeded. However, the maximum residential receptor concentration is lower for the exhaust from the plenum.

DETAILED DISPERSION MODELLING RESULTS – 72 HOUR EVENT

Detailed dispersion modelling assuming that there is an event where all engines operate for 72 hours is provided. It is assumed that each generator is operating at 75% load.

Predicted annual and hourly mean ground level concentrations of NO_2 arising from the installation emissions are presented in *Table C3*. Maximum predicted concentrations are provided along with predicted concentrations for the discrete receptors.

TABLE C3 MAXIMUM PREDICTED NO_2 CONCENTRATIONS FOR A 72 HOUR EVENT - DISCHARGE FROM PLENUM

Receptor/Parameter	Annual Mean		99.8th Percentile of 1-hour Means	
	PC (µg m^{-3})	%age AQO	PC (µg m^{-3})	%age AQO
Maximum off-site	1.1	2.7%	1119.3	559.7%
Maximum Receptor	0.39	1.0%	231.0	115.5%
Maximum Residential	0.21	0.5%	196.1	98.1%
R1. Ardley Close	0.018	0.0%	32.7	16.3%
R2. North Circular Road	0.06	0.1%	84.8	42.4%
R3. A5	0.08	0.2%	104.0	52.0%
R4. Edgeware Road	0.015	0.0%	42.5	21.2%
R5. Dallas Road	0.16	0.4%	102.6	51.3%
R6. Travel Lodge	0.39	1.0%	226.6	113.3%
R8. Brent Park Road	0.21	0.5%	106.6	53.3%
R9. Layfield Road	0.20	0.5%	103.7	51.8%
R10. Woolmead Avenue	0.19	0.5%	196.1	98.1%
R11. Commercial/Industrial	0.15	0.4%	231.0	115.5%
R12. Builders Warehouse	0.17	0.4%	215.5	107.8%
R13 Self Storage WH	0.08	0.2%	167.0	83.5%
R14 Retail	0.068	0.2%	95.5	47.7%

The maximum predicted annual mean concentration is 1.1 µg m^{-3} and is 2.7% of the AQO of 40 µg m^{-3}. This is a factor of two lower than predicted for the generator stacks at the top of the plenum. Predicted hourly mean (99.8th percentile) are also lower for the discharge within the plenum.

EXCEEDANCE RISK FOR SHORT-TERM NO_2 CONCENTRATIONS

Four Hour Tests (Six-monthly)

For the two four-hour tests carried out six-monthly, the predicted maximum number of exceedances (as the PEC) occurs at the boundary of the site at 76 exceedances (compared to 61 exceedances for the discharge stack at the top of the plenum). Using the HPD methodology, this will provide a risk of exceedance 0.0% if total testing occurs for 128 hours per annum (16 generators, twice a year for four hours). Therefore, the probability of exceeding the short-term AQO for NO_2 would be highly unlikely. As the testing occurs over a period of four hours, the factor of 2.5 has been applied.

Event

For an interruption to the power supply event, a number of durations for the event have been considered (72 hours, 48 hours and 3 hours). If the event occurred for only 3 hours and 18 allowable exceedances may occur, then there would be no risk of exceeding the AQO. A summary of the probability of exceeding the AQO, taking into account background concentrations, for the three scenarios is provided in *Table C4*. As the 72-hour and 48-hour events may occur over a period of four hours or more, the factor of 2.5 is applied.

TABLE C4 PROBABILITY OF EXCEEDING THE SHORT-TERM AIR QUALITY OBJECTIVE FOR NO_2 DURING AN EVENT – DISCHARGE FROM PLENUM

Receptor/Parameter	Probability		
	72-hour Event	48-hour Event	3-hour Event
Maximum off-site	0.0%	0.0%	0.0%
R1. Ardley Close	0.0%	0.0%	0.0%
R2. North Circular Road	0.0%	0.0%	0.0%
R3. A5	0.0%	0.0%	0.0%
R4. Edgeware Road	0.0%	0.0%	0.0%
R5. Dallas Road	0.0%	0.0%	0.0%
R6. Travel Lodge	0.0%	0.0%	0.0%
R8. Brent Park Road	0.0%	0.0%	0.0%
R9. Layfield Road	0.0%	0.0%	0.0%
R10. Woolmead Avenue	0.0%	0.0%	0.0%
R11. Commercial/ Industrial	0.0%	0.0%	0.0%
R12. Builders Warehouse	0.0%	0.0%	0.0%
R13 Self Storage WH	0.0%	0.0%	0.0%
R14 Retail	0.0%	0.0%	0.0%

For all locations and event durations, the probability of exceeding the AQO is 0.0% and it is highly unlikely that the AQO would be exceeded. This compares to 159.7% and 12.2% for the maximum off-site for the 72-hour event and 48-hour event for the exhaust at the top of the plenum.

