New Oxford Street Limited

23-25 New Oxford Street

Air quality assessment

Final | 5 February 2020

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Contents

1 Introduction

This air quality assessment has been prepared on behalf of New Oxford Street Limited to assess the potential air quality impact of a new back-up diesel generator installation, in the ground floor units of 23-25 New Oxford Street. This full report supersedes the air quality assessment report previously submitted in October 2019.

The 'Site' (23-25 New Oxford Street) is located to the south of New Oxford Street and to the west of Museum Street in Camden, London. The Site location is shown in Figure 1.

The proposed generator installation is to support essential business continuity of an incoming tenant. The generators will only ever be tested or used in an emergency situation when there is a power outage.

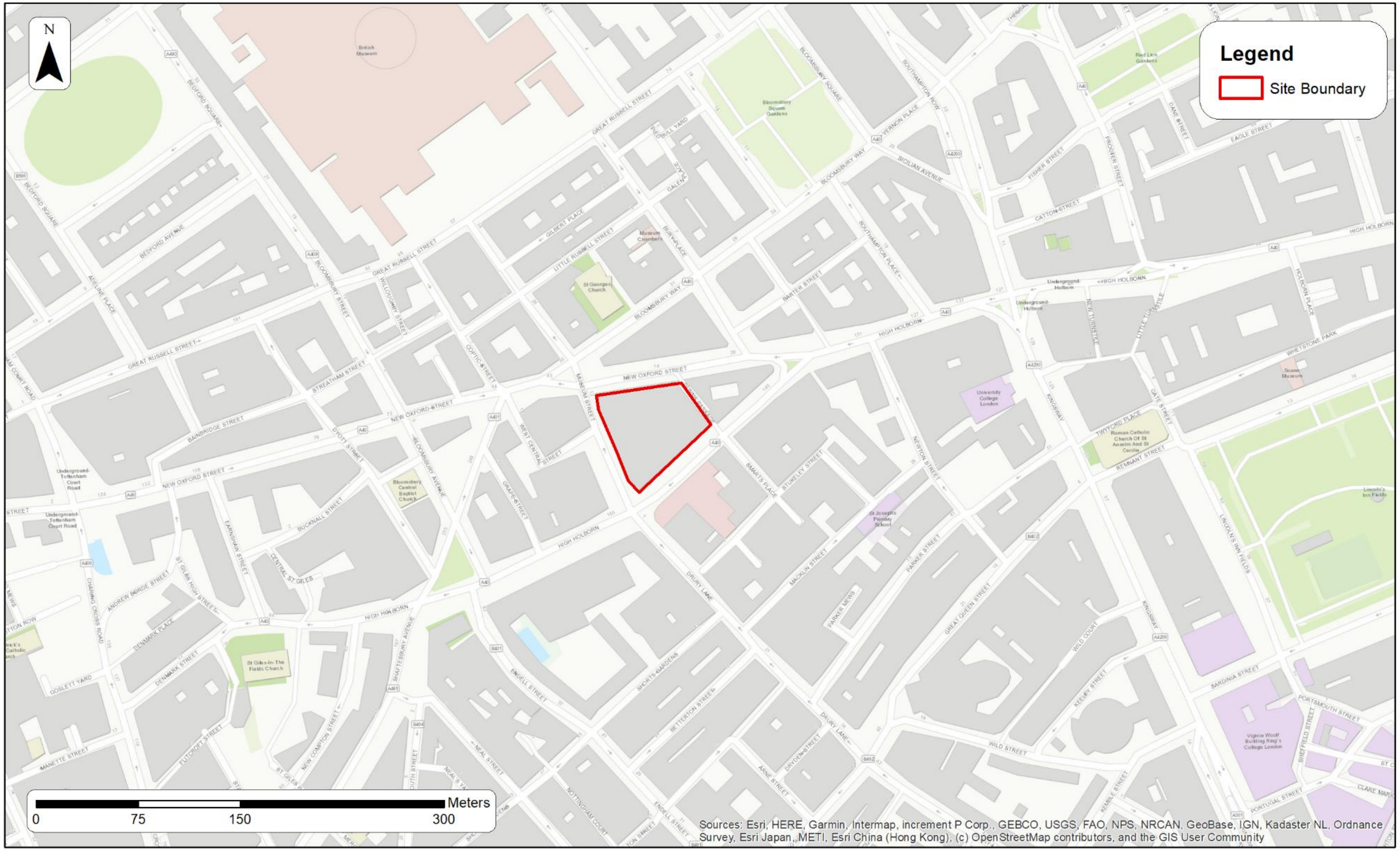
1.1 Scope of assessment

This report reviews the existing air quality conditions in the vicinity of the Site and the likely significant air quality impacts resulting from the installation of the back-up diesel generators. The effects have been assessed in the context of relevant national, regional and local air quality policies.

The overall approach to the air quality assessment comprises:

- A review of the existing air quality conditions at, and in the vicinity of, the Site;
- Consideration of embedded mitigation measures;
- An assessment of the potential air quality impact from the operation of the generators; and
- Formulation of mitigation measures, where appropriate, to ensure any adverse effects on air quality are minimised

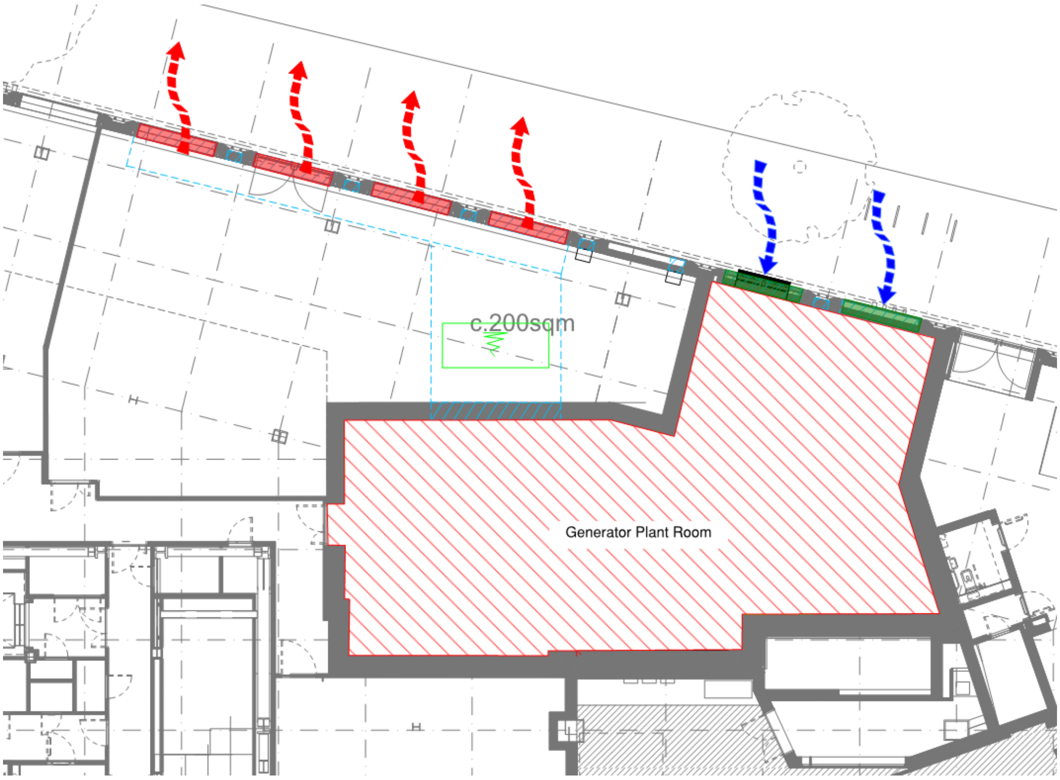
Figure 1: Location of the site



2 Generator design

The business continuity resilience required by the tenant involves the installation of three generators (operated in a duty/assist/standby configuration). It is proposed that these will be housed in a purpose-built plant enclosure on the ground floor behind a retail unit on New Oxford Street. The tenants design team have completed an initial design review process to determine the specification of the proposed generators and the layout of the plant space as shown in Figure 2.

Figure 2: Proposed generator plant room



The generator room requires sufficient ventilation for cooling the generators and providing air for combustion. This airflow will require a series of air intake & exhaust louvres in the northern façade of the building. The tenants have advised that they will require a louvre area of $19.5m^2$ and $17.63m^2$ for the air intake and exhausts respectively.

In order to accommodate the required amount of louvre area to provide the necessary air flow, it is proposed that the louvres will be arranged at 4.68m above ground level on the northern façade of the building (adjacent to New Oxford Street), as well as a single full height louvre at the Eastern end of the façade. The position of these louvres is indicated on the plan image (Figure 2), and the building elevation image (Figure 3), with intake air shown in blue/green, and exhaust in red. In between there is a louvre provided for the ventilation of the retail unit.

Other locations within the building for the installation of the generators have been investigated but have been ruled out due to either technical or spatial constraints.

Figure 3: North Building Elevation: Generator Intake (green) & Exhaust (red) Air Louvre Positions

The proposed exhaust gas discharge strategy is to mix the exhaust gases with the cooling airflow, to dilute the pollutant concentration, and discharge from the building at 4.68m above ground floor.

The principle of flue gas dilution will lower the overall concentrations of pollutants by combining the cleaner outside air, used for cooling, with the exhaust gases from the combustion process. This outside air will dilute the generator waste gases before terminating through the discharge louvres. The system is designed on the principle of diluting the vented products of combustion to reduce the concentration of air pollutants emitted.

The generators will be fixed with Selective Catalytic Reduction (SCR) to reduce emissions of oxides of nitrogen (NOx) and Diesel Particulate Filters (DPF) to reduce emissions of particulate matter (PM). The SCR adjusted figures are estimated to give a 90% reduction for NOx emissions based on the manufacturer's advice when the exhaust temperature is above 220ºC and the DPF is estimated to give an 80% reduction in PM emissions at all loads.

The fuel tanks are designed to allow the generators to run for a maximum of 48 hours (in the event of a power outage only). However, this represents a pessimistic scenario, and the generators are not expected to be used in this way.

The projects utilities specialist, TUSC, has confirmed that United Kingdom Power Networks (UKPN) have encountered only 91 minutes of power outages to the infrastructure serving the building since 2015, of which only 1 minute has been since recent infrastructure upgrades which were completed at the end of 2017.

These unexpected outages are detailed as follows;

- one minute on 2nd May 2019;
- 90 minutes (supply went off at 19:43 and restored at 21:13) on 31st January 2015.

The tenant has advised that in their other buildings, generators have been required to run due to power loss typically less than once per annum for varying durations, and the period of operation has not exceeded 1 hour.

2.1 Embedded mitigation

The following is a summary of the embedded mitigation included within the design of the generators:

- The proposed exhaust gas discharge strategy is to mix the exhaust gases with the cooling airflow, to dilute the pollutant concentrations;
- Discharging at a level above the pavement (4.68m) and with a high temperature, the discharge air will have a level of buoyancy naturally taking the pollutants away from the occupied zone at street level;
- The size of the generators has been optimised, through use of load shedding and intelligent controls; and
- The exhausts have Selective Catalytic Reduction (SCR) for NOx and Diesel Particulate Filter (DPF) for PM installed to reduce emissions.

3 Legislation, policy and guidance

A review of national, regional and local air quality policy, legislation and guidance has been carried out for this assessment. Details of the relevant documents followed for this assessment are presented in Appendix A for objectives and legislation and B for policy and guidance.

4 Method of assessment

4.1 Method of baseline assessment

Existing or baseline ambient air quality refers to the concentration of relevant pollutants that are already present in the environment. These are present from various sources, such as industrial processes, commercial and domestic activities, traffic and natural sources.

A desk-based review of the following data sources has been undertaken to determine baseline conditions of air quality in this assessment:

- Local authority review and assessment reports and local air quality monitoring data[1,2,3];
- London air website[4]; and
- The Environment Agency website[5].

The baseline assessment identifies the main sources of air pollution within 1km of the Site, the local air quality monitoring data from 2015 to 2018 and local background pollutant concentrations.

4.2 Method of operational assessment

4.2.1 Assessment scenarios

The proposed generator usage has been designed to be as low as possible and consists of testing and an emergency situation (in the event of a power outage). Dispersion modelling has been carried out to predict the impact from the emissions of the generators under the three scenarios:

1. Periodic (monthly) testing;
2. Annual testing;
3. Emergency situation.

The loading of the generators, duration and frequency of operation, number of generators in use, and time profile of operation are different for each scenario and the details are summarised in Table 1.

[1] London Borough of Camden (2019) Air Quality Annual Status Report for 2018
[2] Westminster City Council (2019) Air Quality Annual Status report for 2018
[3] City of London (2018) Air Quality Annual Status Report for 2017
[4] London Air website operated by King's College London http://www.londonair.org.uk/LondonAir/Default.aspx [Accessed January 2020]
[5] Environment Agency website https://environment.data.gov.uk/public-register/view/search-industrial-installations; [Accessed: January 2020]

It has been assumed that over a year, there will be 11 part-load periodic testing periods which will take place once per month for 11 months, for 1.5 hours in total, and one full load testing on month 12, for an 8-hour duration.

It should be noted that Scenario 3 for the emergency situation is very pessimistic, assuming two generators running at 100% load for 48 consecutive hours. This is the maximum number of hours that the generators can run based on the fuel allowance. This is considered to be a very unlikely scenario.

Table 1: Summary of dispersion modelling scenarios

Parameter	Scenario 1	Scenario 2	Scenario 3
Description	Periodic testing	Annual testing	Emergency situation (in the event of a power outage)
Loading	25%	100%	100%
Duration	0.5 hour per unit (1.5 hours in total)	8 hours	48 hours
Frequency (per annum)	11 occasions	1 occasion	1 occasion
Number of generators in operation	3 in succession	2 in parallel	2 in parallel
Time profile	0600 - 1800 weekends only	0600 - 1800 weekends only	No restrictions

4.2.2 Sensitive receptors

A desk-top study as well as a site visit were undertaken in order to identify receptors in the vicinity of the proposed development that required specific consideration during the assessment.

The specified receptors chosen for the assessment are detailed in Table 2 and shown in Figure 4. Receptors E and F are residential receptors, while all the others are either hotel or commercial receptors. All receptors were modelled at various heights to assess potential impact at relevant floors in the buildings. A site visit was carried out to the area surrounding 23-25 New Oxford Street in December 2019. The following observations were made while visiting the Site and have been used to assume the heights for modelled receptors:

- The first four floors of 1 Museum Street and Travelodge are a multi-storey car park, which is not a sensitive receptor. The first four floors were considered to be 4m per floor (16m total). Hence the initial height of the receptor is at 16m.
- The ground floor of 10 Bloomsbury Way is the height of two floors and has no openable windows. The initial height of this receptor is 10m, as viewed as the likely height during the site visit.

- The first eight floors of 1 Oxford Street (assumed to be 24m) have no openable windows. Therefore, receptors have been modelled for floors nine and 10 at 27m and 30m respectively.

A 1km x 1km grid of discrete points (with a 10m resolution) centred on the Site has also been modelled to make sure that potential impacts are assessed across the entire study area. The gridded output has been used for contour plotting of the modelled concentrations and to identify the maximum concentration across the gridded domain.

Two heights were modelled for the gridded output: 1.5m and 8m. These represent the pollutant concentrations due to the emissions from the generators at the average human head height at standing level, as well as the first floor of openable windows on the Site where people could be exposed to poor air quality. Gridded output has been provided for NO_2 concentrations as it is the key pollutant of concern.

Table 2: Details of discrete sensitive receptors

ID	Name	Type	NGR (m)		Heights modelled (m)
			X	Y	
A	1 Museum Street, Travelodge	Hotel	530199	181424	16, 30, 45
B	10 Museum Street	Commercial	530197	181450	5, 10, 15
C	Old Crown Public House	Commercial	530193	181459	5, 10, 15
D	36 New Oxford Street	Commercial	530182	181485	5, 10, 15
E	40 Bloomsbury Way	Residential	530189	181495	5, 10, 15, 20
F	40 Bloomsbury Way	Residential	530209	181504	5, 10, 15, 20
G	10 Bloomsbury Way	Commercial	530214	181481	10, 20, 30, 40
H	10 Bloomsbury Way	Commercial	530239	181486	10, 20, 30, 40
I	10 Bloomsbury Way	Commercial	530307	181498	10, 20, 30, 40
J	New Oxford Street - Museum Street corner	Commercial	530210	181460	8, 15, 20, 25, 30
K	23-25 New Oxford Street - above louvres	Commercial	530237	181465	8, 15, 20, 25, 30
L	23-25 New Oxford Street - above louvres	Commercial	530241	181466	8, 15, 20, 25, 30
M	23-25 New Oxford Street - above louvres	Commercial	530246	181466	8, 15, 20, 25, 30
N	23-25 New Oxford Street - above louvres	Commercial	530250	181467	8, 15, 20, 25, 30
O	23-25 New Oxford Street - eastern corner	Commercial	530271	181471	8, 15, 20, 25, 30
P	1 Oxford Street	Commercial	530276	181471	27, 30
Q	1 Oxford Street	Commercial	530312	181477	27, 30

Figure 4: Location of modelled receptors

4.2.3 Dispersion model set-up

The ADMS 5 dispersion model (version 5.2.2) has been used for the modelling of the emissions from the generators. This was the most up-to-date version of the model at the time of the assessment. The ADMS model has been widely validated for combustion emission modelling and is accepted by the industry as being 'fit-for-purpose' for air quality assessments.

