FICHTNER
Consulting Engineers Limited

**Medisort Ltd**

# Hillingdon CWI

Air Quality Technical Note

## 1 Introduction

Fichtner Consulting Engineers has been engaged by Medisort Ltd (the Client) to prepare an application to vary the Environmental Permit (EP) (Ref: EPR/YP3404SE) for the operation of the Hillingdon Clinical Waste Incinerator, Uxbridge, Middlesex (the Facility).

The Facility has been operated as a waste incineration plant since the construction of the hospital in the 1960s. A number of upgrades are currently being made to the boiler and the flue gas treatment systems to meet the requirements of the Industrial Emission Directive (2010/75/EU) and the Waste Incineration BREF (WI BREF). In addition to the improvements to the boiler and the flue gas treatment systems, other minor improvements are also being made to the overall operation of the Facility. The Facility will be re-commissioning following implementation of the improvements.

The improvements include measures such as installation of a twin pass boiler and an automated combustion control system, as well as changes to the flue gas treatment (FGT) system to ensure the Facility can meet the requirements of the WI BREF. These improvements in particular will result in a change in the flue gas conditions and the pollutant release rates. This technical note has been prepared to present the results of a dispersion modelling study undertaken to determine the impact of emissions from the Facility following the changes proposed as part of the EP variation.

## 2 Methodology

Dispersion modelling of emissions from the Facility has been undertaken using ADMS 6. The maximum contribution to ground-level concentrations has been calculated for the following scenarios:

1. The “Permitted Facility”, using the flue gas parameters from a 2004 Air Quality Assessment for the Facility undertaken by RPS (report reference FTD4002).
2. The “Proposed Facility”, based on the expected flue gas parameters following implementation of the improvements, as provided by the EPC Contractor.

The principal model inputs and parameters are provided in Appendix A.

The impact of the changes proposed as part of the EP variation is defined as the difference between scenario 1 and scenario 2. Consideration has also been given to the maximum impact of the Proposed Facility. Both the change in impact and the overall impact of the Proposed Facility have been assessed in accordance with the Environment Agency (EA) guidance ‘Air Emissions Risk Assessment for your Environmental Permit’[1] (“Air Emissions Guidance”).

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

The Air Emissions Guidance states that to screen out 'insignificant' process contributions (PCs):

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

For the purpose of this assessment, the environment standards are the Ambient Air Directive (AAD) Limit Values, Targets, air quality standards and objectives, and Environmental Assessment Levels (EALs) relevant to the pollutants considered. For the remainder of this note these are collectively referred to as air quality assessment levels (AQALs).

If the impact can be screened out as 'insignificant' at the point of maximum impact, further assessment is not required. If PCs cannot be screened out, assessment will be undertaken for the following:

- the Predicted Environmental Concentration (PEC, defined as the PC plus the background concentration) at the point of maximum impact; and
- the PC and PEC at areas of public exposure.

If the long-term PEC is below 70% of the AQAL, or the short-term PC is less than 20% of the headroom[2], it can be concluded that "there is little risk of the PEC exceeding the AQAL", and the impact can be considered 'not significant'.

# 3 Results

The results of the dispersion modelling at the point of maximum impact are presented in Table 1 and Table 2. A 70% long-term and 35% short-term conversion from NOx to nitrogen dioxide has been assumed in accordance with EA guidance. Any impacts of that cannot be screened out as 'insignificant' have been highlighted and further assessment undertaken.

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

*Table 1: Change in impact between Permitted Facility and Proposed Facility – Operation at Daily ELVs*

