

## **Air Quality Assessment: Middlesex Street Estate Car Park, City of London**

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July 2020



Experts in air quality  
management & assessment



## Document Control

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## 1 Introduction

- 1.1 This report describes the potential air quality impacts associated with emissions from extraction systems serving the underground car park at the Middlesex Street Estate in the City of London. The assessment has been carried out by Air Quality Consultants Ltd on behalf of the City of London Corporation.
- 1.2 This report utilises car park usage information and vehicle emission factors, along with specifications for the ventilation systems, to assess the likelihood of significant air quality impacts at existing residential properties as a result of emissions from vehicles using the underground car park.

## 2 Emissions Calculations

- 2.1 The underground car park comprises two main areas, each of which has the following independent ventilation systems:
- Area A - the ventilation system exhausts air extracted from the car park through a large light well roughly in the centre of Petticoat Square. Fresh air is drawn in through the car park entrance off Artizan Street; and
  - Area B – the ventilation system exhausts air extracted from the car park through two louvres located at first floor level on the south western façade of Petticoat Tower. Fresh air is drawn in through another light well in Petticoat Square (separate to that used for the Area A exhaust).
- 2.2 The extraction system has been designed to prevent the built-up of exhaust fumes, or smoke, in the underground car park. It will routinely operate at a rate that ensures three air changes per hour (ACH) for each area of the car park, which results in air extraction rates of 5.7 m<sup>3</sup>/s and 4.2 m<sup>3</sup>/s for Areas A and B respectively. If the extraction system detects elevated carbon monoxide concentrations in the air being extracted, the system will double the extraction rate to achieve six ACH; if smoke is detected the extraction rate will be increased to 10 ACH.
- 2.3 For the purposes of this assessment, it has been assumed that the ventilation systems will operate at three ACH at all times; this is a worst-case approach, as the reduced number of air changes will result in higher pollutant concentrations in the air being exhausted. The assessment is focussed on emissions of nitrogen oxides (NO<sub>x</sub>) and PM<sub>10</sub>, as these are the key pollutants of concern from vehicle emissions (noting that it is the nitrogen dioxide (NO<sub>2</sub>) component of NO<sub>x</sub> that is of primary concern). Other pollutants, such as carbon monoxide, sulphur dioxide, volatile organic hydrocarbons and benzene are only present in trace amounts in modern vehicle exhausts, with no realistic prospect of significant impacts for these pollutants if there are none for NO<sub>x</sub> and PM<sub>10</sub>.
- 2.4 Car park usage has been estimated by the City of London Corporation. It is estimated that approximately 15 vehicles per day enter and leave Area A (15 in, 15 out). Area B is not currently used, but it is anticipated that the future demand will be approximately 30 vehicles per day (30 in, 30 out).
- 2.5 Due to the layout of the car park, cars accessing Area B must pass through Area A, so this has been accounted for in the Area A vehicle emissions. As a worst-case approach, it has been assumed that all vehicles will use the parking spaces furthest from the entrance and exit ramp of the car park, thus maximising the distance travelled and emissions within the car park. Furthermore, it has been assumed that all vehicles will travel at a speed of 5 kph, which is the speed associated with maximum emissions in Defra's Emission Factor Toolkit (EFT) (v9.0) (Defra, 2020), which has been used to derive driving emissions for the cars using the car park, and is thus worst-case.

- 2.6 Vehicles with cold engines tend to initially emit more pollution than vehicles with warm engines; a cold start 'penalty' derived from the National Atmospheric Emissions Inventory (Ricardo Energy & Environment, 2020) has been applied to all outbound trips, making the worst-case assumption that all departing cars have cold engines. The penalty for diesel cars has been applied to all trips, which is higher than that for petrol cars. It should also be noted that these additional emissions typically take place over some distance as the engine warms up; applying them all to the short distance driven to exit the car park will have over-estimated the cold start emissions from the car park, and is thus worst-case.
- 2.7 The total vehicle emission rates for vehicles in Area A and Area B have been divided by the extract rate for the corresponding ventilation systems to yield the concentrations of NO<sub>x</sub> and PM<sub>10</sub> in the air being released at the aforementioned outlets. The emissions calculations are detailed in Table 1, with all figures representing the total emissions from all vehicles using each car park area on a given day.