Stack inputs

The height and dimensions of the four exhaust louvres was provided by the project team's mechanical engineers and the information is summarised in Table 3.

Table 3: Details of louvres

Vent no	1	2	3	4
NGR X, Y (m)	530250, 181467	530246, 181466	530241, 181466	530237, 181465
Height (m, centre point of louvre)	4.68			
Area per louvre (m^2)	4.79			

The louvres have been modelled as four individual stacks (i.e. point sources) in the dispersion model so that the effect of buildings on the dispersion of pollutants could be taken into account. This is considered to be important for this assessment as the site is located in a built-up urban area surrounded by large number of tall buildings. The diameter of the modelled stacks have been calculated to make sure that the exit velocity and volumetric flow rate of exhaust gases are the same as those from the louvres. It has been assumed that the exhaust from the generators will be evenly distributed among the four louvres.

The generator manufacturer has provided the emission factors for NOx and total particulate matter. The generators have different emission factors at different loading and this has been taken into account in the data provided. There is no information on the fractions of the various sizes of particulate matter in the exhaust gas. As a result it has been assumed that all the particulate matter to be in the range of PM_{10}. The modelling parameters for each stack, including pollutant emission factors, are detailed in Table 4.

The assessment of short term effects has used the relevant modelling scenarios and emissions, and concentrations have been calculated using the relevant air quality objective percentiles (i.e. 99.8th percentile for NO_2 and 90.4th percentile for PM_{10}).

The assessment of long term effects was based on the short term predicted emissions. The maximum concentration predicted (i.e. the 100th percentile concentration value) has been multiplied by the maximum number of hours of operation for each scenario, and then divided by the total number of hours in a year (8760). This assumes that the maximum concentration will occur repeatedly over the hours when the generators will be in operation. This method has been applied to calculate the worst-case annual mean concentration at the discrete receptors and on the modelled grid. This is a conservative approach, as it is highly unlikely that the operation of the generators would coincide with the worst case meteorological conditions.

Table 4: Modelling parameters for each stack in each modelling scenario

Parameter		**Scenario 1**	**Scenario 2**	**Scenario 3**
Description		Periodic testing	Annual testing	Emergency situation (in the event of a power outage)
Diameter of modelled stacks (m)		2.47		
Velocity (m/s)		0.64	1.43	
Temperature (°C)		80.49	121.47	
Emission factor (g/s)	NOx	1.42×10^{-2}	5.25×10^{-2}	
	PM_{10}	5.86×10^{-4}	1.09×10^{-3}	

Meteorological data

Meteorological data used in this assessment has been taken from measurements at Heathrow Airport meteorological station for the years 2014 to 2018. Each model scenario has been modelled for each year, and the worst case results have been presented in this assessment.

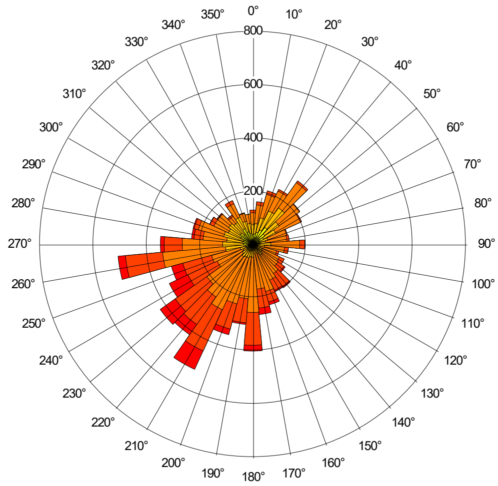
Heathrow Airport is located approximately 23km west of the proposed development. This meteorological site is considered the most suitable for this assessment.

Most dispersion models of roads do not use meteorological data if they relate to calm winds conditions, as dispersion of air pollutants is more difficult to calculate in these circumstances. ADMS-Roads treats calm wind conditions by setting the minimum wind speed to 0.75m/s. LAQM TG(16)[25] guidance states that the meteorological data file is tested in a dispersion model and the relevant output log file checked to confirm the number of missing hours and calm hours that cannot be used by the dispersion model. This is important when considering predictions of high percentiles and the number of exceedances. The guidance recommends that meteorological data should only be used if the percentage of usable hours is greater than 75% and preferably greater than 90%.

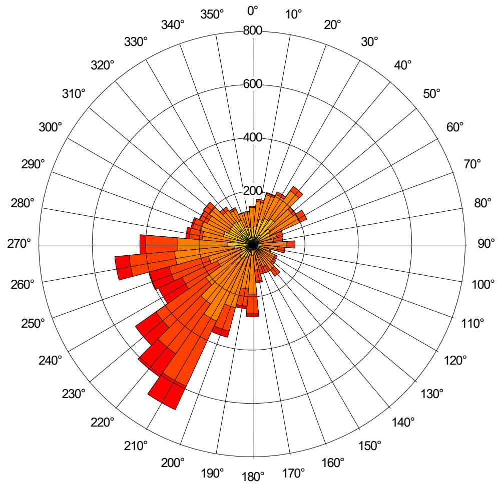
All the meteorological data selected from Heathrow airport includes greater than 95% of usable data. This is above the 90% threshold and this data therefore meets the requirement of the Defra guidance. Wind roses for the Heathrow Airport meteorological data are presented in Figure 5.

Figure 5: Wind roses for Heathrow Airport 2014 to 2018 meteorological data

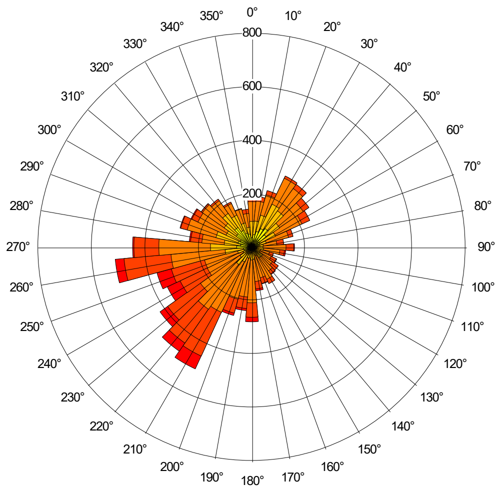
2014



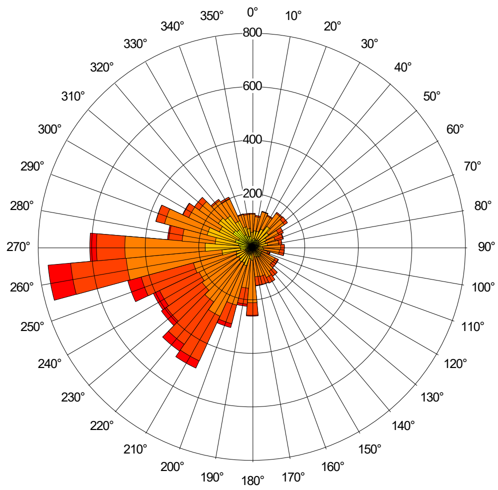
2015



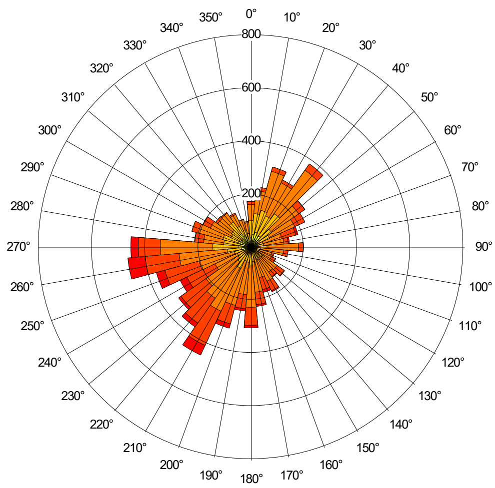
2016

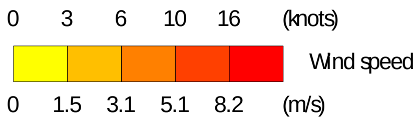


2017



2018





Building effects

Buildings can have a significant effect on the dispersion of pollutants, particularly if they are greater than 30-40% of the height of the stack. The size and proximity of a building to source determines whether the plume will become fully or partially entrained in the cavity zone downwind of the building. This can lead to higher ground concentrations near the modelled stack than would be expected in the absence of buildings and can affect the dispersion of pollutants further downwind.

Buildings can only be added to the ADMS model as rectangular or circular shapes. Therefore, some simplification of the building geometries has been made. The model also requires that one of the buildings is selected as the main building which is used to set the height for the effective building used by the model.

There are a number of buildings surrounding the Site. The geometries for each building included in the dispersion modelling are presented in Table 5 and a map showing the locations of buildings is provided in Figure 6. 23-25 New Oxford Street, where the flues are located, has been modelled as the main building. The louvres for the generator room, modelled as stacks, are situated on the north-side of the building and are influenced by the building wake. Downwash effects have been taken into account by the ADMS dispersion model.

Table 5: Modelled building geometries

ID	Name	Shape	NGR (m)		Height (m)	Length (m) / diameter (m)	Width (m)	Angle (degrees)
			X	Y				
1	23-25 New Oxford Street	Rectangular	530245	181434	48	65	62	80
2	1, Museum Street, Travelodge	Rectangular	530199	181402	55	42	16	160
3	36 New Oxford Street	Rectangular	530158	181479	20	50	11	245
4	Old Crown Public House	Rectangular	530192	181454	17	10	5	160
5	10 Museum Street	Rectangular	530197	181442	17	15	6	160
6	40 Bloomsbury Way	Rectangular	530194	181509	24	23	21	65
7	10 Bloomsbury Way	Rectangular	530259	181499	46	95	20	80
8	1 Oxford Street	Rectangular	530306	181462	33	65	26	80

Figure 6: Modelled buildings and stacks

Other model inputs

The extent of mechanical turbulence (and hence, mixing) in the atmosphere is affected by the roughness of the surface/ground over which the air is passing. Typical surface roughness values range from 1.5m (for cities, forests and industrial areas) to 0.0001m (for water or sandy deserts).

In this assessment, a surface roughness of 1.5m and 0.5m, and a minimum Monin-Obukhov length of 100m and 30m, have been used at the dispersion site and met data site respectively.

4.2.4 NOx to NO_2 conversion

The model predicts NOx concentrations which comprise nitric oxide (NO) and nitrogen dioxide (NO_2). NOx is emitted from combustion processes, primarily as NO with a small percentage of NO_2. The emitted NO reacts with oxidants in the air (mainly ozone) to form NO_2. NO_2 is associated with effects on human health and therefore the air quality standards for the protection of human health are based on NO_2 rather than total NOx or NO.

A suitable NOx:NO_2 conversion has been applied based on a percentage conversion rate. This assessment has assumed that 70% of long-term and 35% of short-term NOx concentrations will convert to NO_2. This is based on the Environment Agency's recommendation for a detailed assessment[6] and it is considered appropriate for this assessment.

4.2.5 Significance criteria

The EPUK/IAQM guidance note 'Land-use planning and development control' provides an approach to determining the air quality impacts resulting from a proposed development and the overall significance of local air quality effects arising from a proposed development, which has been used in this assessment.

Impact descriptors are determined based on the magnitude of incremental change as a proportion of the relevant assessment level, in this instance the annual mean NO_2 and PM_{10} objectives. The change is then examined in relation to the predicted total pollutant concentrations in the assessment year and its relationship with the annual mean NO_2 and PM_{10} objectives. The assessment framework for determining impact descriptors at each of the assessed receptors is shown in Table 6.

The guidance also provides advice for determining the magnitude of change for short-term concentrations, which is shown in Table 7. The impact descriptor is determined by considering the process contribution only. However, in assessing the significance, consideration is also given to total pollutant concentrations,

[6] Environment Agency. Environmental permitting: air dispersion modelling reports. https://www.gov.uk/guidance/environmental-permitting-air-dispersion-modelling-reports [accessed January 2020]

including background concentrations, and comparison of these with short-term objectives.

Table 6: Impact descriptors

Annual average concentrations at receptor in the assessment year	**% Change in concentrations relative to annual mean NO_2 and PM_{10} objectives**			
	1	**2-5**	**6-10**	**>10**
75% or less of objective	Negligible	Negligible	Slight	Moderate
76-94% of objective	Negligible	Slight	Moderate	Moderate
95-102% of objective	Slight	Moderate	Moderate	Substantial
103-109% of objective	Moderate	Moderate	Substantial	Substantial
110% of more of objective	Moderate	Substantial	Substantial	Substantial
Note: Changes in pollutant concentrations of less than 0% i.e. <0.5% would be described as negligible				

Table 7: Magnitude of change for short-term concentrations

Change in hourly mean concentrations at receptor in the assessment year	**Magnitude of Change**	**Impact Descriptor**
<10% of hourly mean NO_2 threshold	Imperceptible	Negligible
10-20% of hourly mean NO_2 threshold	Small	Slight
20-50% of hourly mean NO_2 threshold	Medium	Moderate
>50% of hourly mean NO_2 threshold	Large	Substantial

5 Baseline assessment

5.1 Sources of air pollution

5.1.1 Industrial processes

Industrial air pollution sources are regulated through a system of operating permits or authorisations, requiring stringent emission limits to be met, and ensuring that any releases to the environment are minimised or rendered harmless. Regulated (or prescribed) industrial processes are classified as Part A or Part B processes and are regulated through the Pollution Prevention and Control (PPC) system[7,8]. The larger, more polluting processes are regulated by the EA, and the smaller less polluting ones by the local authorities. Local authorities focus on regulation for emissions to air, whereas the EA regulates emissions to air, water and land.

There are no regulated Part A processes with releases to air relevant to this assessment within 1km of the Site listed on the EA website. The impact of Part A and B processes further from the Site are assumed to be included in local monitoring data.

5.1.2 Road traffic

In recent decades, transport atmospheric emissions, on a national basis, have grown to match or exceed other sources in respect of many pollutants, particularly in urban areas. In this area, vehicle emissions are likely to be the dominant source of air pollutants in the vicinity of the Site. The main pollutants associated with road traffic are:

- Nitrogen dioxide (NO_2);
- Fine particulate matter (PM_{10} and $PM_{2.5}$).

The Site is bound by New Oxford Street to the north, High Holborn to the south-east and Museum Street to the west. High Holborn is a major A road, as are Bloomsbury Way to the north and Shaftesbury Avenue to the west.

5.2 Local air quality

The Environment Act 1995 requires local authorities to review and assess air quality with respect to the air quality objectives for the pollutants specified in the National Air Quality Strategy. Local authorities are required to carry out an Annual Status Report (ASR) of their area every three years. If the ASR identifies potential hotspot areas likely to exceed air quality objectives, then a detailed assessment of those areas is required. Where objectives are not predicted to be

[7] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control)
[8] The Environmental Permitting (England and Wales) (Amendment) Regulations 2013, SI 2013/390

met, local authorities must declare the area as an Air Quality Management Area (AQMA). In addition, local authorities are required to produce an Air Quality Action Plan (AQAP) that includes measures to improve air quality within the AQMA.

The Site is located in the London Borough of Camden (LBC) area but within 1km of City of London (CoL) and the Westminster City Council (WCC) areas. As part of the review and assessment process, LBC, CoL and WCC declared their whole boroughs as AQMAs in 1999, 2001 and 2002 respectively, due to exceedances of the annual mean objective for NO_2 and the daily mean objective for PM_{10}. Figure 7 shows the declared LBC, WCC and CoL AQMAs.

5.3 Local monitoring

Air quality monitoring is undertaken across Camden using both automatic and passive monitoring methods. As the Site is located in south Camden, close to the boundary with Westminster and City of London, monitoring data for the three local authorities has been reviewed. Figure 8 presents air quality monitoring site locations within 1km of the Site.