PREDICTED OPERATIONAL IMPACT ON HABITAT SITES

PREDICTED IMPACT OF EMISSIONS ON HABITAT SITES – MONTHLY TESTING

There are two critical levels for NO_x based on the annual mean and 24-hour mean concentrations. For the exhaust discharging and mixing with the plenum, predicted concentrations for the SSSI and LWS are presented in *Table C5*.

TABLE C5 MAXIMUM PREDICTED AIRBORNE NO_x CONCENTRATIONS AT HABITAT SITES FOR MONTHLY TESTING – DISCHARGE FROM PLENUM

Habitat	Annual Mean PC NO_x ($\mu g\ m^{-3}$)	Annual Mean NOx as %age of Critical Level	24-Hour Mean PC NO_x ($\mu g\ m^{-3}$)	24-Hour Mean NOx as %age of Critical Level
H1. Brent Reservoir SSSI/LNR	0.12	0.4%	24.9	33.2%
H2. Local Wildlife Site	0.001	0.0%	0.8	1.0%
H3. Local Wildlife Site	0.001	0.0%	0.8	1.1%
H4. Local Wildlife Site	0.001	0.0%	1.9	2.6%
H5. Local Wildlife Site	0.001	0.0%	0.9	1.1%
H6. Local Wildlife Site	0.001	0.0%	1.4	1.8%
H7. Local Wildlife Site	0.001	0.0%	1.0	1.3%
H8. Local Wildlife Site	0.000	0.0%	0.6	0.8%
H9. Local Wildlife Site	0.002	0.0%	1.2	1.7%
H10. Local Wildlife Site	0.002	0.0%	1.0	1.4%
H11. Local Wildlife Site	0.001	0.0%	1.1	1.5%
H12. Local Wildlife Site	0.001	0.0%	0.5	0.7%
H13. Local Wildlife Site	0.001	0.0%	0.5	0.7%
H14. Local Wildlife Site	0.000	0.0%	0.3	0.4%
H15. Local Wildlife Site	0.000	0.0%	0.3	0.4%
Critical Level	*30*		*75*	

For NO_x, predicted annual mean concentrations at all habitat receptors are less than 1% of the critical level of 30 $\mu g\ m^{-3}$ and would be assessed as not significant.

For the Brent Reservoir SSSI, the maximum contribution from the installation to 24-hour mean concentrations is 33.2% of the critical level, slightly less than predicted for the exhausts at the top of the plenum. Combined with background concentrations, the PEC would be 66.2 $\mu g\ m^{-3}$ and there is no predicted exceedance of the 24-hour mean critical level. It should also be noted that these represent worst-case conditions with testing assumed to be carried out every day of the year to take account of worst-case meteorological conditions.

PREDICTED IMPACT OF EMISSIONS ON HABITAT SITES – SIX-MONTH TESTING

Predicted NO_x concentrations for the SSSI and LWS are presented in *Table C6* for the four-hour six-monthly testing regime. This assumes that two generators are tested each day.