**Table 1: Summary of Ventilation System Emissions Calculations**

	NO <sub>x</sub>		PM <sub>10</sub>	
	Area A	Area B	Area A	Area B
<b>Vehicle Emission Rate (mg/s)</b>	0.06	0.02	0.003	0.001
<b>Cold Start Emission Rate (mg/s)</b>	0.06	0.12	0.004	0.009
<b>Total Emission Rate (mg/s)</b>	0.12	0.14	0.007	0.010
<b>Exhaust air volume flow (m<sup>3</sup>/s)</b>	5.7	4.2	5.7	4.2
<b>Concentration in Extracted Air (µg/m<sup>3</sup>)</b>	21.1	34.4	1.3	2.3

- 2.8 The exhausted air will rapidly mix with the surrounding air, diluting the pollutant concentrations considerably within metres of the point of exhaust, thus these concentrations at the point of exhaust should not be taken to represent likely concentrations at the nearest residential properties. It is, however, not considered necessary to use a dispersion model to establish the impacts as a result of the emissions; instead the exhaust concentrations can be compared to those of a typical source of emissions that is routinely located in close proximity to people's living spaces.
- 2.9 The total NO<sub>x</sub> emission rates have been compared to those for a typical 24 kW domestic boiler compliant with the emission limit (40 mgNO<sub>x</sub>/kWh) set out in the Greater London Authority's (GLA) Supplementary Planning Guidance on Sustainable Design and Construction (GLA, 2014). Such a boiler would have a NO<sub>x</sub> emission rate of approximately 0.29 mg/s, which is greater than the predicted car park exhaust emission rates (0.12 mg/s for Area A and 0.14 mg/s for Area B). Furthermore, as boiler emissions have a significantly smaller volume of exhaust gas (when

compared to the large volumes extracted each second from the car park), the initial NO<sub>x</sub> concentration in the boiler exhaust is dramatically higher, at 41,439 µg/m<sup>3</sup> (which is 1,200 times that of the higher of the two car park exhausts).

- 2.10 Domestic boiler exhausts are routinely located on the façades of properties in every town and city, often no more than a metre or two from a home's doors or windows, whereas the car park's extraction system exhausts are located at least 6 m from the nearest residential property. Given that the emissions from the car park's extraction systems will be a fraction of those from a single boiler, and neither source will typically have a very great exit velocity (thus initial mixing rates will be broadly similar), it is clear that the emissions are extremely small and pose no risk to the health of residents of residential properties near to the extraction system exhausts.
- 2.11 In terms of PM<sub>10</sub>, typical gas-fired domestic boilers release negligible quantities of particulate matter, so making a comparison to the predicted car park emissions, as done for NO<sub>x</sub>, is not appropriate. However, the calculated concentrations of PM<sub>10</sub> in the extracted air (presented in Table 1) are not expected to significantly impact air quality at existing residential properties, as they are smaller than the NO<sub>x</sub> emission rates by approximately a factor of 15 (or a factor of about 10 if assuming that 70% of the NO<sub>x</sub> is NO<sub>2</sub>, as is commonly assumed), yet the air quality objectives for PM<sub>10</sub> and NO<sub>2</sub> are set at the same concentration (40 µg/m<sup>3</sup>).
- 2.12 The assessment has applied a number of worst-case assumptions, thus the emission rates presented for the car park exhaust systems likely represent over-predictions. Regardless of this, the emissions from the car park extraction systems are so small that significant impacts should not be expected even if the car park usage rates detailed in Paragraph 2.4 represent under-predictions, unless drastically under-predicted (e.g. under-predicted by more than half).