Figure 7: LBC, WCC and CoL AQMA

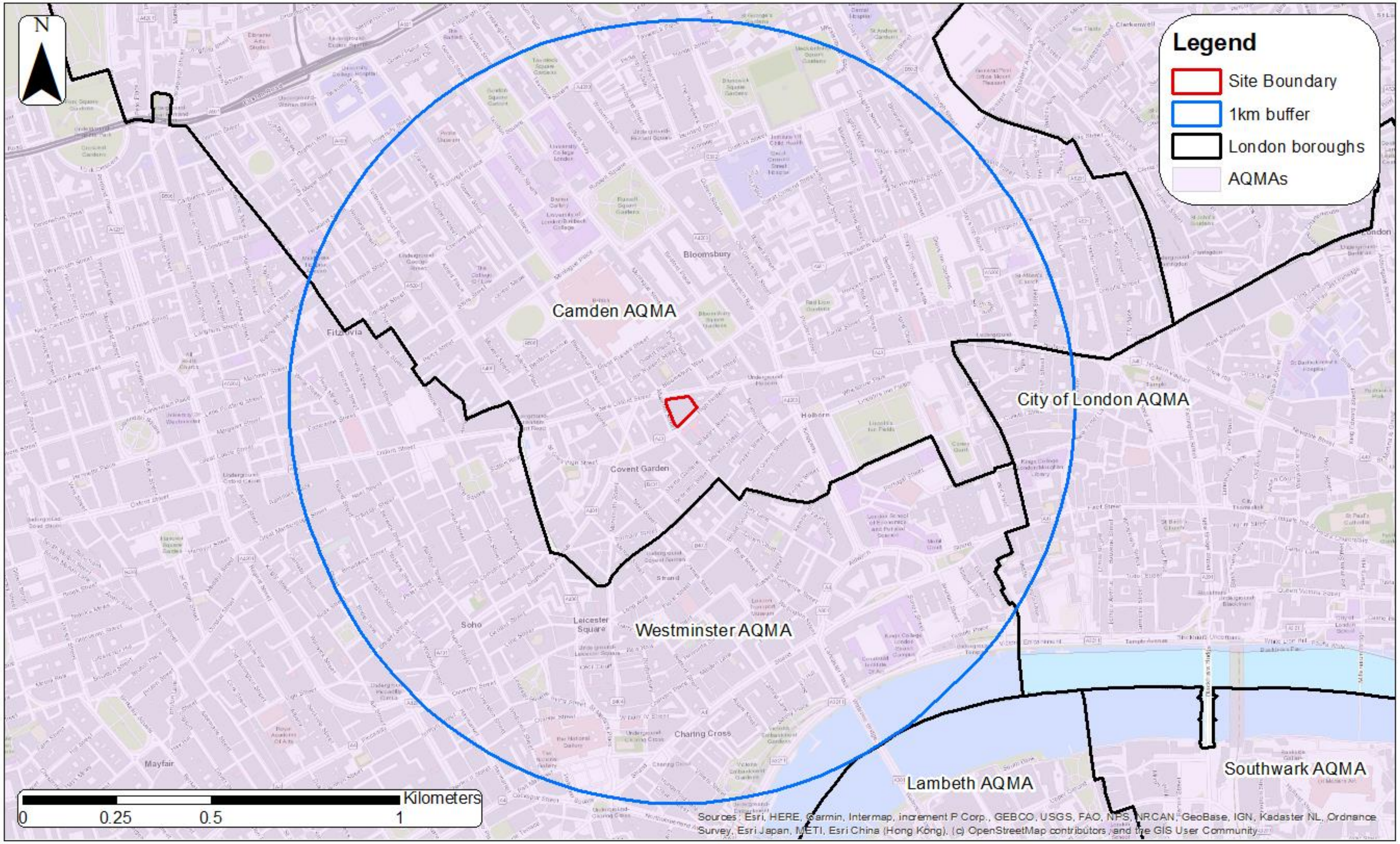
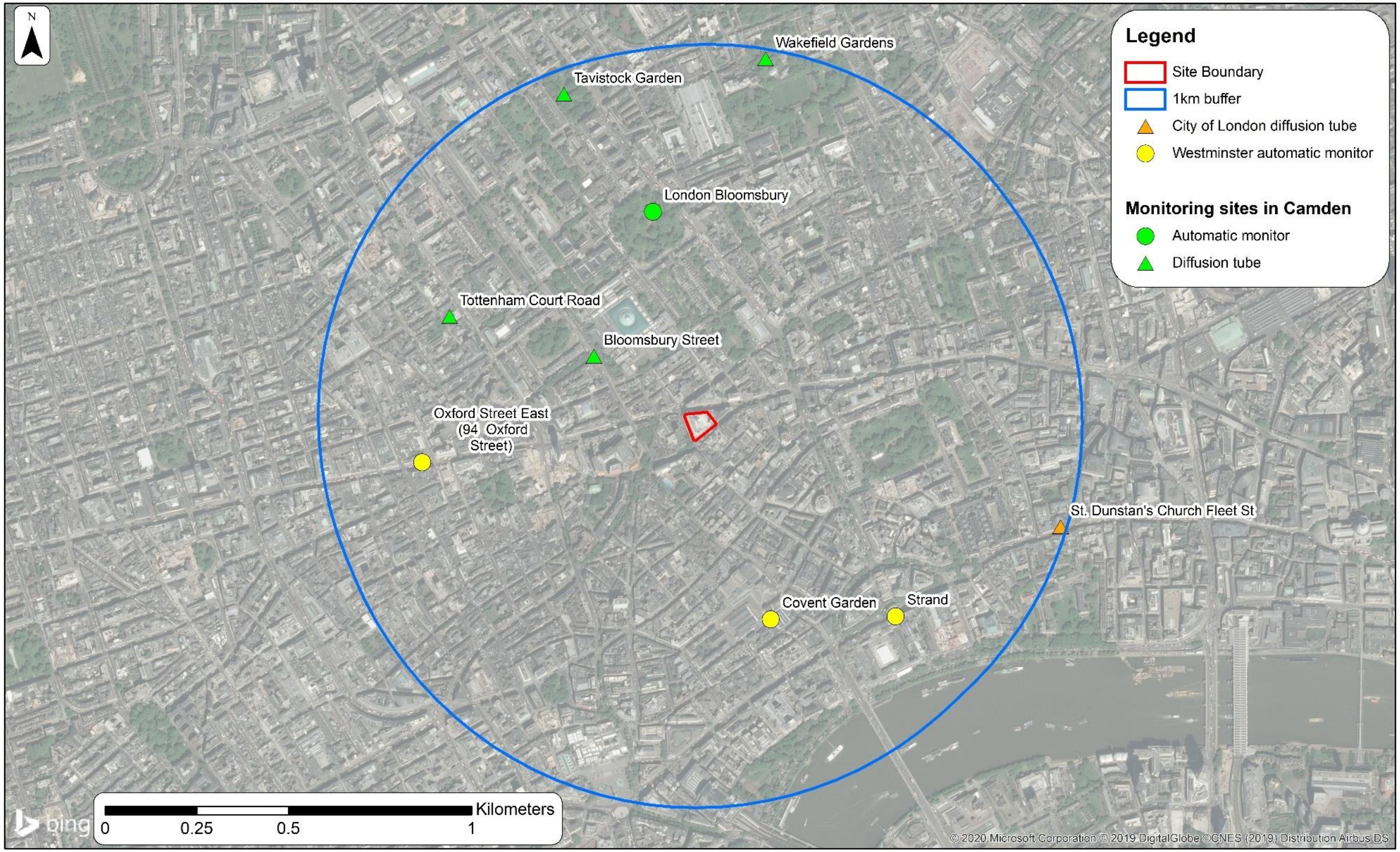


Figure 8: Monitoring sites within 1km of the Site



5.3.1 Automatic Monitoring

A review of the LBC[1], WCC[2] and CoL[3] ASRs showed that within 1km of the Site there are four automatic monitors. There is one urban background site (London Bloomsbury) in LBC; one urban background (Covent Garden) site and two roadside (Strand and Oxford Street East) monitoring sites in WCC. There are no automatic monitoring sites in CoL within 1km of the Site. The details of these monitoring sites are provided in Table 8. The Euston Road monitoring site is more than 1km from the Site, however this has been requested by LBC as being included in the assessment.

Table 8: Automatic monitoring stations within 1km of the Site

Site Name	NGR (m)		Site Type	Pollutants monitored	Distance and direction from Site	Local Authority
	X	Y				
London Bloomsbury	530123	182014	Urban Background	NO_x/NO_2, PM_{10}, $PM_{2.5}$, SO_2, O_3	570m N	LBC
Euston Road	529878	182648	Roadside	NO_x/NO_2, PM10, PM2.5	1.2km N	LBC
Strand	530785	180911	Roadside	NO_x/NO_2	715m SE	WCC
Covent Garden	530444	180903	Urban Background	NO_x/NO_2	522m S	WCC
Oxford Street East (94 Oxford Street)	529493	181331	Roadside	NO_x/NO_2, PM_{10}	726m W	WCC

Table 9 presents the recent NO_2 monitoring results from 2015 to 2018 from these four automatic monitoring stations. At the time of writing, 2019 results have not yet been fully ratified. Results in bold indicate an exceedance of the relevant air quality objective.

Significant exceedances above the annual mean NO_2 objective of 40 $\mu g/m^3$ occurred at the roadside sites on the Strand and Oxford Street East. The data suggests there has been a downward trend in NO_2 concentrations at the Strand, but concentration recorded in 2018 was over double the annual mean objective (88$\mu g/m^3$). Annual mean concentrations recorded at Oxford Street East roadside site were also significantly above the objective in 2018 (76$\mu g/m^3$).

Annual mean NO_2 concentrations recorded at the urban background sites at London Bloomsbury and Covent Garden in 2017 and 2018 were below the objective. Concentrations were elevated at the urban background site London Bloomsbury in 2015 and 2016 but reduced to below the annual mean objective in 2017 and 2018.

Exceedances of the hourly mean NO_2 objective were recorded at the Strand roadside monitoring site over the period from 2015-2018. The number of hourly exceedances in 2017 and 2018 at the Strand were significantly lower than those in 2015 and 2016 but still in breach of the objective, which is 200µg/m^3 not to be exceeded more than 18 times a year. The short-term hourly mean objective was not breached at the Oxford Street East roadside site or at the two urban background sites.

Table 9: Automatic monitoring results for NO_2 concentrations from 2015 to 2018

Site location	**NO_2 annual mean concentration (µg/m^3)**				**NO_2 hourly mean exceedances**			
	2015	**2016**	**2017**	**2018**	**2015**	**2016**	**2017**	**2018**
London Bloomsbury	**48**	**42**	38	36	0	0	0	0
Euston Road	**90**	**88**	**83**	**82***	**54**	**39**	**25**	18
Strand	**122**	**101**	**92**	**88**	**284**	**235**	**26**	**34**
Covent Garden	n/a	n/a	37	39	n/a	n/a	0	0
Oxford Street East (94 Oxford Street)	n/a	n/a	n/a	**76***	n/a	n/a	n/a	11
*Data has been annualised								

Table 10 presents the recent PM_{10} monitoring results from 2015 to 2018. The results indicate that annual mean concentrations of PM_{10} are well below the annual mean PM_{10} objective of 40µg/m^3. The daily mean objective (50µg/m^3) has not been exceeded more than 35 times a year between 2015 and 2018 at either London Bloomsbury, Euston Road or Oxford Street East sites.

Table 10: Automatic monitoring results for PM_{10} concentrations from 2015 to 2018

Site location	**PM_{10} annual mean concentration (µg/m^3)**				**PM_{10} 24-hour mean exceedances**			
	2015	**2016**	**2017**	**2018**	**2015**	**2016**	**2017**	**2018**
London Bloomsbury	19	20	19	17	6	9	6	1
Euston Road	18	24	20	23	5	10	3	2
Oxford Street East (94 Oxford Street)	n/a	n/a	n/a	28*	n/a	n/a	n/a	1
*Data has been annualised								

Table 11 presents the recent $PM_{2.5}$ monitoring results from 2015 to 2018 from the London Bloomsbury and Euston Road monitoring sites. London Bloomsbury is the only station monitoring $PM_{2.5}$ within 1km of the Site. There were no exceedances of the $PM_{2.5}$ annual mean air quality objective (25µg/m^3) between 2015 and 2018.

Table 11: Automatic monitoring results for $PM_{2.5}$ concentrations from 2015 to 2018

Site location	$PM_{2.5}$ annual mean concentration (µg/m^3)			
	2015	2016	2017	2018
London Bloomsbury	11	12	13	10
Euston Road	17	17	14	16

5.3.2 Passive Monitoring

LBC monitors NO_2 using a network of 14 diffusion tubes across the borough. There are four diffusion tubes located within 1km of the development. CoL also have one diffusion tube monitoring site within 1km of the Site. The details of these monitoring locations are listed in Table 12.

Table 12: Passive monitoring sites within 1km of the Site

Site Name	NGR (m)		Site Type	Distance and direction from Site	Local Authority
	X	Y			
Bloomsbury Street	529962	181620	Roadside	289m NW	LBC
Tottenham Court Road	529568	181728	Kerbside	691m NW	
Tavistock Gardens	529880	182334	Urban Background	935m N	
Wakefield Gardens	530430	182430	Urban Background	990m NE	
St. Dunstan's Church, Fleet St	531235	181155	Roadside	960m SE	CoL

Table 13 presents the recent NO_2 monitoring results from 2015 to 2018. The results indicate consistent exceedances of the annual mean NO_2 objective at the roadside and kerbside monitoring locations along Bloomsbury Street and Tottenham Court Road. Exceedances of the annual mean NO_2 objective have also been recorded at the urban background monitoring locations in 2015 (44.57µg/m^3) but have reduced to below the objective between 2016 and 2018. The Tottenham Court Road site measured an annual mean NO_2 concentration of 65.7µg/m^3 in 2018. This is the highest NO_2 concentration measured in 2018 from the five diffusion tubes and is above the annual mean air quality objective (40µg/m^3).

Table 13: Passive monitoring results for NO_2 concentrations from 2015 to 2018

Site Name	**Annual mean NO_2 concentration ($\mu g/m^3$)**			
	2015*	**2016***	**2017***	**2018***
Bloomsbury Street	**71.4**	**72.2**	**80.7**	**59.4**
Tottenham Court Road	**85.6**	**83.6**	n/a	**65.7**
Tavistock Gardens	**44.6**	39.7	n/a	35.4
Wakefield Gardens	35.8	31.3	n/a	26.7
St. Dunstan's Church, Fleet St	**87.0**	**81.0**	**82.0**	n/a
Notes: n/a – no data available; *means have been "annualised" in accordance with LLAQM Technical Guidance, if valid data capture is less than 75%				

5.4 Background pollutant concentrations

It has been agreed with the EHO at LBC that the Site is classified as being between a roadside and an urban background location. This is because the Site is set back from main roads, but near to New Oxford Street to the north, High Holborn to the south-east and Museum Street to the west. Given the location of the Site it is considered that monitored concentrations at London Bloomsbury and Bloomsbury Street will be the most representative of pollutant concentrations. Based on this, background concentrations of annual mean NO_2 will likely be between 38-59.4$\mu g/m^3$ (based on 2018 concentrations), and therefore an annual mean NO_2 background concentration of **48.7$\mu g/m^3$** has been used in the assessment.

LBC has also requested that the measured PM concentrations at the Euston Road monitoring station for 2018 are used as background PM concentrations for this assessment. As a result, the annual mean PM_{10} background concentration of **20.97$\mu g/m^3$** has been used in the assessment. LBC advised that their ASR includes data for 2018, however since submission, Kings College have made some adjustments to the final set of ratified data therefore the concentrations here are the final annualised results.

For short-term concentration calculations the annual mean background concentrations have been **multiplied by two** as per Environment Agency's guidance[9].

The background concentrations used in the assessment have been agreed with the EHO at LBC.

[9] Environmental Agency (2016) Air emissions risk assessment for your environmental permit guidance

6 Operation assessment

6.1 Long-term impact (annual mean)

The annual mean process contribution from scenarios 1 (periodic monthly testing) and 2 (annual testing) have been combined to determine the long-term impact from all the planned testing that would occur throughout a year. The long-term impact from scenario 3 is considered in isolation as it is an unknown when an emergency situation would occur.

It should be noted that the long-term annual mean air quality objectives only apply at locations where "*members of the public might be regularly exposed. Building façades of residential properties, schools, hospitals, care homes etc*"[25]. As a result, the long-term impact has been considered at Receptors E and F only where residential dwellings are present.

6.1.1 Scenarios 1 and 2 combined

For the discrete receptors, the maximum predicted change in annual mean NO_2 concentrations (0.14µg/m^3) is predicted to occur on the façade of 40 Bloomsbury Way at Receptor E (all heights). The impact is predicted to be negligible at all residential receptors assessed.

The contour plots showing the predicted long-term NO_2 process contribution for scenarios 1 and 2 combined at 1.5m and 8m are shown in Appendix D, Section D1 and D2. The contour plots show the façade of 40 Bloomsbury Way is predicted to be exposed to a maximum process contribution of 0.43µg/m^3 at 1.5m and 0.52µg/m^3 at 8m.

The maximum predicted change in annual mean PM_{10} concentrations (0.002µg/m^3) is predicted to occur on the façade of 40 Bloomsbury Way at Receptors E and F. The impact is predicted to be negligible at all residential receptors.

For the modelled grid, the façade of 40 Bloomsbury Way is predicted to be exposed to a maximum PM_{10} annual mean process contribution of 0.003µg/m^3 at 1.5m and at 8m heights.

The predicted long-term process contribution and impact for NO_2 and PM_{10} at receptors for scenarios 1 and 2 combined are shown in Appendix C, Section C1.

The overall effect of scenarios 1 and 2 is considered to be not significant at sensitive receptors.

6.1.2 Scenario 3

For the discrete receptors, the maximum predicted change in annual mean NO_2 concentrations (0.7µg/m^3) is predicted to occur on the façade of 40 Bloomsbury Way at Receptor F (all heights). This gives a predicted impact of substantial adverse at Receptor F and moderate adverse at Receptor E. This scenario is a highly conservative approach as there is only a remote possibility that the operation of the generators would coincide with the worst case meteorological conditions.

The contour plots showing the predicted long-term NO_2 process contribution for scenario 3 at ground level and at 8m are shown in Appendix D, Section D1 and D2. The contour plots show the façade of 40 Bloomsbury Way is predicted to be exposed to a maximum NO_2 process contribution of 6.53µg/m^3 at 1.5m and 8.83µg/m^3 8m.

The maximum predicted change in annual mean PM_{10} concentrations (0.01µg/m^3) is predicted to occur on the façade of 40 Bloomsbury Way at Receptor F (all heights). The impact is predicted to be negligible for PM_{10} at all residential receptors.