TABLE C6 MAXIMUM PREDICTED AIRBORNE NO_x CONCENTRATIONS AT HABITAT SITES FOR SIX MONTH TESTING – DISCHARGE FROM PLENUM

Habitat	Annual Mean PC NO_x ($\mu g\ m^{-3}$)	Annual Mean NOx as %age of Critical Level	24-Hour Mean PC NO_x ($\mu g\ m^{-3}$)	24-Hour Mean NOx as %age of Critical Level
H1. Brent Reservoir SSSI/LNR	0.32	1.1%	58.5	78.0%
H2. Local Wildlife Site	0.004	0.0%	1.2	1.6%
H3. Local Wildlife Site	0.003	0.0%	0.8	1.1%
H4. Local Wildlife Site	0.004	0.0%	1.9	2.5%
H5. Local Wildlife Site	0.002	0.0%	1.2	1.6%
H6. Local Wildlife Site	0.004	0.0%	1.5	2.0%
H7. Local Wildlife Site	0.002	0.0%	0.8	1.1%
H8. Local Wildlife Site	0.001	0.0%	0.8	1.0%
H9. Local Wildlife Site	0.010	0.0%	1.9	2.5%
H10. Local Wildlife Site	0.015	0.0%	2.6	3.4%
H11. Local Wildlife Site	0.009	0.0%	1.5	2.0%
H12. Local Wildlife Site	0.008	0.0%	1.8	2.5%
H13. Local Wildlife Site	0.005	0.0%	1.5	2.0%
H14. Local Wildlife Site	0.001	0.0%	0.7	0.9%
H15. Local Wildlife Site	0.001	0.0%	0.6	0.8%
Critical Level	*30*		*75*	

For the Brent Reservoir SSSI, the maximum contribution from the installation to 24-hour mean concentrations is 78.0% of the critical level and is slightly higher than predicted for the exhausts at the top of the plenum. Combined with background concentrations, the PEC would be 99.8 $\mu g\ m^{-3}$ (133% of the critical level) and there is the potential for the 24-hour mean critical level to be exceeded. It should be noted that these represent worst-case conditions with testing carried out every day of the year to take account of worst-case meteorological conditions.

PREDICTED IMPACT OF EMISSIONS ON HABITAT SITES – OUTAGE EVENT

Predicted concentrations for the SSSI and LWS are presented in *Table C7*. This provides a screening assessment for a 72-hour outage where it is assumed that all generators operate for a period of 72 hours. However, for 24-hour mean predictions it is assumed that the generators run continuously 8,760 hours per year to account for the worst-case meteorological conditions.

TABLE C7 MAXIMUM PREDICTED AIRBORNE NO_x CONCENTRATIONS AT HABITAT SITES FOR A 72 HOUR EVENT – DISCHARGE FROM PLENUM

Habitat	Annual Mean PC NO_x ($\mu g\ m^{-3}$)	Annual Mean NOx as %age of Critical Level	24-Hour Mean PC NO_x ($\mu g\ m^{-3}$)	24-Hour Mean NOx as %age of Critical Level
H1. Brent Reservoir SSSI/LNR	0.6	2.0%	688.4	917.9%
H2. Local Wildlife Site	0.024	0.1%	40.8	54.4%
H3. Local Wildlife Site	0.021	0.1%	33.7	44.9%
H4. Local Wildlife Site	0.017	0.1%	61.4	81.8%
H5. Local Wildlife Site	0.012	0.0%	44.8	59.7%
H6. Local Wildlife Site	0.016	0.1%	46.7	62.2%
H7. Local Wildlife Site	0.013	0.0%	26.0	34.7%
H8. Local Wildlife Site	0.006	0.0%	21.1	28.1%
H9. Local Wildlife Site	0.052	0.2%	57.8	77.1%
H10. Local Wildlife Site	0.077	0.3%	73.4	97.9%
H11. Local Wildlife Site	0.054	0.2%	37.5	50.0%
H12. Local Wildlife Site	0.061	0.2%	40.4	53.8%
H13. Local Wildlife Site	0.027	0.1%	46.4	61.8%
H14. Local Wildlife Site	0.010	0.0%	36.6	48.8%
H15. Local Wildlife Site	0.011	0.0%	23.8	31.8%
Critical Level	*30*		*75*	

Predicted annual mean and 24-hour mean concentrations are lower for the discharge into the plenum, by a factor of around two for the Brent Reservoir SSSI.

The 24-hour mean critical level is exceeded at the Brent Reservoir but not at the LWS. These represent worst-case conditions with all generators assumed to run continuously 8,760 hours per year to take account of worst-case meteorological conditions.

EXCEEDANCE RISK OF THE 24-HOUR MEAN CRITICAL LEVEL

Six-monthly Testing - Two Tests per Day

For the maximum predicted impact at the Brent Reservoir SSSI, there is a potential risk of exceeding the 24-hour mean NO_x critical level of 75 µg m^{-3}. It is assumed that testing is carried out over 16 days per year (i.e. two tests per day). It is also assumed that testing of the generators is carried out between 09:00 and 17:00. A summary of the probability of exceedance of the critical level of 75 µg m^{-3} is provided in *Table C8*. This is the PEC and takes account of the background NO_x concentration.