| Pollutant | Quantity | Units | AQAL | Permitted Facility PC | | Proposed Facility PC | | Change in PC | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Conc. | as % of AQAL | Conc. | as % of AQAL | Conc. | as % of AQAL |
| Nitrogen dioxide | Annual mean | µg/m³ | 40 | 0.56 | **1.39%** | 0.56 | **1.40%** | 0.003 | 0.01% |
| | 99.79th %ile of hourly means | µg/m³ | 200 | 6.71 | 3.36% | 7.54 | 3.77% | 0.833 | 0.42% |
| Sulphur dioxide | 99.18th %ile of daily means | µg/m³ | 125 | 1.05 | 0.84% | 1.00 | 0.80% | -0.046 | -0.04% |
| | 99.73rd %ile of hourly means | µg/m³ | 350 | 4.42 | 1.26% | 4.36 | 1.25% | -0.059 | -0.02% |
| | 99.9th %ile of 15 min. means | µg/m³ | 266 | 6.36 | 2.39% | 6.33 | 2.38% | -0.033 | -0.01% |
| $PM_{10}$ | Annual mean | µg/m³ | 40 | 0.04 | 0.10% | 0.02 | 0.06% | -0.018 | -0.04% |
| $PM_{2.5}$ | Annual mean | µg/m³ | 20 | 0.11 | 0.23% | 0.06 | 0.13% | -0.051 | -0.10% |
| | | | 10* | 0.04 | 0.20% | 0.02 | 0.11% | -0.018 | -0.09% |
| Carbon monoxide | 8 hour running mean | µg/m³ | 10,000 | 7.05 | 0.07% | 9.05 | 0.09% | 1.997 | 0.02% |
| | Hourly mean | µg/m³ | 30,000 | 10.84 | 0.04% | 14.32 | 0.05% | 3.477 | 0.01% |
| Hydrogen chloride | Hourly mean | µg/m³ | 750 | 2.17 | 0.29% | 2.29 | 0.31% | 0.121 | 0.02% |
| Hydrogen fluoride | Annual mean | µg/m³ | 16 | 0.00 | 0.02% | 0.00 | 0.03% | 0.0005 | 0.003% |
| | Hourly mean | µg/m³ | 160 | 0.22 | 0.14% | 0.29 | 0.18% | 0.070 | 0.04% |
| Ammonia | Annual mean | µg/m³ | 180 | 0.04 | 0.02% | 0.04 | 0.02% | 0.005 | 0.003% |
| | Hourly mean | µg/m³ | 2,500 | 2.17 | 0.09% | 2.86 | 0.11% | 0.695 | 0.03% |
| | Annual mean | µg/m³ | 5 | 0.04 | 0.80% | 0.04 | 0.89% | 0.005 | 0.09% |

| Pollutant | Quantity | Units | AQAL | Permitted Facility PC | | Proposed Facility PC | | Change in PC | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Conc. | as % of AQAL | Conc. | as % of AQAL | Conc. | as % of AQAL |
| VOCs (as benzene) | Daily mean | µg/m³ | 30 | 0.42 | 1.39% | 0.52 | 1.75% | 0.107 | 0.36% |
| VOCs (as 1,3-butadiene) | Annual mean | µg/m³ | 2.25 | 0.04 | **1.77%** | 0.04 | **1.98%** | 0.005 | 0.21% |
| Mercury | Annual mean | ng/m³ | 250 | 0.20 | 0.08% | 0.09 | 0.04% | -0.110 | -0.04% |
| | Hourly mean | ng/m³ | 7,500 | 10.84 | 0.14% | 5.73 | 0.08% | -5.112 | -0.07% |
| Cadmium | Annual mean | ng/m³ | 5 | 0.20 | **3.98%** | 0.09 | **1.78%** | -0.110 | -2.20% |
| PAHs | Annual mean | pg/m³ | 250 | 0.80 | 0.32% | 0.89 | 0.36% | 0.094 | 0.04% |
| Dioxins | Annual mean | fg/m³ | - | 0.40 | - | 0.36 | - | -0.042 | - |
| PCBs | Annual mean | ng/m³ | 200 | 0.02 | 0.01% | 0.02 | 0.01% | 0.002 | 0.001% |
| | Hourly mean | ng/m³ | 6,000 | 1.08 | 0.02% | 1.43 | 0.02% | 0.348 | 0.01% |

**AQAL of 10 µg/m³ taken from the Environmental Targets (fine particulate matter) (England) regulations 2023 – to be achieved by 2040.*