For the modelled grid, the façade of 40 Bloomsbury Way is predicted to be exposed to a maximum PM_{10} annual mean process contribution of 0.015µg/m^3 at 1.5m and 0.017µg/m^3 at 8m.

The predicted long-term process contribution and impact for NO_2 and PM_{10} at receptors for scenario 3 are shown in Appendix C, Section C1.

The overall effect is considered to be not significant for PM_{10} and significant for NO_2. Mitigation to reduce the potential impact is discussed in Section 7.

6.2 Short-term impact (hourly or daily mean)

Predicted short term impacts have been compared to the relevant short term objectives; hourly mean for NO_2 and 24-hour mean for PM_{10}. Concentrations have been calculated using the relevant air quality objective percentiles (i.e. 99.8th percentile for NO_2 and 90.4th percentile for PM_{10}).

6.2.1 Scenario 1

For the discrete receptors, the maximum predicted change in hourly mean NO_2 concentrations (13.6µg/m^3) is predicted to occur on the façade of 23-25 New Oxford Street at Receptor N (8m), which is immediately above the louvres for the generator room. There is a negligible impact for NO_2 predicted at all modelled discrete receptors.

For the modelled grid, the contour plots showing the predicted short-term NO_2 process contribution for scenario 1 at ground level and at 8m are shown in Appendix D, Section D3 and D4. The contour plots show the highest process contributions are predicted to the north of the Site in the street canyon on New Oxford Street, but there is no relevant exposure at this location. The highest predicted process contribution for 99.8th percentile of hourly mean NO_2 on the modelled grid is 25µg/m^3 at 1.5m and 12µg/m^3 at 8m.

For the discrete receptors, the maximum predicted change in daily mean PM_{10} concentrations (0.3µg/m^3) is predicted to occur on the façade of 23-25 New Oxford Street at Receptor N (8m). For the modelled grid the predicted process contribution for the 90.4th percentile of daily mean PM_{10} on the modelled grid is 0.33µg/m^3 at 1.5m and 0.29µg/m^3 at 8m. There is a negligible impact predicted for PM_{10} at all modelled discrete receptors and points on the modelled grid.

The predicted short-term process contribution and impact for NO_2 and PM_{10} at receptors for scenario 1 are shown in Appendix C, Section C2.

The overall effect is considered to be not significant.

6.2.2 Scenario 2

For the discrete receptors, the maximum predicted change in hourly mean NO_2 concentrations (58.4µg/m^3) is predicted to occur on the façade of 23-25 New Oxford Street at Receptor N (8m), which is immediately above the louvres for the generator room. There is a moderate adverse impact predicted at most of the modelled receptors, except for Receptors C to F which have a slight adverse impact predicted. However, it should be noted that the maximum total predicted hourly mean NO_2 concentration is below the NO_2 hourly mean objective of 200µg/m^3 at all modelled receptors.

For the modelled grid, the contour plots showing the predicted short-term NO_2 process contribution for scenario 2 at ground level and at 8m are shown in Appendix D, Section D3 and D4. The contour plots show the highest process contribution is predicted to the north of the Site in the street canyon on New Oxford Street, but there is no relevant exposure at this location. The highest predicted process contribution for 99.8th percentile of hourly mean NO_2 is 80µg/m^3 at 1.5m and 45µg/m^3 at 8m.

For the discrete receptors, the maximum predicted change in daily mean PM_{10} concentrations (0.6µg/m^3) is predicted to occur on the façade of 23-25 New Oxford Street at Receptors N and M (8m). For the modelled grid the predicted process contribution for the 90.4th percentile of daily mean PM_{10} on the modelled grid is 0.61µg/m^3 at 1.5m and 0.54µg/m^3 at 8m. There is a negligible impact predicted for PM_{10} at all modelled discrete receptors and points on the modelled grid.

The predicted short-term process contribution and impact for NO_2 and PM_{10} at receptors for scenario 2 are shown in Appendix C, Section C2.

Although there are moderate adverse impacts predicted for the short-term NO_2 concentrations, the total predicted concentration does not exceed the air quality objective. Therefore, the overall effect is considered to be not significant.

6.2.3 Scenario 3

For the discrete receptors during emergency operation of the generators, the maximum predicted change in hourly mean NO_2 concentrations (308.7µg/m^3) is predicted to occur on the façade of 23-25 New Oxford Street at Receptor M (8m), which is immediately above the louvres for the generator room. There is a substantial adverse impact predicted at the Site at Receptors L to N (8m) and moderate adverse impacts are predicted at all but one modelled receptor (Receptor E where a slight adverse impact is predicted).

The maximum total predicted hourly mean NO_2 concentration is below the NO_2 hourly mean objective at all locations except for on the façade of 23-25 New Oxford Street at Receptors L to N (8m).

For the modelled grid, the contour plots showing the predicted short-term NO_2 process contribution for scenario 3 at ground level and at 8m are shown in Appendix D, Section D3 and D4. The contour plots show the highest process contribution is predicted to the north of the Site in the street canyon on New Oxford Street, but there is no relevant exposure at this location. The highest predicted process contribution for the 99.8th percentile of hourly mean NO_2 is 110µg/m^3 at 1.5m and 90µg/m^3 at 8m.

For discrete receptors, the maximum predicted change in daily mean PM_{10} concentrations (2.0µg/m^3) is predicted to occur at Receptors L and M (8m) at 23-25 New Oxford Street. For the modelled grid the predicted process contribution for the 90.4th percentile of daily mean PM_{10} on the modelled grid is 1.8µg/m^3 at 1.5m and 1.7µg/m^3 at 8m. There is a negligible impact predicted for PM_{10} at all modelled discrete receptors and points on the modelled grid.

The predicted short-term process contribution and impact for NO_2 and PM_{10} at receptors for scenario 3 are shown in Appendix C, Section C2.

In view of the moderate adverse impacts predicted, together with the hourly mean concentration predicted being above the air quality objective at Receptors L to N, the overall effect is considered to be significant. Mitigation to reduce the potential impact is discussed in Section 7.

It should be noted that modelling has been carried out based on the pessimistic assumption that the generators will run for 48-hours continuously under an emergency scenario. However, the generator is never expected to be used in this way. As detailed in Section 3.2, the projects utilities specialist has confirmed that there have been only 91 minutes of power outages to the infrastructure serving the building since 2015. As a result, it is highly likely that the potential impact from the proposed generators during the emergency scenario would be lower than that predicted in this assessment.

7 Mitigation measures

In addition to the embedded mitigation as described in section 2.1, the following additional mitigation measures are required during operation of the generators:

- When there is planned testing of the generators tenants should be informed in advance to allow openable windows near to the exhaust louvres to be closed and locked;
- The operational strategy for 23-25 New Oxford Street should state that windows on the northern façade of the building above the louvres are closed and locked when the generators are running, especially during the emergency situation. This will ensure the ingress of external pollutants from the generators is minimised;
- A management process will be put in place. For any planned maintenance the pavement will be closed in advance. In an emergency situation, the building management/security team (manned 24/7) will be notified and will proceed to immediately close the pavement. It is proposed that the process for closing the pavement is agreed with LBC as part of the planning consent;
- The access door to the retail unit situated directly below the exhausts will not be used during operation of the generators;
- Testing of the generators will take place during weekend periods from 06:00-18:00. This will avoid peak traffic levels, and avoid more sensitive times from an acoustic point of view; and
- The adjacent retail unit (also to be occupied by the same tenant) should be designed so that the air exhaust louvres are in the bay adjacent to the generator exhausts and the air intakes are further away, to keep the generator exhaust from being pulled into their louvres.

It is considered that these design solutions offer sufficient mitigation and address the requirements listed in the London Plan[19], relating to minimising increased exposure and the provision to reduce emissions from a development.

8 Conclusions

No significant effect is predicted due to the operation of the back-up generators for 23-25 New Oxford Street, with the exception of the short-term exposure to elevated NO_2 concentration under Scenario 3 (emergency situation). However, the emergency situation as assessed is very unlikely to occur. In addition, mitigation measures will be put in place to minimise any impact.

Appendix A

Air quality objectives and legislation

A1 European Air Quality Management

In 1996 the European Commission published the Air Quality Framework Directive on ambient air quality assessment and management (96/62/EC)10. This Directive defined the policy framework for 12 air pollutants, including NO_2, known to have harmful effects on human health and the environment. Limit values (pollutant concentrations not to be exceeded by a certain date) for each specified pollutant were set through a series of Daughter Directives, including Directive 1999/30/EC (the 1st Daughter Directive) 11, which sets limit values for nitrogen dioxide (NO_2) and particulate matter (amongst other pollutants) in ambient air.

In May 2008, the Directive 2008/50/EC[12] on ambient air quality and cleaner air for Europe came into force. This Directive consolidates the above (apart from the 4th Daughter Directive) and makes provision for extended compliance deadlines for NO_2 and PM_{10}.

The Directive has been transposed into national legislation in England by the Air Quality Standards Regulations 2010[13]. The Secretary of State for the Environment, Food and Rural Affairs has the duty of ensuring compliance with the air quality limit values.

A2 Environment Act 1995

Part IV of the Environment Act 1995[14] places a duty on the Secretary of State for the Environment to develop, implement and maintain an Air Quality Strategy with the aim of reducing atmospheric emissions and improving air quality. The Air Quality Strategy[15] for England, Scotland, Wales and Northern Ireland provides the national air quality objectives and a framework for ensuring compliance with these values based on a combination of international, national and local measures to reduce emissions and improve air quality. This includes the statutory duty, also under Part IV of the Environment Act 1995, for local authorities to undergo a process of local air quality management and declare Air Quality Management Areas (AQMA) where pollutant concentrations exceed the national air quality objectives. Where an AQMA is declared the local authority would also need to produce an Air Quality Action Plan (AQAP) which outlines the strategy for improving air quality in these areas.

[10] Directive 96/62/EC of 27 September 1996 on ambient air quality assessment and management
[11] Directive 1999/30/EC of 22 April 1999 relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air
[12] Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe
[13] The Air Quality Standards Regulations 2010, SI 2010/1001
[14] Environment Act 1995, Chapter 25, Part IV Air Quality
[15] Defra (2007) The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, Volume 1, July 2007

A3 Air quality objectives

Some pollutants have standards expressed as annual average concentrations due to the chronic way in which they affect health or the natural environment, i.e. effects occur after a prolonged period of exposure to elevated concentrations. Other pollutants have standards expressed as 24-hour, 1-hour or 15-minute average concentrations due to the acute way in which they affect health or the natural environment, i.e. after a relatively short period of exposure. Some pollutants have standards expressed in terms of both long and short-term concentrations.

In this assessment, the term ‘air quality standard’ has been used to refer to both the UK objectives and European limit values. Table A1 sets out the EU air quality limit values and national air quality objectives for NO_2, PM_{10} and $PM_{2.5}$. Other pollutants have been screened out of this air quality assessment, since they are not likely to cause exceedances of their respective standards.

Table A 1: Air quality objectives

Pollutant	Averaging period	Limit value / objective
Nitrogen Dioxide (NO_2)	Annual mean	40µg/m^3
	1-hour mean	200µg/m^3 not to be exceeded more than 18 times a year (99.8th percentile)
Particulate Matter (PM_{10})	Annual mean	40µg/m^3
	24-hour mean	50µg/m^3 not to be exceeded more than 35 times a year (90.4th percentile)
Particulate Matter ($PM_{2.5}$)	Annual mean	25µg/m^3

Appendix B

Policy and guidance

B1 National policy and guidance

B1.1 National Planning Policy Framework (2019)

The National Planning Policy Framework (NPPF) was published in February 2019[16] with the purpose of planning to achieve sustainable development. Paragraph 181 of the NPPF on air quality states that:

"Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan."

In addition, paragraph 103 states that:

"The planning system should actively manage patterns of growth in support of these objectives. Significant development should be focused on locations which are or can be made sustainable, through limiting the need to travel and offering a genuine choice of transport modes. This can help to reduce congestion and emissions, and improve air quality and public health. However, opportunities to maximise sustainable transport solutions will vary between urban and rural areas, and this should be taken into account in both plan-making and decision-making."

Paragraph 170 discusses how planning policies and decisions should contribute to and enhance the natural and local environment. In relation to air quality, NPPF notes that this can be achieved by:

"e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans"

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[16] Secretary of State for Ministry of Housing, Communities and Local Government (2018) National Planning Policy Framework. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/740441/National_Planning_Policy_Framework_web_accessible_version.pdf [Accessed: January 2020]

B1.2 National Planning Practice Guidance

National Planning Practice Guidance (NPPG) on air quality to supplement the latest NPPF was updated in November 2019[17]. The guidance refers to the significance of air quality assessments to determine the impacts of proposed developments in the area and describes the role of local and neighbourhood plans with regards to air quality. It also provides a flowchart methodology to assist local authorities to determine how considerations of air quality fit into the development management process.

B2 Regional policy and guidance

B2.1 The London Plan

The London Plan, consolidated with alterations in 2016[18] forms part of the development strategy for the Greater London area until 2036 and integrates all economic, environmental, transport and social frameworks. This has been amended to be consistent with the NPPF. Specifically, for new development proposals, the London Plan, looks at air quality by proposing the following measures:

- Minimise increased exposure to existing poor air quality and make provision to address local problems of air quality such as by design solutions, buffer zones or steps to promote greater use of sustainable transport modes through travel plans;
- Promote sustainable design and construction to reduce emissions from the demolition and construction of buildings following the best practice guidance in the Greater London Authority (GLA) and London Councils' 'The control of dust and emissions from construction and demolition';
- Be at least 'air quality neutral' and not lead to further deterioration of existing poor air quality (such as areas designated as Air Quality Management Areas);
- Ensure that where provision needs to be made to reduce emissions from a development, this is usually made on-site; and
- Where the development requires a detailed air quality assessment and biomass boilers are included, the assessment should forecast pollutant concentrations.

A consultation draft of a new London Plan was published in 2019[19]. Within this document, Policy S|1 Improving air quality is to ensure new developments are designed and built, as far as is possible to improve local air quality and reduce the exposure of the public to poor air quality. The measures are as follows:

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[17] Ministry of Housing, Communities & Local Government, Air Quality https://www.gov.uk/guidance/air-quality--3 [Accessed: January 2020]

[18] Greater London Authority (2016) The London Plan: The Spatial Development Strategy for London Consolidated with Alterations Since 2011

[19] Mayor of London (2019) Draft London Plan

"A. Development plans, through relevant strategic, site specific and area-based policies should seek opportunities to identify and deliver further improvements to air quality and should not reduce air quality benefits that result from the Mayor's or boroughs' activities to improve air quality

B. To tackle poor air quality, protect heath and meet legal obligations the following criteria should be addressed:

1. Development proposals should not:

a) lead to further deterioration of existing poor air quality

b) create any new area that exceed air quality limits, or delay the date at which compliance will be achieved in areas that are currently in exceedance of legal limits

c) create unacceptable risk of high levels of exposure to poor quality

2. In order to meet the requirement in Part 1, as a minimum:

a) Development proposals must be at least air quality neutral

b) Development proposals should use design solutions to prevent or minimise increased exposure to existing air pollution and make provision to address local problems of air quality in preference to post-design or retro-fitted mitigation measures

c) Major development proposals must be submitted with an Air Quality Assessment. Air quality assessments should show how the development will meet the requirements of B1

d) Development proposals in Air Quality Focus Areas or that are likely to be used by large numbers of people particularly vulnerable to poor air quality, such as children or older people, which do not demonstrate that design measures have been used to minimise exposure should be refused

C. Masterplans and development briefs for large-scale development proposals subject to an Environmental Impact Assessment should consider how local air quality can be improved across the area of the proposal as part of an air quality positive approach. To achieve this a statement should be submitted demonstrating:

a) How proposals have considered ways to maximise benefits to local air quality, and

b) What measures or design features will be put in place to reduce exposure to pollution, and how they will achieve this.

D. In order to reduce the impact on air quality during the construction and demolition phase development proposals must demonstrate how they plan to comply with the Non-Road Mobile Machinery Low Emission Zone and reduce emissions form the demolition and construction of buildings following best practice guidance.

E. Development proposals should ensure that where emissions need to be reduced to meet the requirements of Air Quality Neutral or to make the impact of development on local air quality acceptable, this is done on-site. Where it can be demonstrated that emissions cannot be further reduced by on-site measures, off-site measures to improve local air quality may be acceptable, provided that equivalent air quality benefits can be demonstrated within the area affected by the development."

These policies have been considered throughout this air quality assessment.

B2.2 London Local Air Quality Management Policy and Technical guidance

The London Local Air Quality Management technical guidance (LLAQM.TG(16))[20] applies only to London's 32 boroughs (and the City of London), while LAQM.TG(16) applies to all other UK local authorities. Although the LLAQM.TG(16) technical guidance has many common elements with the updated national guidance LAQM.TG(16), it does incorporate London-specific elements of the LAQM system.

This guidance is designed to support London authorities in carrying out their duties to review and assess air quality in their area. Where relevant, this guidance has been taken into account in this assessment.

B3 Local policy and guidance

B3.1 Camden Local Plan

The London Borough of Camden (LBC) 2016 Local Plan[21], adopted in 2017, discusses air quality in two policies (A1 and CC4).