### 3 Conclusions

- 3.1 The potential air quality impacts of emissions from two underground car park ventilation systems on conditions at existing residential properties in the Middlesex Street Estate have been assessed.
- 3.2 The assessment has applied a number of worst-case assumptions, thus the emission rates presented for the car park exhaust systems likely represent over-predictions.
- 3.3 The worst-case predicted NO<sub>x</sub> emission rates for the two ventilation systems have been shown to be significantly smaller than that for a single typical domestic boiler (which would often be installed considerably closer to living spaces than the car park ventilation exhausts are), thus it can be inferred that there is no risk of adverse impacts as a result of emissions from these systems.
- 3.4 With regards to PM<sub>10</sub>, emissions from the car park extraction systems are considerably lower than those for NO<sub>x</sub>, and also not of concern. NO<sub>x</sub> and PM<sub>10</sub> are the key pollutants of concern from vehicle emissions, thus it can be concluded that if the impacts for these pollutants will be insignificant, the same will be true for any other pollutants in the vehicle exhausts.
- 3.5 Significant impacts should not be expected even if the car park usage rates used in the assessment represent under-predictions, unless the under-prediction is extreme (e.g. under-predicted by more than half).
- 3.6 The overall air quality effects of emissions from the underground car park are judged to be not significant.

## 4 References

Defra (2020) *Local Air Quality Management Support Website*, Available: <http://laqm.defra.gov.uk>.

GLA (2014) *Sustainable Design and Construction Supplementary Planning Guidance*, Available: <https://www.london.gov.uk/what-we-do/planning/implementing-london-plan/supplementary-planning-guidance/sustainable-design-and>.

Ricardo Energy & Environment (2020) *National Atmospheric Emissions Inventory Emission factors for transport* Available: <https://naei.beis.gov.uk/data/ef-transport>.



## 5 Glossary

<b>ACH</b>	Air Changes per Hour
<b>AQC</b>	Air Quality Consultants
<b>Defra</b>	Department for Environment, Food and Rural Affairs
<b>EFT</b>	Emission Factor Toolkit
<b>GLA</b>	Greater London Authority
<b>kph</b>	Kilometres Per hour
<b>kW</b>	Kilowatt
<b>kWh</b>	Kilowatt-hour
<b>µg/m<sup>3</sup></b>	Microgrammes per cubic metre
<b>NO<sub>2</sub></b>	Nitrogen dioxide
<b>NO<sub>x</sub></b>	Nitrogen oxides (taken to be NO <sub>2</sub> + NO)
<b>PM<sub>10</sub></b>	Small airborne particles, more specifically particulate matter less than 10 micrometres in aerodynamic diameter

## 6 Appendices

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## A1 Professional Experience

### **Guido Pellizzaro, BSc (Hons) MIAQM MIEEnvSc PIEMA**

Mr Pellizzaro is an Associate Director with AQC, with more than 14 years' experience in the field of air quality management and assessment. His main experience relates to managing and delivering air quality assessments for major planning applications and EIA development. Guido is a Member of the Institute of Environmental Sciences and of the Institute of Air Quality Management, and a Practitioner of the Institute of Environmental Management and Assessment.

### **Ricky Gellatly, BSc (Hons) CSci MIEEnvSc MIAQM**

Mr Gellatly is a Principal Consultant with AQC with over eight years' relevant experience. He has undertaken air quality assessments for a wide range of projects, assessing many different pollution sources using both qualitative and quantitative methodologies, with most assessments having included dispersion modelling (using a variety of models). He has assessed road schemes, airports, energy from waste facilities, anaerobic digesters, poultry farms, urban extensions, rail freight interchanges, energy centres, waste handling sites, sewage works and shopping and sports centres, amongst others. He also has experience in ambient air quality monitoring, the analysis and interpretation of air quality monitoring data, the monitoring and assessment of nuisance odours and the monitoring and assessment of construction dust. He is a Member of the Institute of Air Quality Management and is a Chartered Scientist.

### **Jack Buckley BSc (Hons) MSc AMIEEnvSc AMIAQM**

Mr Buckley is a Consultant with AQC with two years' experience in the field of air quality. Prior to joining AQC in June 2019, he worked as a Consultant at Capita, where he gained experience in the assessment of air quality impacts for a range of projects, including road and rail infrastructure schemes, residential developments and industrial facilities sites. He has experience in producing air quality assessments for EIA schemes, using qualitative and quantitative methods, including ADMS-Roads and air quality neutral calculations, and has undertaken diffusion tube monitoring studies. Prior to joining Capita, Jack completed a BSc (Hons) in Chemistry and an MSc in Environmental Science and Management, with both dissertations investigating the performance of low-cost air quality sensors. He is an Associate Member of both the Institute of Air Quality Management and the Institution of Environmental Sciences.