*Table 2: Change in impact between Permitted Facility and Proposed Facility – Operation at Short-Term ELVs*

| Pollutant | Quantity | Units | AQAL | Permitted Facility PC | | Proposed Facility PC | | Change in PC | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Conc. | as % of AQAL | Conc. | as % of AQAL | Conc. | as % of AQAL |
| Nitrogen dioxide | 99.79$^{th}$ %ile of hourly means | µg/m³ | 200 | 13.42 | 6.71% | 16.76 | 8.38% | 3.34 | 1.67% |
| Sulphur dioxide | 99.73$^{rd}$ %ile of hourly means | µg/m³ | 350 | 17.69 | 5.05% | 21.82 | 6.23% | 4.13 | 1.18% |
| | 99.9$^{th}$ %ile of 15 min. means | µg/m³ | 266 | 25.45 | 9.57% | 31.65 | **11.90%** | 6.20 | 2.33% |
| Carbon monoxide | 8 hour running mean | µg/m³ | 10,000 | 21.16 | 0.21% | 27.15 | 0.27% | 5.99 | 0.06% |
| | Hourly mean | µg/m³ | 30,000 | 32.51 | 0.11% | 42.95 | 0.14% | 10.43 | 0.03% |
| Hydrogen chloride | Hourly mean | µg/m³ | 750 | 13.01 | 1.73% | 17.16 | 2.29% | 4.16 | 0.55% |
| Hydrogen fluoride | Hourly mean | µg/m³ | 160 | 0.87 | 0.54% | 1.15 | 0.72% | 0.28 | 0.17% |

As shown, any increases in impact are less than 1% of the long-term and 10% of the short-term AQALs and can be screened out as 'insignificant' for all pollutants. For some pollutants the impact decreases due to reduction in emission limits (refer to Table 8 in Appendix A), whereas for pollutants where the emission limit is unchanged or only slightly lower there is a slight increase in impacts due to the reduction in flue gas efflux velocity.

In addition, the impact of the Proposed Facility is less than 1% of the long-term and 10% of the short-term AQALs and can be screened out as 'insignificant' for all pollutants except:

- Annual mean nitrogen dioxide;
- Annual mean VOCs as 1,3-butadiene;
- Annual mean cadmium; and
- 15-minute mean sulphur dioxide.

For annual mean nitrogen dioxide and 1,3-butadiene, and 15-minute mean sulphur dioxide, the impact of the Proposed Facility is marginally higher than that of the Permitted Facility. Consideration has been given to the PEC for these pollutants to determine the significance of effect.

For cadmium, although the PC cannot be screened out (under the assumption that cadmium is emitted at the combined emission limit for cadmium and thallium), the impact is lower than the Permitted Facility as the emission limit is much lower for the Proposed Facility (refer to Appendix A). As such, no further assessment is required for cadmium.

A review of sources of baseline pollutant concentrations has been undertaken to determine the significance of the impact of the Proposed Facility. Sulphur dioxide and 1,3-butadiene are not monitored locally so the mapped background concentrations published by Defra for the grid square containing the Facility have been used as the baseline concentration, noting that these are from the most recent 2001-based dataset and are likely to be an over-estimate. The mapped background concentration of nitrogen dioxide from the 2018 based background maps has also been extracted. The mapped background concentrations for the 1 km x 1 km grid square containing the Facility are presented in Table 3.

*Table 3: Mapped Background Data*

| Pollutant | Annual mean concentration (µg/m³) | Dataset |
|---|---|---|
| Nitrogen dioxide | 22.43 | Defra 2018 Dataset |
| Sulphur dioxide | 5.47 | Defra 2001 Dataset |
| 1,3-butadiene | 0.37 | Defra 2001 Dataset |

*Source: © Crown 2023 copyright Defra via uk-air.defra.gov.uk, licenced under the Open Government Licence (OGL).*

In addition, the London Borough of Hillingdon undertakes monitoring of nitrogen dioxide. There are two roadside diffusion tube monitoring locations within 1 km of the Facility. Monitoring results from these sites are presented in Table 4.

*Table 4: Summary of non-automatic nitrogen dioxide monitoring data within 1 km of the Site*

| ID | Distance from Site (m) | Annual mean concentration (µg/m³) | | | | |
|---|---|---|---|---|---|---|
| | | 2017 | 2018 | 2019 | 2020 | 2021 |
| **Roadside Monitoring** | | | | | | |
| HILL04 | 765 | 28.2 | 28.5 | 27.8 | 22.6 | 23.3 |
| HILL05 | 230 | 36.1 | 33.4 | 34.1 | 27.4 | 25.4 |

*Source: London Borough of Hillingdon 2021 LAQM Annual Status Report (May 2022) and © Crown 2023 copyright Defra via uk-air.defra.gov.uk, licenced under the Open Government Licence (OGL).*

As shown, no exceedances of the annual mean AQAL for nitrogen dioxide have been recorded at these roadside sites in the most recent 5 years of monitoring. The highest monitored concentration is 36.1 µg/m³, with a decreasing trend in concentrations being evident. However, monitored concentrations in 2020 and 2021 are likely to be lower than the long-term trend due to the effects of the Covid-19 pandemic. As a conservative measure the highest monitored value of 36.1 µg/m³ has been used as the baseline concentration in the first instance.