Policy A1 Managing the impact of development includes air quality in the objective that:

"The Council will seek to protect the quality of life of occupiers and neighbours. We will grant permission for development unless this causes unacceptable harm to amenity." "The factors we will consider include:" "… odour, fumes and dust;"

There is a policy specifically for air quality (CC4) which states:

"The Council will ensure that the impact of development on air quality is mitigated and ensure that exposure to poor air quality is reduced in the borough.

[20] Greater London Authority (2016) London Local Air Quality Management Technical Guidance
[21] Camden Local Plan (2017) adopted 2017 https://www.camden.gov.uk/documents/20142/4820180/Local+Plan.pdf/ce6e992a-91f9-3a60-720c-70290fab78a6 [Accessed: January 2020]

The Council will take into account the impact of air quality when assessing development proposals, through the consideration of both the exposure of occupants to air pollution and the effect of the development on air quality. Consideration must be taken to the actions identified in the Council's Air Quality Action Plan.

Air Quality Assessments (AQAs) are required where development is likely to expose residents to high levels of air pollution. Where the AQA shows that a development would cause harm to air quality, the Council will not grant planning permission unless measures are adopted to mitigate the impact. Similarly, developments that introduce sensitive receptors (i.e. housing, schools) in locations of poor air quality will not be acceptable unless designed to mitigate the impact.

Development that involves significant demolition, construction or earthworks will also be required to assess the risk of dust and emissions impacts in an AQA and include appropriate mitigation measures to be secured in a Construction Management Plan."

The LBC provides further details on their website of when an AQA is deemed necessary and the information that is expected to be included. For a basic AQA, this includes:

- *"a review of air quality around the development site using existing air quality monitoring and/or modelling data;*
- *an assessment of the impact on air quality during the construction phase and detailed mitigation methods for controlling dust and pollution emissions associated with plant and vehicles;*
- *an indication of the number of receptors that will be exposed to poor air quality as a result of the development, with the locations shown on a map;*
- *the significance of air pollution exposure should be quantified in accordance with the "Air Quality Impact Significance Criteria – New Exposure" outlined in the NSCA Guidance Note;*
- *an outline and justification of mitigation measures associated with the design, location and operation of the development in order to reduce air pollution and exposure to poor air quality. Where a proposed development is in an area of poor air quality it is essential to demonstrate that from the earliest stages, the building has been designed to reduce occupant exposure. This includes consideration of orientation, elevation of residences, and the use of green infrastructure such as green walls, screens and trees."*

In addition, an air quality planning checklist is provided by LBC Council on their website[22]. The checklist includes a section on exposure which has been considered where possible in this assessment.

[22] Camden Air Quality Planning Checklist https://www.camden.gov.uk/documents/20142/0/Air+Quality+Planning+Checklist_Revised+2019.pdf/a9ced487-87e0-9748-05be-b9321e77dad7

B3.2 Camden's Clean Air Action Plan 2019 – 2022

Camden Clean Air Action Plan[23] has been produced as part of the local authority's obligation to London Local Air Quality Management. It outlines the actions LBC will take to improve air quality in Camden between 2019 and 2022. The Clean Air Action Plan is the first of three plans aiming to bring Camden into compliance with World Health Organisation (WHO) guidelines for air quality by 2030.

The Clean Air Action Plan is organised around the following seven broad themes:

- Building emissions;
- Construction emissions;
- Transport emissions;
- Communities and schools;
- Delivery servicing and freight;
- Public health and awareness raising; and
- Lobbying

The seven main aims are:

- *"Working to reduce emissions from our own estate and operations;*
- *Helping residents and visitors to reduce emissions and exposure;*
- *Using planning policy and regulation to reduce air pollution;*
- *Implementing innovative projects across the borough to improve air quality;*
- *Using our influence to lobby for increased financial and regulatory support for the mitigation of air pollution;*
- *Maintaining a monitoring network and ensuring the data is freely accessible;*
- *Raising awareness on how to reduce emissions and exposure".*

Whilst the Camden Clean Air Action Plan specifically mentions reducing building emissions as one of their seven Clean Air Action Plan themes, the fact that the generator is expected to be used so rarely it is considered that this proposal would not contravene this.

It is also noted that Camden has formally adopted the WHO air quality guidelines. The goal is to achieve WHO limits by 2030 and this will be steered by the Council's Clean Air Action Plan.

[23] Camden Clean Air Action Plan 2019-2022 https://www.camden.gov.uk/documents/20142/0/Clean+air+action+plan+2019-2022_final2.pdf/f7cd1a68-e707-0755-528a-59388adf0995 [Accessed: January 2020]

B4 Other relevant policy and guidance

B4.1 Local Air Quality Management Policy and Technical Guidance

The 2016 policy guidance note from Department for Environment, Food and Rural Affairs (DEFRA), LAQM (PG16)[24], provides additional guidance on the links between transport and air quality. LAQM (PG16) describes how road transport contributes to local air pollution and how transport measures may bring improvements in air quality. Key transport-related Government initiatives are set out, including regulatory measures and standards to reduce vehicle emissions and improve fuels, tax-based measures and the development of an integrated transport strategy.

LAQM (PG16) also provides guidance on the links between air quality and the land-use planning system. The guidance advises that air quality considerations should be integrated into the planning process at the earliest stage and is intended to aid local authorities in developing action plans to deal with specific air quality problems and create strategies to improve air quality. It summarises the main ways in which the land use planning system can help deliver compliance with the air quality objectives.

Technical Guidance (TG16)[25] is designed to support local authorities in carrying out their duties to review and assess air quality in their area. The document also provides guidance on how to set-up dispersion modelling which has been followed during this assessment.

[24] Defra (2016) Local Air Quality Management Policy Guidance

[25] Defra (2016) Local Air Quality Management Technical Guidance

Appendix C

Results

C1 Predicted long-term impact (annual mean)

Table C1. 1: Combined scenario 1 and 2 predicted annual mean NO_2 and PM_{10} concentrations

ID	Description	Height (m)	Year with maximum NO_2 PC	NO_2 annual mean concentration (µg/m^3)			Year with maximum PM_{10} PC	PM_{10} annual mean concentration (µg/m^3)		
				Maximum process contribution (PC)	Predicted Environmental Concentration (PEC)	Impact		Maximum process contribution (PC)	Predicted Environmental Concentration (PEC)	Impact
E	40 Bloomsbury Way	5	2016	0.1	47.8	Negligible	2017	0.002	21.0	Negligible
		10	2016	0.1	47.8	Negligible	2017	0.002	21.0	Negligible
		15	2016	0.1	47.8	Negligible	2017	0.002	21.0	Negligible
		20	2016	0.1	47.8	Negligible	2017	0.002	21.0	Negligible
F		5	2017	0.1	47.8	Negligible	2017	0.002	21.0	Negligible
		10	2017	0.1	47.8	Negligible	2017	0.002	21.0	Negligible
		15	2017	0.1	47.8	Negligible	2017	0.002	21.0	Negligible
		20	2017	0.1	47.8	Negligible	2017	0.002	21.0	Negligible
Maximum concentration at receptors					**47.8**				**21.0**	

Table C1. 2: Scenario 3 predicted annual mean NO_2 and PM_{10} concentrations

ID	Description	Height (m)	Year with maximum NO_2 PC	NO_2 annual mean concentration (µg/m^3)			Year with maximum PM_{10} PC	PM_{10} annual mean concentration (µg/m^3)		
				Maximum process contribution (PC)	Predicted Environmental Concentration (PEC)	Impact		Maximum process contribution (PC)	Predicted Environmental Concentration (PEC)	Impact
E	40 Bloomsbury Way	5	2014	0.6	48.3	Moderate adverse	2015	0.009	21.0	Negligible
		10	2014	0.6	48.3	Moderate adverse	2015	0.009	21.0	Negligible
		15	2014	0.6	48.3	Moderate adverse	2015	0.009	21.0	Negligible
		20	2014	0.6	48.3	Moderate adverse	2015	0.009	21.0	Negligible
F		5	2016	0.7	48.4	Substantial adverse	2017	0.010	21.0	Negligible
		10	2016	0.7	48.4	Substantial adverse	2017	0.010	21.0	Negligible
		15	2016	0.7	48.4	Substantial adverse	2017	0.010	21.0	Negligible
		20	2016	0.7	48.4	Substantial adverse	2017	0.010	21.0	Negligible
Maximum concentration at receptors				**48.4**			**-**	**21.0**		

C2 Predicted short-term impact (hourly mean and daily mean)

Table C2. 1: Scenario 1 predicted hourly mean NO_2 and daily mean PM_{10} concentrations

ID	Description	Height (m)	Year with maximum NO_2 PC	NO_2 hourly mean concentration (µg/m³)			Year with maximum PM_{10} PC	PM_{10} daily mean concentration (µg/m³)		
				Maximum process contribution (PC)	Predicted Environmental Concentration (PEC)	Impact		Maximum process contribution (PC)	Predicted Environmental Concentration (PEC)	Impact
A	1 Museum Street, Travelodge	16	2016	11.3	106.7	Negligible	2018	0.2	42.1	Negligible
		30	2016	11.3	106.7	Negligible	2018	0.2	42.1	Negligible
		45	2016	11.3	106.7	Negligible	2018	0.2	42.1	Negligible
B	10 Museum Street	5	2014	11.1	106.5	Negligible	2018	0.2	42.1	Negligible
		10	2014	11.1	106.5	Negligible	2018	0.2	42.1	Negligible
		15	2014	11.1	106.5	Negligible	2018	0.2	42.1	Negligible
C	Old Crown Public House	5	2014	10.7	106.1	Negligible	2016	0.2	42.1	Negligible
		10	2014	10.7	106.1	Negligible	2016	0.2	42.1	Negligible
		15	2014	10.7	106.1	Negligible	2016	0.2	42.1	Negligible
D	36 New Oxford Street	5	2014	7.2	102.6	Negligible	2017	0.1	42.0	Negligible
		10	2014	7.2	102.6	Negligible	2017	0.1	42.0	Negligible
		15	2014	7.2	102.6	Negligible	2017	0.1	42.0	Negligible
E	40 Bloomsbury Way	5	2016	6.9	102.3	Negligible	2017	0.1	42.0	Negligible
		10	2016	6.9	102.3	Negligible	2017	0.1	42.0	Negligible
		15	2016	6.9	102.3	Negligible	2017	0.1	42.0	Negligible
		20	2016	6.9	102.3	Negligible	2017	0.1	42.0	Negligible
F	40 Bloomsbury Way	5	2016	7.9	103.3	Negligible	2016	0.1	42.0	Negligible
		10	2016	7.9	103.3	Negligible	2016	0.1	42.0	Negligible
		15	2016	7.9	103.3	Negligible	2016	0.1	42.0	Negligible
		20	2016	7.9	103.3	Negligible	2016	0.1	42.0	Negligible
G	10 Bloomsbury Way	10	2014	11.8	107.2	Negligible	2018	0.2	42.2	Negligible
		20	2014	11.8	107.2	Negligible	2018	0.2	42.2	Negligible
		30	2014	11.8	107.2	Negligible	2018	0.2	42.2	Negligible

ID	Description	Height (m)	Year with maximum NO_2 PC	NO_2 hourly mean concentration (µg/m^3)			Year with maximum PM_{10} PC	PM_{10} daily mean concentration (µg/m^3)		
				Maximum process contribution (PC)	Predicted Environmental Concentration (PEC)	Impact		Maximum process contribution (PC)	Predicted Environmental Concentration (PEC)	Impact
		40	2014	11.8	107.2	Negligible	2018	0.2	42.2	Negligible
H	10 Bloomsbury Way	10	2018	11.6	107.0	Negligible	2018	0.3	42.2	Negligible
		20	2018	11.6	107.0	Negligible	2018	0.3	42.2	Negligible
		30	2018	11.6	107.0	Negligible	2018	0.3	42.2	Negligible
		40	2018	11.6	107.0	Negligible	2018	0.3	42.2	Negligible
I	10 Bloomsbury Way	10	2018	11.2	106.6	Negligible	2018	0.2	42.2	Negligible
		20	2018	11.2	106.6	Negligible	2018	0.2	42.2	Negligible
		30	2018	11.2	106.6	Negligible	2018	0.2	42.2	Negligible
		40	2018	11.2	106.6	Negligible	2018	0.2	42.2	Negligible
J	New Oxford Street - Museum Street corner	8	2015	12.0	107.4	Negligible	2018	0.3	42.2	Negligible
		15	2015	11.8	107.2	Negligible	2018	0.3	42.2	Negligible
		20	2015	11.8	107.2	Negligible	2018	0.3	42.2	Negligible
		25	2015	11.8	107.2	Negligible	2018	0.3	42.2	Negligible
		30	2015	11.8	107.2	Negligible	2018	0.3	42.2	Negligible
K	23-25 New Oxford Street - above louvres	8	2014	13.3	108.7	Negligible	2017	0.3	42.2	Negligible
		15	2016	12.5	107.9	Negligible	2017	0.3	42.2	Negligible
		20	2016	12.5	107.9	Negligible	2017	0.3	42.2	Negligible
		25	2016	12.5	107.9	Negligible	2017	0.3	42.2	Negligible
		30	2016	12.5	107.9	Negligible	2017	0.3	42.2	Negligible
L	23-25 New Oxford Street - above louvres	8	2016	13.2	108.6	Negligible	2017	0.3	42.2	Negligible
		15	2016	12.5	107.9	Negligible	2017	0.3	42.2	Negligible
		20	2016	12.5	107.9	Negligible	2017	0.3	42.2	Negligible
		25	2016	12.5	107.9	Negligible	2017	0.3	42.2	Negligible
		30	2016	12.5	107.9	Negligible	2017	0.3	42.2	Negligible
M		8	2014	13.3	108.7	Negligible	2017	0.3	42.2	Negligible
		15	2016	12.5	107.9	Negligible	2017	0.3	42.2	Negligible

ID	Description	Height (m)	Year with maximum NO_2 PC	NO_2 hourly mean concentration (µg/m^3)			Year with maximum PM_{10} PC	PM_{10} daily mean concentration (µg/m^3)		
				Maximum process contribution (PC)	Predicted Environmental Concentration (PEC)	Impact		Maximum process contribution (PC)	Predicted Environmental Concentration (PEC)	Impact
	23-25 New Oxford Street - above louvres	20	2016	12.5	107.9	Negligible	2017	0.3	42.2	Negligible
		25	2016	12.5	107.9	Negligible	2017	0.3	42.2	Negligible
		30	2016	12.5	107.9	Negligible	2017	0.3	42.2	Negligible
N	23-25 New Oxford Street - above louvres	8	2014	13.6	109.0	Negligible	2017	0.3	42.3	Negligible
		15	2016	12.5	107.9	Negligible	2017	0.3	42.2	Negligible
		20	2016	12.5	107.9	Negligible	2017	0.3	42.2	Negligible
		25	2016	12.5	107.9	Negligible	2017	0.3	42.2	Negligible
		30	2016	12.5	107.9	Negligible	2017	0.3	42.2	Negligible
O	23-25 New Oxford Street - New Oxford Street corner	8	2016	13.2	108.6	Negligible	2017	0.3	42.2	Negligible
		15	2016	12.9	108.3	Negligible	2017	0.3	42.2	Negligible
		20	2016	12.9	108.3	Negligible	2017	0.3	42.2	Negligible
		25	2016	12.5	107.9	Negligible	2017	0.3	42.2	Negligible
		30	2016	12.5	107.9	Negligible	2017	0.3	42.2	Negligible
P	1 Oxford Street	27	2016	12.5	107.9	Negligible	2017	0.3	42.2	Negligible
		30	2016	12.5	107.9	Negligible	2017	0.3	42.2	Negligible
Q	1 Oxford Street	27	2016	12.2	107.6	Negligible	2017	0.2	42.2	Negligible
		30	2016	12.2	107.6	Negligible	2017	0.2	42.2	Negligible
Maximum concentration at receptors					**109.0**		**-**		**42.3**	

Table C2. 2: Scenario 2 predicted hourly mean NO_2 and daily mean PM_{10} concentrations

ID	Description	Height (m)	Year with maximum NO_2 PC	NO_2 hourly mean concentration (µg/m³)			Year with maximum PM_{10} PC	PM_{10} daily mean concentration (µg/m³)		
				Maximum process contribution (PC)	Predicted Environmental Concentration (PEC)	Impact		Maximum process contribution (PC)	Predicted Environmental Concentration (PEC)	Impact
A	1 Museum Street, Travelodge	16	2016	41.8	137.2	Moderate Adverse	2016	0.4	42.3	Negligible
		30	2016	41.8	137.2	Moderate Adverse	2016	0.4	42.3	Negligible
		45	2016	41.8	137.2	Moderate Adverse	2016	0.4	42.3	Negligible
B	10 Museum Street	5	2014, 2015	41.0	136.4	Moderate Adverse	2018	0.4	42.3	Negligible
		10	2014, 2015	41.0	136.4	Moderate Adverse	2018	0.4	42.3	Negligible
		15	2014, 2015	41.0	136.4	Moderate Adverse	2018	0.4	42.3	Negligible
C	Old Crown Public House	5	2014	39.4	134.8	Slight Adverse	2016	0.3	42.3	Negligible
		10	2014	39.4	134.8	Slight Adverse	2016	0.3	42.3	Negligible
		15	2014	39.4	134.8	Slight Adverse	2016	0.3	42.3	Negligible
D	36 New Oxford Street	5	2016	26.3	121.7	Slight Adverse	2018	0.1	42.1	Negligible
		10	2016	26.3	121.7	Slight Adverse	2018	0.1	42.1	Negligible
		15	2016	26.3	121.7	Slight Adverse	2018	0.1	42.1	Negligible
E	40 Bloomsbury Way	5	2016	25.5	120.9	Slight Adverse	2017	0.1	42.1	Negligible
		10	2016	25.5	120.9	Slight Adverse	2017	0.1	42.1	Negligible
		15	2016	25.5	120.9	Slight Adverse	2017	0.1	42.1	Negligible
		20	2016	25.5	120.9	Slight Adverse	2017	0.1	42.1	Negligible
F	40 Bloomsbury Way	5	2016	29.3	124.7	Slight Adverse	2016	0.2	42.1	Negligible
		10	2016	29.3	124.7	Slight Adverse	2016	0.2	42.1	Negligible
		15	2016	29.3	124.7	Slight Adverse	2016	0.2	42.1	Negligible