TABLE C8 PROBABILITY OF THE PEC EXCEEDING THE 24-HOUR MEAN CRITICAL LEVEL FOR NOX – SIX-MONTHLY TESTING - DISCHARGE FROM PLENUM

Habitat	Probability	Risk
H1. Brent Reservoir SSSI/LNR	58.3%	Potential exceedance
H2. LWS	0.0%	Highly unlikely
H3. LWS	0.0%	Highly unlikely
H4. LWS	0.0%	Highly unlikely
H5. LWS	0.0%	Highly unlikely
H6. LWS	0.0%	Highly unlikely
H7. LWS	0.0%	Highly unlikely
H8. LWS	0.0%	Highly unlikely
H9. LWS	0.0%	Highly unlikely
H10. LWS	0.0%	Highly unlikely
H11. LWS	0.0%	Highly unlikely
H12. LWS	0.0%	Highly unlikely
H13. LWS	0.0%	Highly unlikely
H14. LWS	0.0%	Highly unlikely
H15. LWS	0.0%	Highly unlikely

At the SSSI, the background concentration of NO_x is 41.3 µg m^{-3} and the probability of the PEC exceeding 75 µg m^{-3} is 58.3% as the maximum anywhere within the SSSI. This represents a potential exceedance.

Six-monthly Testing - One Tests per Day

If only one four-hour test was undertaken per day, predicted 24-hour mean concentrations would reduce by around a half. Maximum predicted concentrations at the SSSI would reduce to 29.2 µg m^{-3} (39.0% of the critical level) and the PEC would be 70.5 µg m^{-3} (94.0% of the critical level). Therefore, it would be highly unlikely that the critical level would be exceeded.

Unplanned Outage

A summary of the probability of exceedance of the critical level of 75 μg m^{-3} for a 72-hour outage is provided in *Table C9*. This is the PC and does not take account of the background NO_x concentration.

TABLE C9 PROBABILITY OF THE PC EXCEEDING THE 24-HOUR MEAN CRITICAL LEVEL FOR NO_x FOR A 72-HOUR EVENT - DISCHARGE FROM PLENUM

Habitat	Probability	Risk
H1. Brent Reservoir SSSI/LNR	50.5%	Potential exceedance
H2. LWS	0.0%	Highly unlikely
H3. LWS	0.0%	Highly unlikely
H4. LWS	0.0%	Highly unlikely
H5. LWS	0.0%	Highly unlikely
H6. LWS	0.0%	Highly unlikely
H7. LWS	0.0%	Highly unlikely
H8. LWS	0.0%	Highly unlikely
H9. LWS	0.0%	Highly unlikely
H10. LWS	0.0%	Highly unlikely
H11. LWS	0.0%	Highly unlikely
H12. LWS	0.0%	Highly unlikely
H13. LWS	0.0%	Highly unlikely
H14. LWS	0.0%	Highly unlikely
H15. LWS	0.0%	Highly unlikely

For the LWS, the probability of exceeding the 24-hour mean critical level during a 72-hour event is highly unlikely and these have been screened from further analysis. For the Brent Reservoir SSSI, there is a high potential for exceedance of the critical level as the maximum predicted anywhere within the habitat site.

A 72-hour event would be an extreme event particularly since outage data from Elstree indicates that there have only been three very small interruptions of less than two minutes in duration over the last ten years. The site is contracted to provide a service for a continuous period of 48 hours. However, even this is considered to be an extreme operational scenario. Assuming the duration of an event was continuous, the probability of the PC or PEC exceeding the 24-hour mean critical level for NO_x is presented in *Table C10* for the following scenarios.

- 72 hours continuous;
- 48 hours continuous;
- 3 hours occurring in one year.

The 3-hour scenario is based on the Elstree data where there have been three outages over a ten-year period. Although the outages are of a very short duration, it is assumed that the generators operate for an hour for each interruption due to the instability of the power supply. It is assumed that the three hours of interruption occur on different days over one year since the three outages at Elstree occurred on different days over a period of ten years.

TABLE C10 PROBABILITY OF THE PC AND PEC EXCEEDING THE 24-HOUR MEAN CRITICAL LEVEL AT THE BRENT RESERVOIR SSSI - DISCHARGE FROM PLENUM

Event Duration	PC Exceeds 75 μg m^{-3}	PEC Exceeds 75 μg m^{-3}
72 hours continuous	65.2%	79.4%
48 hours continuous	50.5%	65.0%
3 hours in one year	0.0%	0.0%

For the 3 hour/a scenario, the probability of exceeding 75 μg m^{-3} would be 0.0% (highly unlikely) and 0.0% (highly unlikely) for the PEC exceeding 75 μg m^{-3}.