Using the baseline data detailed above, the annual mean PECs for nitrogen dioxide and 1,3-butadiene have been calculated and are presented in Table 5.

*Table 5: Annual Mean Impacts – Further Assessment*

| Pollutant | Proposed Facility PC | | Proposed Facility PEC | |
|---|---|---|---|---|
| | µg/m³ | as % of AQAL | µg/m³ | as % of AQAL |
| Nitrogen dioxide | 0.56 | 1.40% | 36.66 | 91.65% |
| 1,3-butadiene | 0.04 | 1.98% | 0.41 | 18.22% |

As shown, the annual mean PEC of 1,3-butadiene is below 70% of the AQAL, so the impact of the Proposed Facility is 'not significant'.

Although the PEC of nitrogen dioxide is greater than 70% of the AQAL, this conservatively assumes that the baseline concentration is the maximum roadside concentration recorded in the vicinity of the Facility in the most recent 5 years of monitoring. Even with this conservative assumption, the PEC remains below the AQAL.

A plot file showing the extent of the impact of annual mean nitrogen dioxide that cannot be screened out as 'insignificant' is presented as Figure 1 of Appendix B. This shows that the impact is almost identical in the two scenarios, with the maximum impact occurring slightly closer to the stack for the Proposed Facility due to the reduction in flue gas efflux velocity. There are no monitoring locations in the area where the impact exceeds 1% of the AQAL. However, this area includes residential properties along the A437 where the concentrations monitored at site HILL05 are considered to be applicable.

As the impact of the Proposed Facility is only 0.01% of the AQAL higher than the Permitted Facility, the descriptor applied to the impact is unchanged, and it is considered that no significant effects would occur as a result of emissions of nitrogen dioxide from the Proposed Facility.

The headroom for 15-minute mean sulphur dioxide has been calculated as the AQAL minus the short-term baseline concentration, which has been assumed to be twice the annual mean concentration. The headroom is 266 µg/m³ - 10.94 µg/m³ = 255.06 µg/m³. The PC from the Proposed Facility, assuming operation at the short-term ELV during the worst-case weather conditions for dispersion, is 31.65 µg/m³, equivalent to 12.41% of the headroom. As this is less than 20% of the headroom, the impact is 'not significant'.

# 4 Conclusions

A dispersion modelling study has been undertaken to determine the effect of the proposed EP variation on pollutant concentrations at the point of maximum impact. This has shown that the impact of the Proposed Facility is less than the impact of the Permitted Facility for most pollutants. For those pollutants where the impact increases, and the impact of the Proposed Facility cannot be screened out as 'insignificant', further analysis has been undertaken.

The further analysis has confirmed that, taking into account baseline pollutant concentrations, the descriptor applied to the impact of the Proposed Facility is the same as for the Permitted Facility (with the exception of 15-minute mean sulphur dioxide, for which the impact of the Permitted Facility is screened out as 'insignificant' and the impact of the Proposed Facility is described as 'not significant'). Therefore, the operation of the Proposed Facility is not considered to result in an unacceptable change in air quality impacts.

Yours sincerely

FICHTNER Consulting Engineers Limited

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**Lead Consultant**

# Appendices

# A Dispersion Model Inputs

Modelling has been undertaken using 5 years of meteorological data from Heathrow from 2017 – 2021. The model has been set up with the following parameters:

- Output grid: 1 km x 1 km grid of resolution 10 m;
- Dispersion site roughness length: 0.5 m;
- Meteorological site roughness length: 0.5 m;
- Dispersion site minimum Monin-Obukhov length: 30 m;
- Meteorological site minimum Monin-Obukhov length: 30 m;

The building parameters, stack parameters, and pollutant emission rates are detailed in Table 6 to Table 8.