ID	Description	Height (m)	Year with maximum NO_2 PC	NO_2 hourly mean concentration (µg/m^3)			Year with maximum PM_{10} PC	PM_{10} daily mean concentration (µg/m^3)		
				Maximum process contribution (PC)	Predicted Environmental Concentration (PEC)	Impact		Maximum process contribution (PC)	Predicted Environmental Concentration (PEC)	Impact
		20	2016	29.3	124.7	Slight Adverse	2016	0.2	42.1	Negligible
G	10 Bloomsbury Way	10	2014	43.4	138.8	Moderate Adverse	2018	0.4	42.4	Negligible
		20	2014	43.4	138.8	Moderate Adverse	2018	0.4	42.4	Negligible
		30	2014	43.4	138.8	Moderate Adverse	2018	0.4	42.4	Negligible
		40	2014	43.4	138.8	Moderate Adverse	2018	0.4	42.4	Negligible
H	10 Bloomsbury Way	10	2018	42.9	138.3	Moderate Adverse	2018	0.5	42.4	Negligible
		20	2018	42.9	138.3	Moderate Adverse	2018	0.5	42.4	Negligible
		30	2018	42.9	138.3	Moderate Adverse	2018	0.5	42.4	Negligible
		40	2018	42.9	138.3	Moderate Adverse	2018	0.5	42.4	Negligible
I	10 Bloomsbury Way	10	2018	41.5	136.9	Moderate Adverse	2018	0.4	42.4	Negligible
		20	2018	41.5	136.9	Moderate Adverse	2018	0.4	42.4	Negligible
		30	2018	41.5	136.9	Moderate Adverse	2018	0.4	42.4	Negligible
		40	2018	41.5	136.9	Moderate Adverse	2018	0.4	42.4	Negligible
J	23-25 New Oxford Street - Museum Street corner	8	2015	44.4	139.8	Moderate Adverse	2016	0.5	42.4	Negligible
		15	2015	43.5	138.9	Moderate Adverse	2016	0.5	42.4	Negligible

ID	Description	Height (m)	Year with maximum NO_2 PC	NO_2 hourly mean concentration (µg/m^3)			Year with maximum PM_{10} PC	PM_{10} daily mean concentration (µg/m^3)		
				Maximum process contribution (PC)	Predicted Environmental Concentration (PEC)	Impact		Maximum process contribution (PC)	Predicted Environmental Concentration (PEC)	Impact
		20	2015	43.5	138.9	Moderate Adverse	2016	0.5	42.4	Negligible
		25	2015	43.5	138.9	Moderate Adverse	2016	0.5	42.4	Negligible
		30	2015	43.5	138.9	Moderate Adverse	2016	0.5	42.4	Negligible
K	23-25 New Oxford Street - above louvres	8	2015	49.5	144.9	Moderate Adverse	2017	0.5	42.5	Negligible
		15	2015	46.3	141.7	Moderate Adverse	2017	0.5	42.5	Negligible
		20	2015	46.3	141.7	Moderate Adverse	2017	0.5	42.5	Negligible
		25	2015	46.3	141.7	Moderate Adverse	2017	0.5	42.5	Negligible
		30	2015	46.3	141.7	Moderate Adverse	2017	0.5	42.5	Negligible
L	23-25 New Oxford Street - above louvres	8	2014	49.3	144.7	Moderate Adverse	2017	0.6	42.5	Negligible
		15	2014	48.2	143.6	Moderate Adverse	2017	0.5	42.5	Negligible
		20	2014	48.2	143.6	Moderate Adverse	2017	0.5	42.5	Negligible
		25	2015	46.3	141.7	Moderate Adverse	2017	0.5	42.5	Negligible
		30	2015	46.3	141.7	Moderate Adverse	2017	0.5	42.5	Negligible
M		8	2014	52.4	147.8	Moderate Adverse	2017	0.6	42.5	Negligible

ID	Description	Height (m)	Year with maximum NO_2 PC	NO_2 hourly mean concentration (µg/m^3)			Year with maximum PM_{10} PC	PM_{10} daily mean concentration (µg/m^3)		
				Maximum process contribution (PC)	Predicted Environmental Concentration (PEC)	Impact		Maximum process contribution (PC)	Predicted Environmental Concentration (PEC)	Impact
	23-25 New Oxford Street - above louvres	15	2016	48.8	144.2	Moderate Adverse	2017	0.5	42.5	Negligible
		20	2015	46.3	141.7	Moderate Adverse	2017	0.5	42.5	Negligible
		25	2015	46.3	141.7	Moderate Adverse	2017	0.5	42.5	Negligible
		30	2015	46.3	141.7	Moderate Adverse	2017	0.5	42.5	Negligible
N	23-25 New Oxford Street - above louvres	8	2017	58.4	153.8	Moderate Adverse	2017	0.6	42.5	Negligible
		15	2016	48.8	144.2	Moderate Adverse	2017	0.5	42.5	Negligible
		20	2015	46.3	141.7	Moderate Adverse	2017	0.5	42.5	Negligible
		25	2015	46.3	141.7	Moderate Adverse	2017	0.5	42.5	Negligible
		30	2015	46.3	141.7	Moderate Adverse	2017	0.5	42.5	Negligible
O	23-25 New Oxford Street - New Oxford Street corner	8	2014	48.7	144.1	Moderate Adverse	2017	0.6	42.5	Negligible
		15	2016	47.5	142.9	Moderate Adverse	2017	0.5	42.5	Negligible
		20	2016	47.5	142.9	Moderate Adverse	2017	0.5	42.5	Negligible
		25	2016	47.5	142.9	Moderate Adverse	2017	0.5	42.5	Negligible
		30	2015	46.3	141.7	Moderate Adverse	2017	0.5	42.5	Negligible

ID	Description	Height (m)	Year with maximum NO_2 PC	NO_2 hourly mean concentration (µg/m^3)			Year with maximum PM_{10} PC	PM_{10} daily mean concentration (µg/m^3)		
				Maximum process contribution (PC)	Predicted Environmental Concentration (PEC)	Impact		Maximum process contribution (PC)	Predicted Environmental Concentration (PEC)	Impact
P	1 Oxford Street	27	2015	46.3	141.7	Moderate Adverse	2017	0.5	42.5	Negligible
		30	2015	46.3	141.7	Moderate Adverse	2017	0.5	42.5	Negligible
Q	1 Oxford Street	27	2016	45.0	140.4	Moderate Adverse	2016	0.4	42.4	Negligible
		30	2016	45.0	140.4	Moderate Adverse	2016	0.4	42.4	Negligible
Maximum concentration at receptors				**153.80**			**-**	**42.52**		

Table C2. 3: Scenario 3 predicted hourly mean NO_2 and daily mean PM_{10} concentrations

ID	Description	Height (m)	Year with maximum NO_2 PC	NO_2 hourly mean concentration (µg/m^3)			Year with maximum PM_{10} PC	PM_{10} daily mean concentration (µg/m^3)		
				Maximum process contribution (PC)	Predicted Environmental Concentration (PEC)	Impact		Maximum process contribution (PC)	Predicted Environmental Concentration (PEC)	Impact
A	1 Museum Street, Travelodge	16	2016	64.3	159.7	Moderate Adverse	2016	1.3	43.3	Negligible
		30	2016	64.3	159.7	Moderate Adverse	2016	1.3	43.3	Negligible
		45	2016	64.3	159.7	Moderate Adverse	2016	1.3	43.3	Negligible
B	10 Museum Street	5	2016	64.3	159.7	Moderate Adverse	2016	1.3	43.3	Negligible
		10	2016	64.3	159.7	Moderate Adverse	2016	1.3	43.3	Negligible
		15	2016	64.3	159.7	Moderate Adverse	2016	1.3	43.3	Negligible
C	Old Crown Public House	5	2014	53.8	149.2	Moderate Adverse	2016	1.2	43.1	Negligible
		10	2014	53.8	149.2	Moderate Adverse	2016	1.2	43.1	Negligible
		15	2014	53.8	149.2	Moderate Adverse	2016	1.2	43.1	Negligible
D	36 New Oxford Street	5	2018	43.8	139.2	Moderate Adverse	2016	0.6	42.6	Negligible
		10	2018	43.8	139.2	Moderate Adverse	2016	0.6	42.6	Negligible
		15	2018	43.8	139.2	Moderate Adverse	2016	0.6	42.6	Negligible
E	40 Bloomsbury Way	5	2014	36.7	132.1	Slight Adverse	2016	0.6	42.5	Negligible
		10	2014	36.7	132.1	Slight Adverse	2016	0.6	42.5	Negligible

ID	Description	Height (m)	Year with maximum NO_2 PC	NO_2 hourly mean concentration ($\mu g/m^3$) Maximum process contribution (PC)	Predicted Environmental Concentration (PEC)	Impact	Year with maximum PM_{10} PC	PM_{10} daily mean concentration ($\mu g/m^3$) Maximum process contribution (PC)	Predicted Environmental Concentration (PEC)	Impact
		15	2014	36.7	132.1	Slight Adverse	2016	0.6	42.5	Negligible
		20	2014	36.7	132.1	Slight Adverse	2016	0.6	42.5	Negligible
F	40 Bloomsbury Way	5	2014, 2016	45.4	140.8	Moderate Adverse	2016	0.7	42.7	Negligible
		10	2014, 2016	45.4	140.8	Moderate Adverse	2016	0.7	42.7	Negligible
		15	2014, 2016	45.4	140.8	Moderate Adverse	2016	0.7	42.7	Negligible
		20	2014, 2016	45.4	140.8	Moderate Adverse	2016	0.7	42.7	Negligible
G	10 Bloomsbury Way	10	2017	58.4	153.8	Moderate Adverse	2016	1.5	43.4	Negligible
		20	2017	58.4	153.8	Moderate Adverse	2016	1.5	43.4	Negligible
		30	2017	58.4	153.8	Moderate Adverse	2016	1.5	43.4	Negligible
		40	2017	58.4	153.8	Moderate Adverse	2016	1.5	43.4	Negligible
H	10 Bloomsbury Way	10	2016, 2018	53.5	148.9	Moderate Adverse	2016	1.5	43.4	Negligible
		20	2016, 2018	53.5	148.9	Moderate Adverse	2016	1.5	43.4	Negligible
		30	2016, 2018	53.5	148.9	Moderate Adverse	2016	1.5	43.4	Negligible
		40	2016, 2018	53.5	148.9	Moderate Adverse	2016	1.5	43.4	Negligible
I	10 Bloomsbury Way	10	2014, 2016, 2018	51.0	146.4	Moderate Adverse	2016	1.4	43.4	Negligible

ID	Description	Height (m)	Year with maximum NO_2 PC	NO_2 hourly mean concentration (µg/m^3)			Year with maximum PM_{10} PC	PM_{10} daily mean concentration (µg/m^3)		
				Maximum process contribution (PC)	Predicted Environmental Concentration (PEC)	Impact		Maximum process contribution (PC)	Predicted Environmental Concentration (PEC)	Impact
		20	2014, 2016, 2018	51.0	146.4	Moderate Adverse	2016	1.4	43.4	Negligible
		30	2014, 2016, 2018	51.0	146.4	Moderate Adverse	2016	1.4	43.4	Negligible
		40	2014, 2016, 2018	51.0	146.4	Moderate Adverse	2016	1.4	43.4	Negligible
J	23-25 New Oxford Street - Museum Street corner	8	2017	64.3	159.7	Moderate Adverse	2016	1.6	43.5	Negligible
		15	2017	64.5	159.9	Moderate Adverse	2016	1.5	43.5	Negligible
		20	2017	63.6	159.0	Moderate Adverse	2016	1.5	43.5	Negligible
		25	2017	63.6	159.0	Moderate Adverse	2016	1.5	43.5	Negligible
		30	2017	63.6	159.0	Moderate Adverse	2016	1.5	43.5	Negligible
K	23-25 New Oxford Street - above louvres	8	2018	96.4	191.8	Moderate Adverse	2016	1.7	43.7	Negligible
		15	2016, 2017	73.4	168.8	Moderate Adverse	2017	1.7	43.6	Negligible
		20	2016	73.4	168.8	Moderate Adverse	2016	1.7	43.6	Negligible
		25	2016	73.4	168.8	Moderate Adverse	2016	1.7	43.6	Negligible
		30	2016	73.4	168.8	Moderate Adverse	2016	1.7	43.6	Negligible

ID	Description	Height (m)	Year with maximum NO_2 PC	NO_2 hourly mean concentration (µg/m^3)			Year with maximum PM_{10} PC	PM_{10} daily mean concentration (µg/m^3)		
				Maximum process contribution (PC)	Predicted Environmental Concentration (PEC)	Impact		Maximum process contribution (PC)	Predicted Environmental Concentration (PEC)	Impact
L	23-25 New Oxford Street - above louvres	8	2016	297.7	393.1	Substantial Adverse	2016	2.0	43.9	Negligible
		15	2016	73.4	168.8	Moderate Adverse	2016	1.7	43.6	Negligible
		20	2016	73.4	168.8	Moderate Adverse	2016	1.7	43.6	Negligible
		25	2016	73.4	168.8	Moderate Adverse	2016	1.7	43.6	Negligible
		30	2016	73.4	168.8	Moderate Adverse	2016	1.7	43.6	Negligible
M	23-25 New Oxford Street - above louvres	8	2018	308.7	404.1	Substantial Adverse	2016	2.0	43.9	Negligible
		15	2016	73.4	168.8	Moderate Adverse	2016	1.7	43.6	Negligible
		20	2016	73.4	168.8	Moderate Adverse	2016	1.7	43.6	Negligible
		25	2016	73.4	168.8	Moderate Adverse	2016	1.7	43.6	Negligible
		30	2016	73.4	168.8	Moderate Adverse	2016	1.7	43.6	Negligible
N	23-25 New Oxford Street - above louvres	8	2014	168.8	264.2	Substantial Adverse	2016	1.8	43.7	Negligible
		15	2015, 2016, 2017	73.4	168.8	Moderate Adverse	2016	1.7	43.6	Negligible
		20	2016	73.4	168.8	Moderate Adverse	2016	1.7	43.6	Negligible
		25	2016	73.4	168.8	Moderate Adverse	2016	1.7	43.6	Negligible

ID	Description	Height (m)	Year with maximum NO_2 PC	NO_2 hourly mean concentration (µg/m^3)			Year with maximum PM_{10} PC	PM_{10} daily mean concentration (µg/m^3)		
				Maximum process contribution (PC)	Predicted Environmental Concentration (PEC)	Impact		Maximum process contribution (PC)	Predicted Environmental Concentration (PEC)	Impact
		30	2016	73.4	168.8	Moderate Adverse	2016	1.7	43.6	Negligible
O	23-25 New Oxford Street - New Oxford Street corner	8	2016	73.7	169.1	Moderate Adverse	2016	1.7	43.6	Negligible
		15	2015, 2016, 2018	77.2	172.6	Moderate Adverse	2016	1.7	43.6	Negligible
		20	2015, 2016, 2017	73.4	168.8	Moderate Adverse	2016	1.7	43.6	Negligible
		25	2016	73.4	168.8	Moderate Adverse	2016	1.7	43.6	Negligible
		30	2016	73.4	168.8	Moderate Adverse	2016	1.7	43.6	Negligible
P	1 Oxford Street	27	2016	73.4	168.8	Moderate Adverse	2016	1.7	43.6	Negligible
		30	2016	73.4	168.8	Moderate Adverse	2016	1.7	43.6	Negligible
Q	1 Oxford Street	27	2016	73.4	168.8	Moderate Adverse	2017	1.5	43.4	Negligible
		30	2016	73.4	168.8	Moderate Adverse	2017	1.5	43.4	Negligible
Maximum concentration at receptors				**404.12**			**-**	**43.90**		

Appendix D

Contour plots

D1 Annual mean NO_2 process contribution at 1.5m

Figure D1. 1: Scenario 1 and 2 combined annual mean NO_2 process contribution ($\mu g/m^3$) at 1.5m