ANNEX D

EMISSION PARAMETERS FOR EXHAUST MIXING IN PLENUM

One-hour Test - Single Generator 10% Load

	10% Single Plenum One Engine	
Power	331	kW
Gen Temperature	268	oC
Gen Temperature	541	K
Cooling temp	353	K (83.1oC)
Flow gen	2.3	Am3/s at 754K (assumed actual)
Flow gen	1.18	Nm3/s 273K
Flow cooling	4.4	Am3/s at 353K
Flow cooling	3.4	Nm3/s
Temp mixed	418.8	K
Combined flow	4.5	Nm3/s 273K
Combined flow	7.0	Am3/s at 424.8K
Gen flow dry	1.1	Nm3/s at 273K, dry
Moisture	6.7	%
Oxygen wet	15.8	%
Oxygen dry	16.9	%
Gen flow dry, 5%O2	0.28	Nm3/s at 273K, dry, 5%O2
Gen stack area	0.28	Based on flue diameter of 0.5 m
Gen velocity from stack	8.29	m/s
Plenum area	25.00	5m x 5m
Total velocity from Plenur	0.28	m/s
NOx	2411	mg/Nm3 at ref conditions
NOx	0.66	g/s
NOx	9.1	g/kWh
NOx	0.84	g/s

Four-hour Test - Single Engine 100% Load

	100% Single Plenum One Engine	
Power	3307	kW
Gen Temperature	482	oC
Gen Temperature	755	K
Cooling temp	353	K (83.1oC)
Flow gen	11.8	Am3/s at 754K (assumed actual)
Flow gen	4.27	Nm3/s 273K
Flow cooling	43.5	Am3/s at 353K
Flow cooling	33.6	Nm3/s
Temp mixed	438.8	K
Combined flow	37.9	Nm3/s 273K
Combined flow	60.9	Am3/s at 424.8K
Gen flow dry	4.0	Nm3/s at 273K, dry
Moisture	6.7	%
Oxygen wet	9.9	%
Oxygen dry	10.6	%
Gen flow dry, 5%O2	2.58	Nm3/s at 273K, dry, 5%O2
Gen stack area	0.28	Based on flue diameter of 0.5 m
Gen velocity from stack	41.72	m/s
Plenum area	25.00	5m x 5m
Total velocity from Plenur	2.44	m/s
NOx	2362	mg/Nm3 at ref conditions
NOx	6.08	g/s
NOx	6.6	g/kWh
NOx	6.06	g/s

Event - Two Generators (16 in Total) 75% Load

	75% Single Plenum One Engine	75% Single Plenum Two Engines	
Power	2480	4960	kW
Gen Temperature	427	427	oC
Gen Temperature	700	700	K
Cooling temp	353	353	K (83.1oC)
Flow gen	9.1	18.2	Am3/s at 754K (assumed actual)
Flow gen	3.54	7.08	Nm3/s 273K
Flow cooling	32.6	65.25	Am3/s at 353K
Flow cooling	25.2	50.46	Nm3/s
Temp mixed	428.5	428.5	K
Combined flow	28.8	57.5	Nm3/s 273K
Combined flow	45.2	90.3	Am3/s at 424.8K
Gen flow dry	3.3	6.6	Nm3/s at 273K, dry
Moisture	6.7	6.7	%
Oxygen wet	11.2	11.2	%
Oxygen dry	12.0	12.0	%
Gen flow dry, 5%O2	1.85	3.70	Nm3/s at 273K, dry, 5%O2
Gen stack area	0.28		Based on flue diameter of 0.5 m
Gen velocity from stack	32.10		m/s
Plenum area	25.00	25.00	5m x 5m
Total velocity from Plenur	1.81	3.61	m/s
NOx	2172	2172	mg/Nm3 at ref conditions
NOx	4.0	8.0	g/s
NOx	5.9	5.9	g/kWh
NOx	4.1	8.13	g/s

Gair Consulting Limited
Osterley
White Lackington
Piddletrenthide
Dorchester
DT2 7QU

Tel: 01869 278889