*Table 6: Building Details*

| Buildings | Centre Point | | Height (m) | Length (m) | Width (m) | Angle (°) |
|---|---|---|---|---|---|---|
| | X (m) | Y (m) | | | | |
| A | 506946.0 | 182143.0 | 8.5 | 19.0 | 20.5 | 305 |
| B | 506931.2 | 182146.7 | 8.5 | 23.0 | 33.0 | 95 |
| C | 506941.6 | 182140.4 | 12.0 | 9.5 | 4.4 | 95 |
| D(1) | 506957.8 | 182151.7 | 14.0 | 7.7 | 7.7 | 215 |

*Note:*
*(1) Selected as the main building for the Facility*

*Table 7: Stack Parameters*

| Parameter | Units | Permitted Facility | Proposed Facility |
|---|---|---|---|
| Location | m,m | | 506942, 182146 |
| Height | M | | 36.5 |
| Effective diameter – x2 ducts combined | m | 0.53 | 0.53 |
| Flow rate at discharge conditions | $m^3/h$ | 27,500 | 17,157 |
| | $m^3/s$ | 7.64 | 4.77 |
| Flow rate at reference conditions (273K, dry gas, 11% O2, 101.3 kPa) | $Nm^3/h$ | 11,200 | 10,587 |
| | $Nm^3/s$ | 3.11 | 2.94 |
| Oxygen content | % v/v, dry | Not stated | 10.33% |
| Moisture content | % v/v | Not stated | 8.34% |
| Temperature | °C | 160 | 160 |
| Efflux velocity | m/s | 17.3131 | 10.80 |

*Note:*
*All data is for both ducts combined.*

*Table 8: Pollutant Emissions Concentrations and Release Rates*

| Pollutant | Emission concentration (mg/Nm³ - except where stated) | | Release rate (g/s - except where stated) | | |
|---|---|---|---|---|---|
| | Permitted Facility | Proposed Facility | Permitted Facility | Proposed Facility | % change |
| Oxides of nitrogen | 200 | 180 | 0.622 | 0.529 | -14.93% |
| Sulphur dioxide | 50 | 40 | 0.156 | 0.118 | -24.38% |
| Carbon monoxide | 50 | 50 | 0.156 | 0.147 | -5.47% |
| Dust | 10 | 5 | 0.031 | 0.015 | -52.74% |
| Hydrogen chloride | 10 | 8 | 0.031 | 0.024 | -24.38% |
| VOCs | 10 | 10 | 0.031 | 0.029 | -5.47% |
| Hydrogen fluoride | 1 | 1 | 3.111 mg/s | 2.941 mg/s | -5.47% |
| Ammonia | 10 | 10 | 0.031 | 0.029 | -5.47% |
| Mercury | 0.05 | 0.02 | 0.156 mg/s | 0.059 mg/s | -62.19% |
| Cadmium and Thallium | 0.05 | 0.02 | 0.156 mg/s | 0.059 mg/s | -62.19% |
| Other Metals(1) | 0.5 | 0.3 | 1.556 mg/s | 0.882 mg/s | -43.28% |
| Dioxins and Furans | 0.1 ng I-TEQ/Nm³ | 0.08 ng I-TEQ/Nm³ | 0.311 ng I-TEQ/s | 0.235 ng I-TEQ/s | -24.38% |
| PaHs(2) | 0.2 µg/Nm³ | 0.2 µg/Nm³ | 0.622 µg/s | 0.588 µg/s | -5.47% |
| PCBs(3) | 5 µg/Nm³ | 5 µg/Nm³ | 0.016 mg/s | 0.015 mg/s | -5.47% |