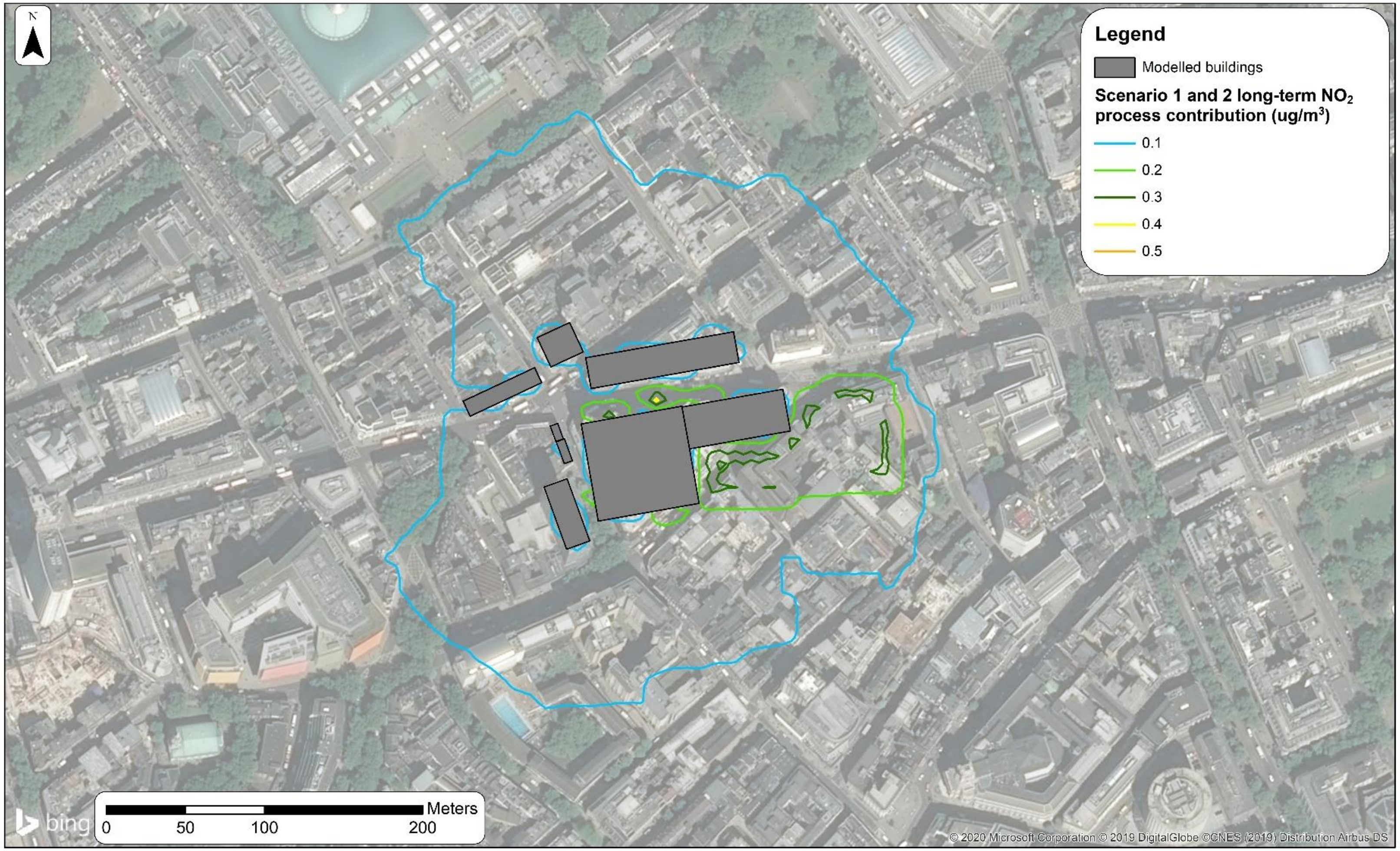
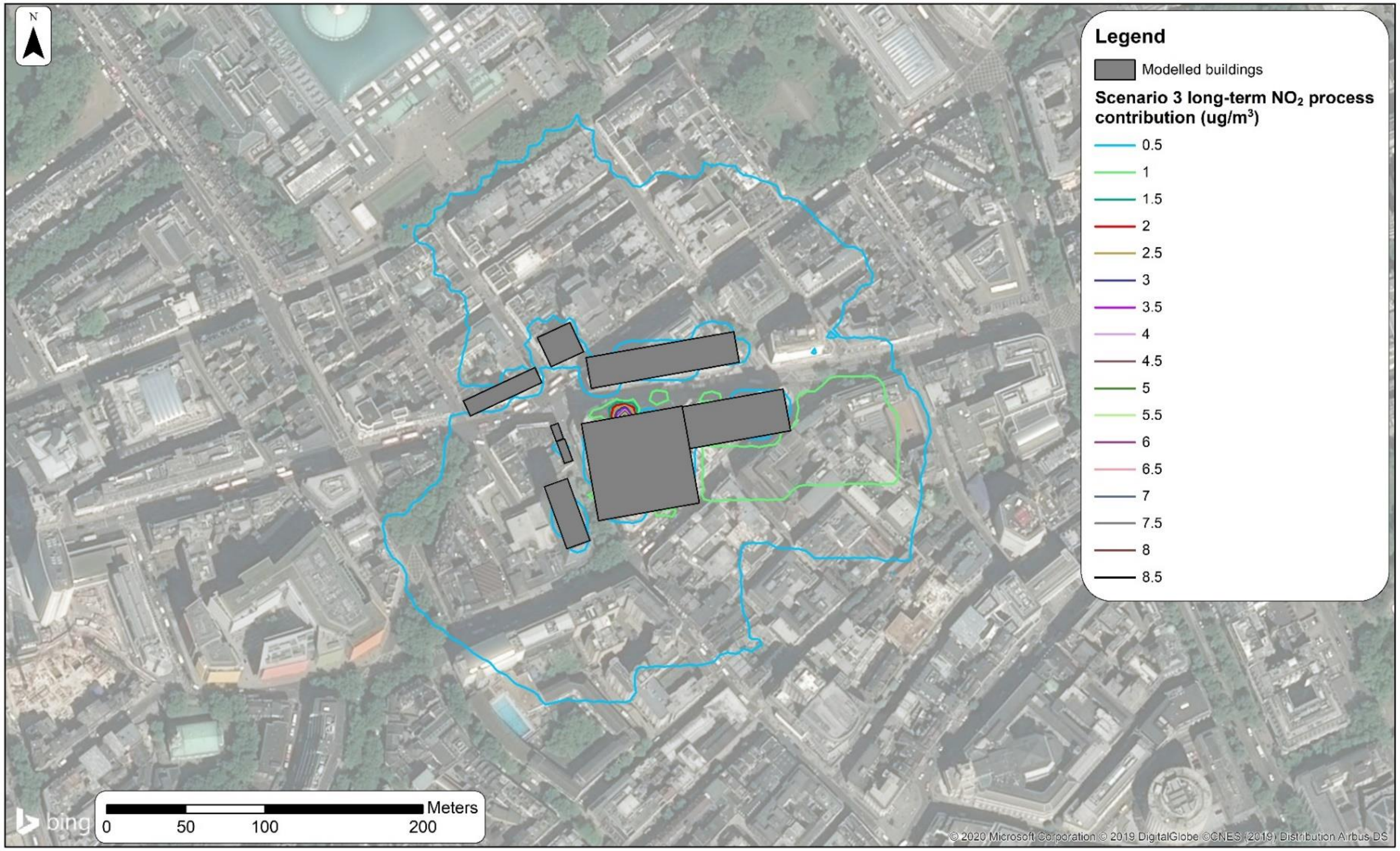


Figure D1. 2: Scenario 3 annual mean NO_2 process contribution (µg/m^3) at 1.5m



D2 Annual mean NO_2 process contribution at 8m

Figure D2. 1: Scenario 1 and 2 combined annual mean NO_2 process contribution ($\mu g/m^3$) at 8m

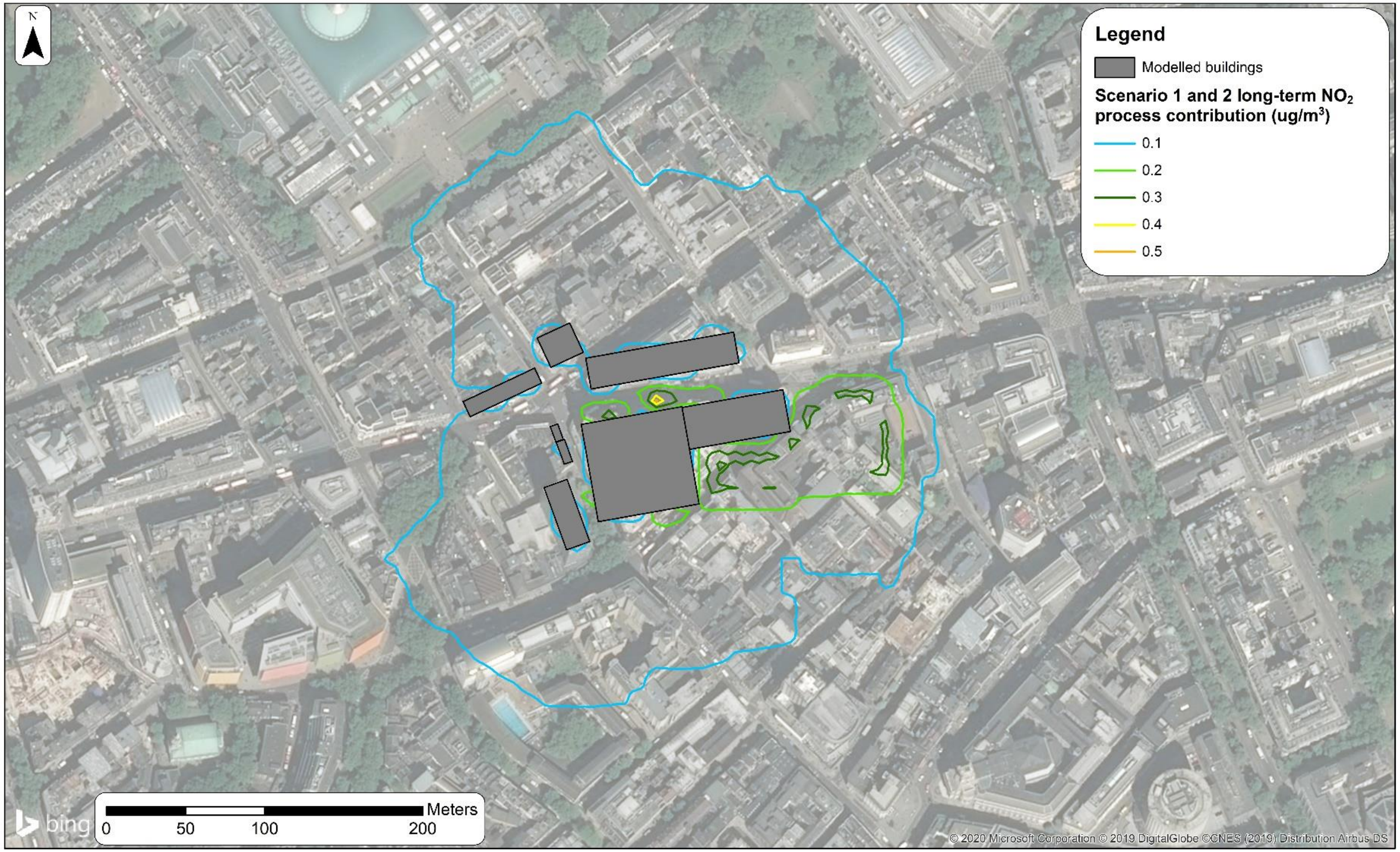
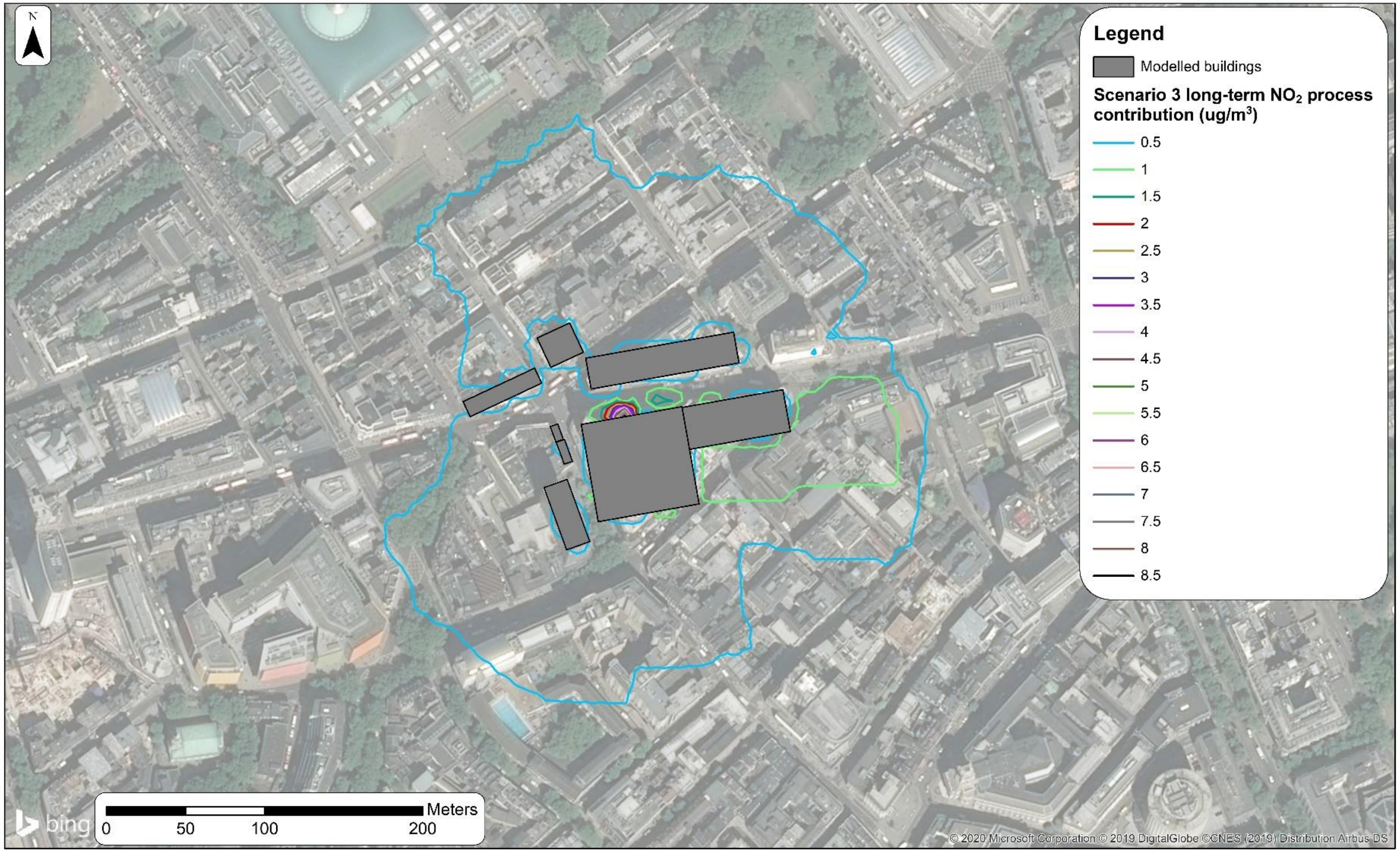


Figure D2. 2: Scenario 3 annual mean NO_2 process contribution ($\mu g/m^3$) at 8m



D3 Hourly mean NO_2 process contribution at 1.5m

Figure D3. 1: Scenario 1 hourly mean NO_2 process contribution ($\mu g/m^3$) at 1.5m