*Notes:*

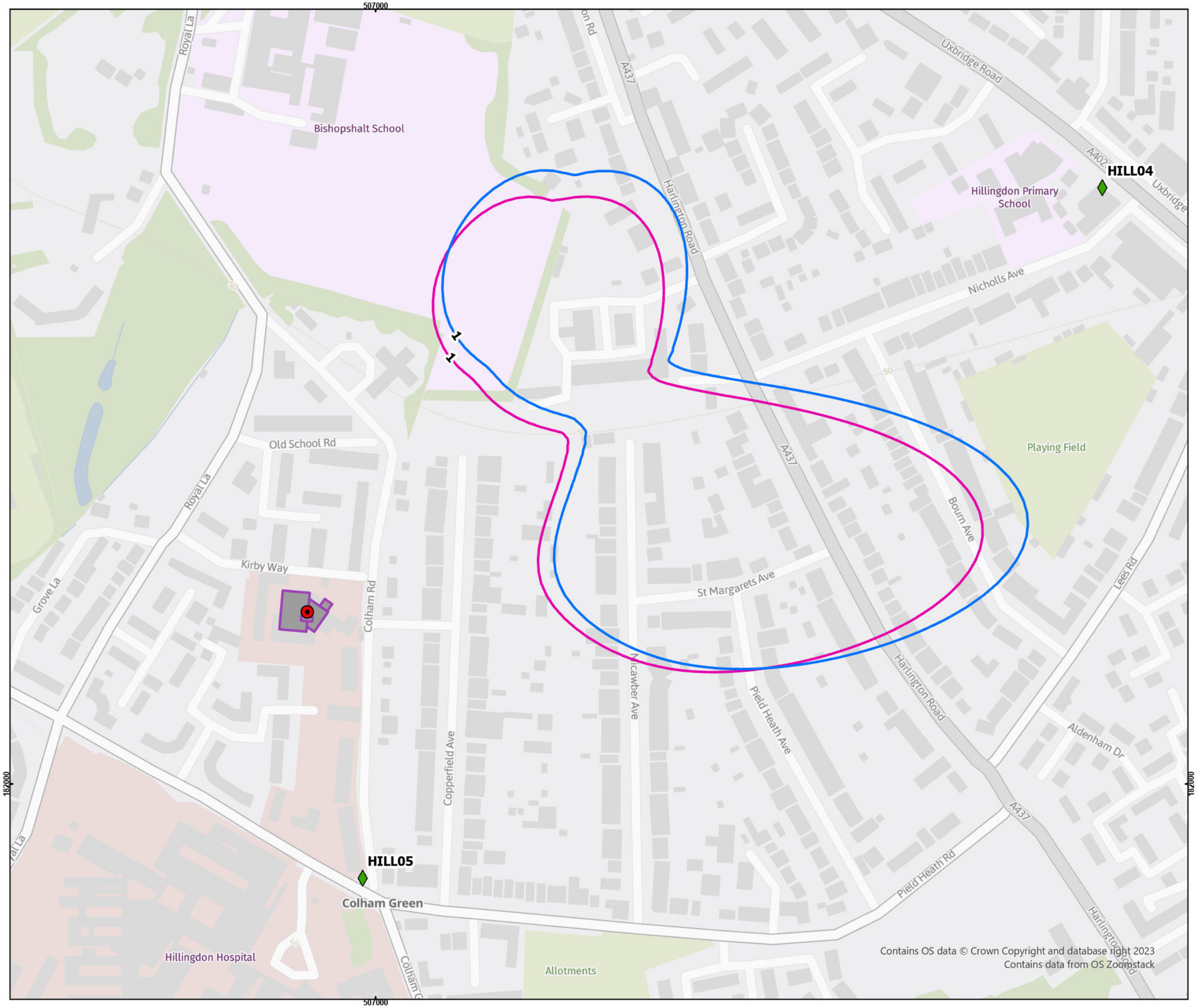
*All emissions are expressed at reference conditions of dry gas, 11% oxygen, 273.15K.*

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

*(2) 0.2 µg/m³ is the maximum recorded at a UK plant (2019 Waste Incineration BREF, Figure 8.121). This is assumed to be the emission concentration for the Facility.*

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

# B Figures




**Legend**

- Stack
- Buildings Modelled
- Nitrogen Dioxide Monitoring Locations
- Annual Mean Nitrogen Dioxide as % of AQAL - Permitted Facility
- Annual Mean Nitrogen Dioxide as % of AQAL - Proposed Facility

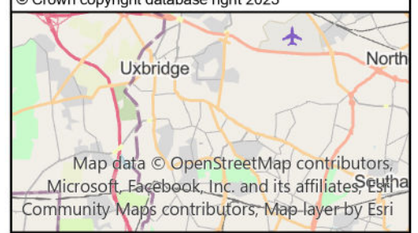
*Notes:*
*Assumes 70% NOx to NO2 conversion rate*

| | |
|---|---|
| Client: | Medisort Ltd |
| Site: | Hillingdon CWI |
| Project: | EP Variation |
| Title: | |

Figure 1. Annual Mean Nitrogen Dioxide

| | |
|---|---|
| Drawn by: SMN | Date: 22/09/2023 |






0 0.03 0.06 0.12 km

N

Scale: 1:3,000

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