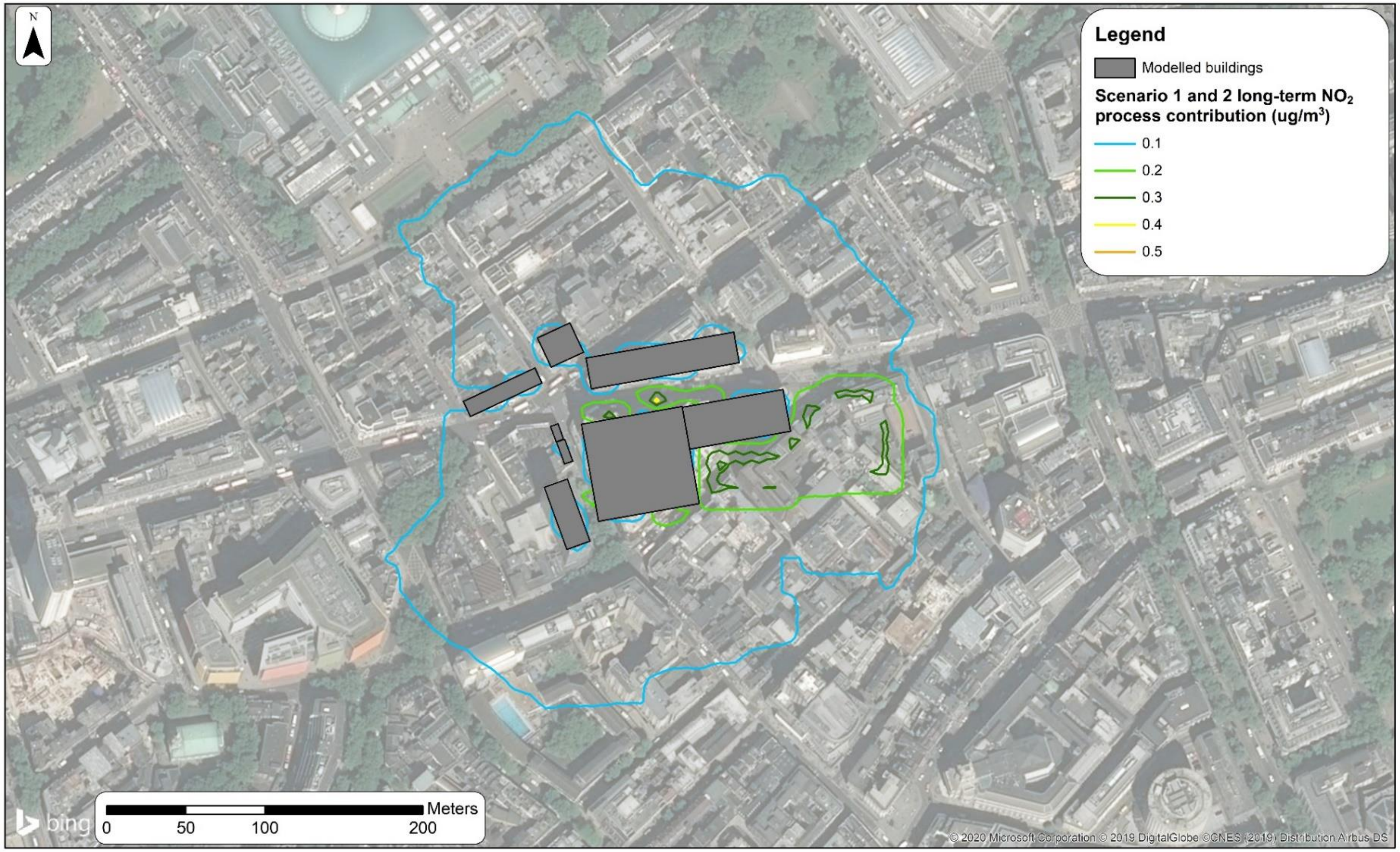


Figure D3. 2: Scenario 2 hourly mean NO2 process contribution (µg/m3) at 1.5m

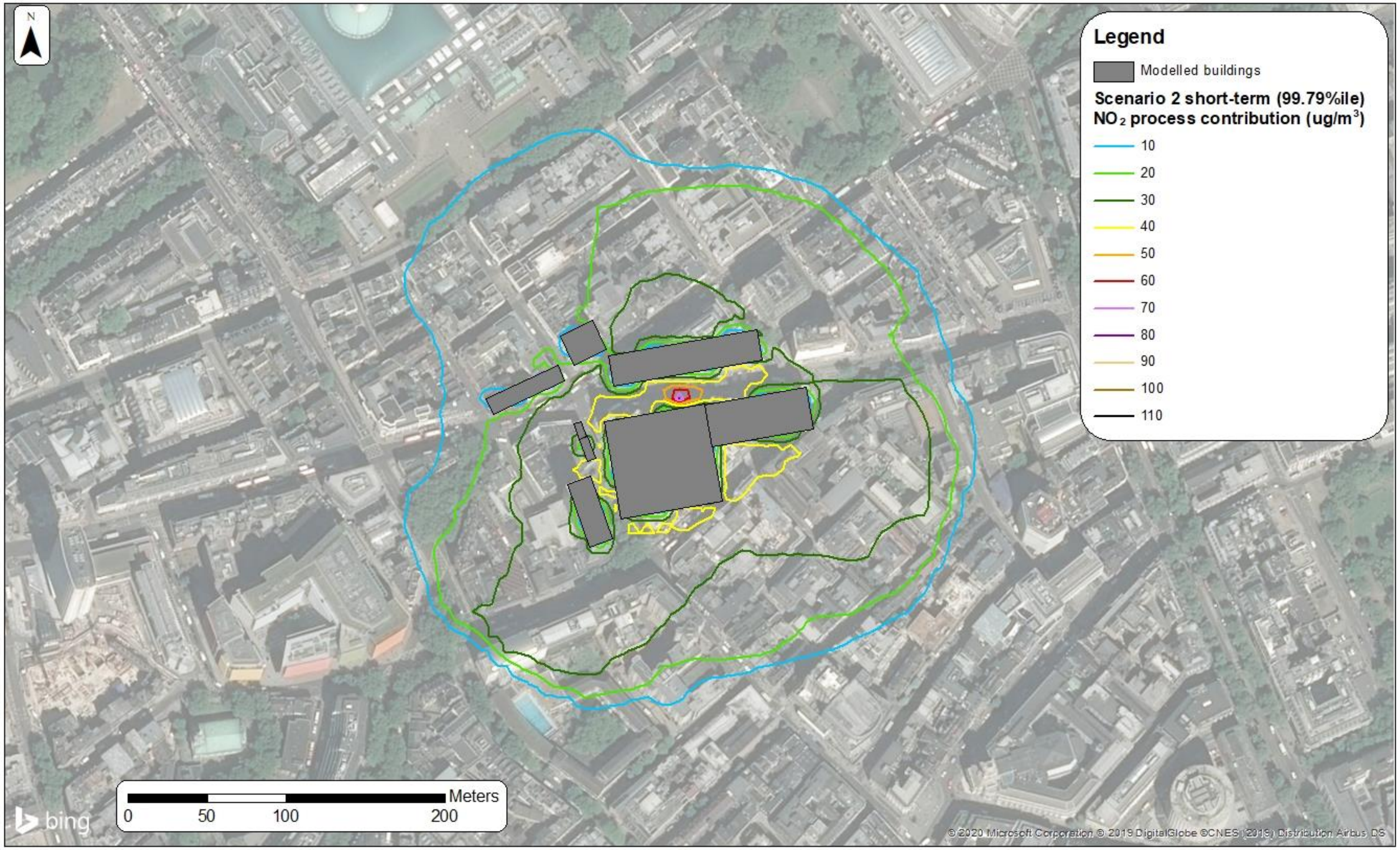
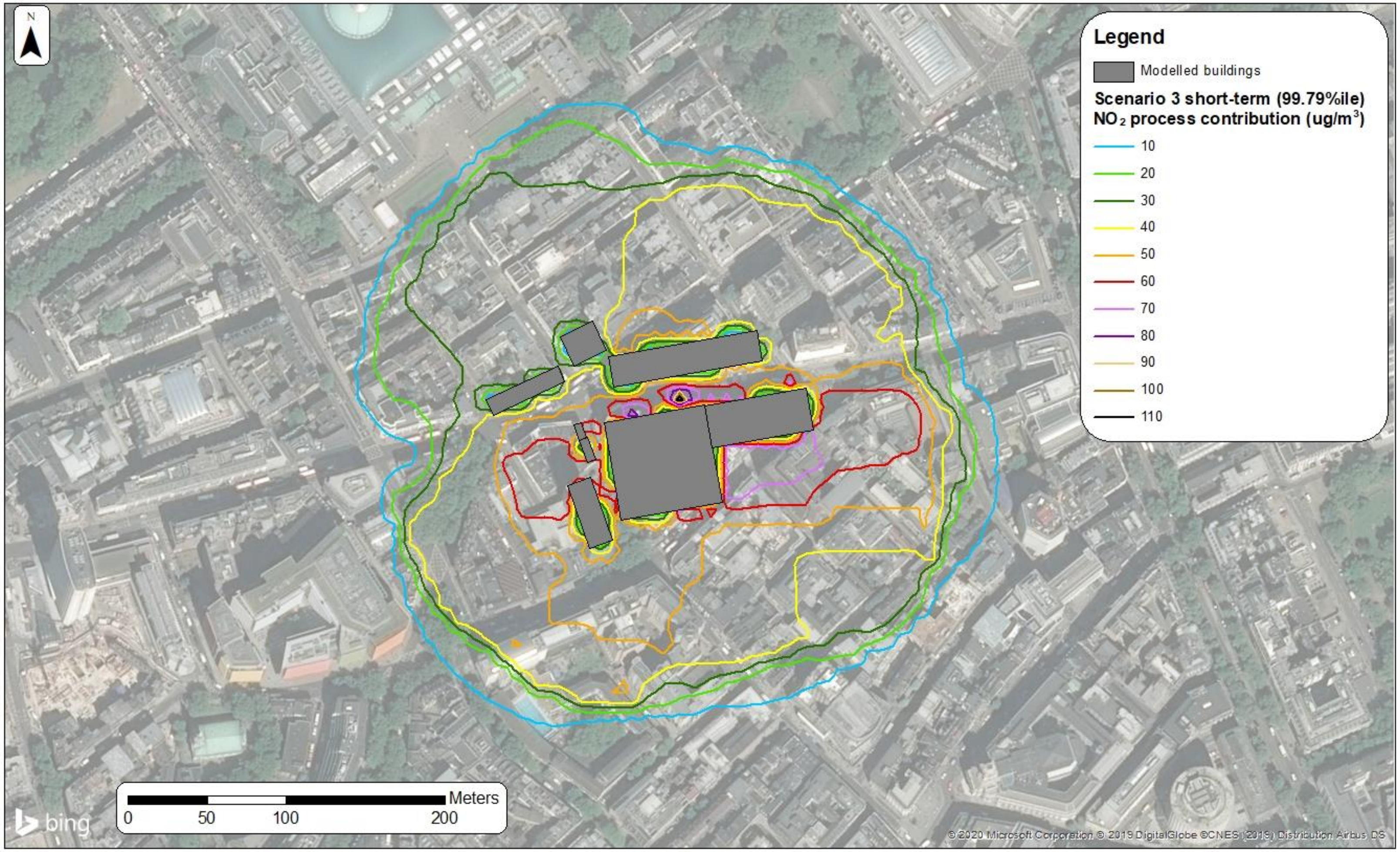


Figure D3. 3: Scenario 3 hourly mean NO_2 process contribution ($\mu g/m^3$) at 1.5m



D4 Hourly mean NO_2 process contribution at 8m

Figure D4. 1: Scenario 1 hourly mean NO_2 process contribution ($\mu g/m^3$) at 8m

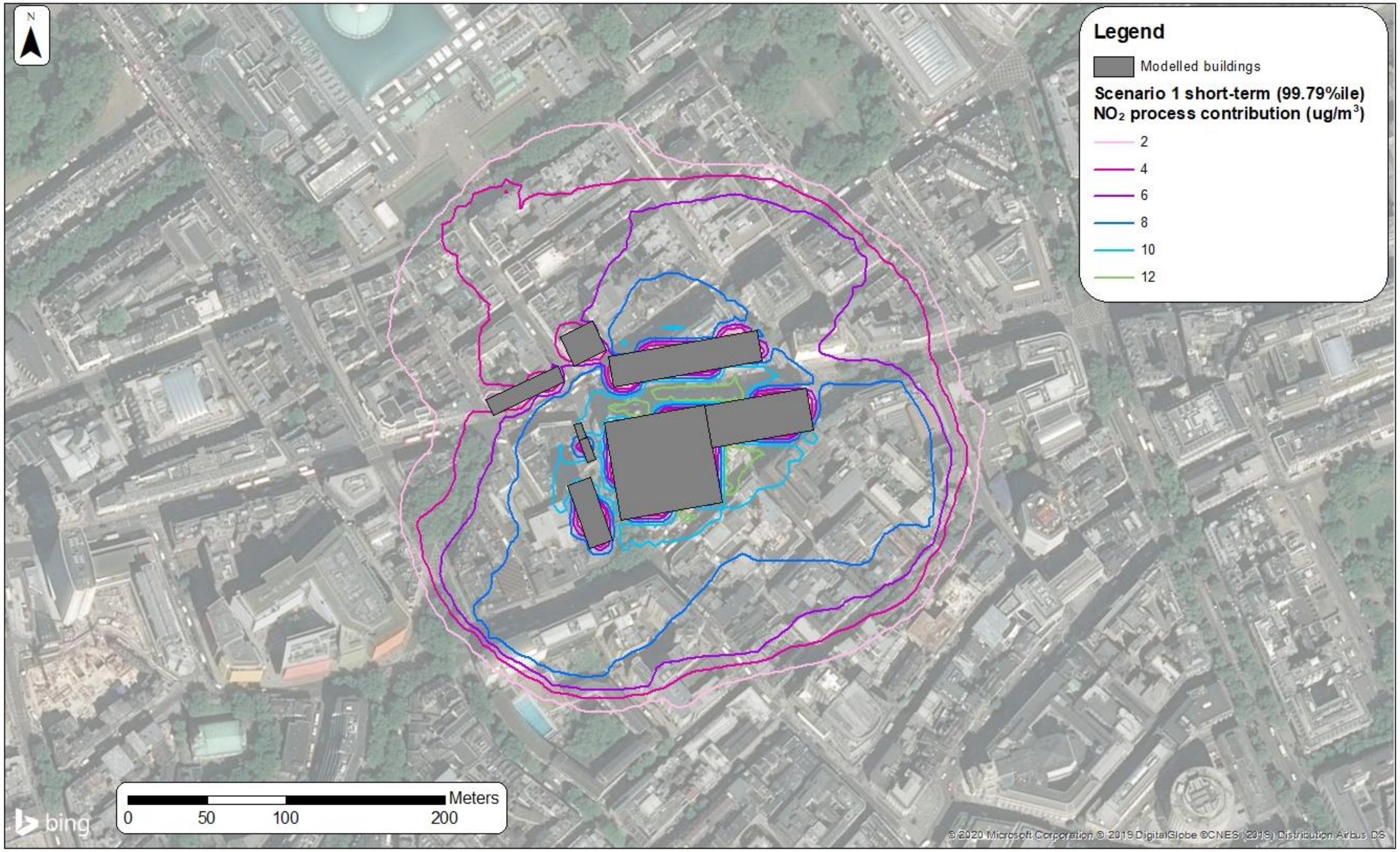


Figure D4. 2: Scenario 2 hourly mean NO_2 process contribution ($\mu g/m^3$) at 8m

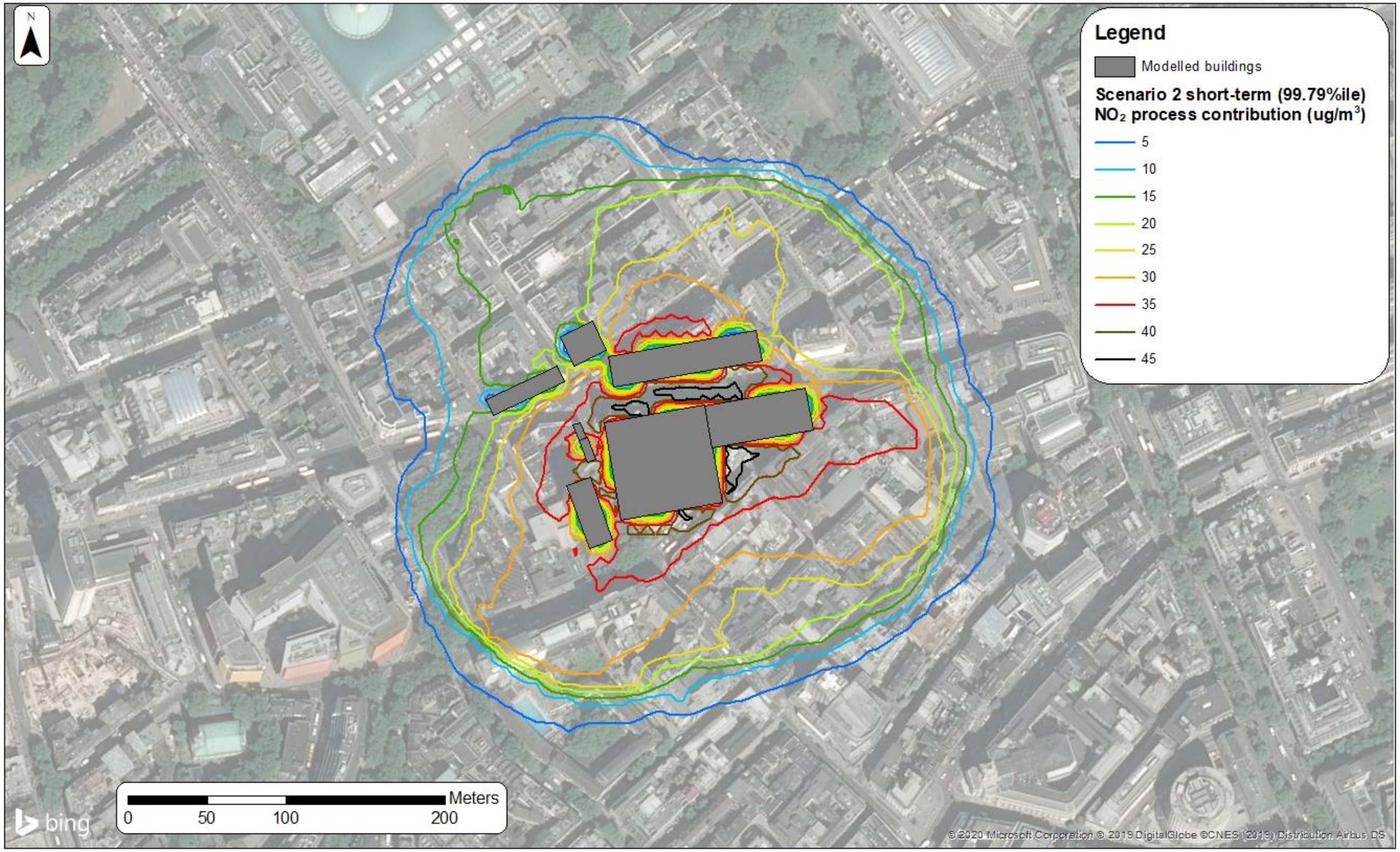


Figure D4. 3: Scenario 3 hourly mean NO_2 process contribution (µg/m^3) at 8m