# AQUIND Limited

# AQUIND INTERCONNECTOR

## Environmental Statement – Volume 3 – Appendix 23.4 Air Quality Generator Emissions Modelling

The Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 – Regulation 5(2)(a)

The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017

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# APPENDIX 23.4 AIR QUALITY GENERATOR EMISSIONS MODELLING

## 1.1. SCOPE OF THE ASSESSMENT

### 1.1.1. INTRODUCTION

1.1.1.1. This appendix details the methodology for the assessment of point emission sources involved with the construction and the permanent operation of the AQUIND Interconnector development.

### 1.1.2. STUDY AREA

1.1.2.1. The study areas for this assessment are defined as being a 1.5 km radius buffer from the point emissions source locations.

**Horizontal Directional Drilling**

1.1.2.2. Details were provided by the High Voltage Direct Current ('HVDC') engineering team on the predicted locations associated with Horizontal Directional Drilling ('HDD') operations. The HDD operation is predicted to involve the following:

- A diesel Power Pack to provide power to the drilling rig;
- A diesel-powered pump to remove mud, liquid and other detritus from the drill head;
- A diesel generator to run the mud recycling plant for processing material removed from the drill head; and
- A diesel generator to provide power for the site office and welfare facilities.

The predicted locations cross the following sections:

- Section 2;
- Section 3;
- Section 3;
- Section 6;
- Section 7;
- Section 8;
- Section 9; and

- Section 10.

**Fibre Optic Cable Facility**

1.1.2.3. Backup generators are to be provided at the Fibre Optic Cable ('FOC') facility at the landfall site to provide filtering and signal boost to fibre-optic cables that accompany the HVDC cables in the event of a power outage. The FOC facility is located in the Fort Cumberland Road car park in Section 10 as shown in Figure 23.5 of the ES Volume 2 (document reference 6.2.23.5).

1.1.2.4. The power rating of the generators is not yet determined, with estimates ranging between 50 kVA and 200 kVA.

## 1.2. ASSESSMENT METHODOLOGY

1.2.1.1. This section describes the methodology used for the derivation of emission factors and calculation of pollutant concentrations resulting from the operation of diesel power generators. For both the operation and construction stages, the following pollutants were modelled in the assessment:

- Nitrogen oxides ($NO_x$)
- Nitrogen dioxide ($NO_2$)
- Carbon monoxide (CO)
- Particulate matter ($PM_{10}$)
- Total hydrocarbons (THC)

1.2.1.2. Sulphur Dioxide ($SO_2$) is not assessed because ultra-low sulphur diesel will be used. Exhaust gas concentrations of general particulate matter were provided. Therefore, $PM_{2.5}$ is assumed to equal $PM_{10}$ for comparison with the target value. This represents a conservative approach because as the exhaust gas concentration of the finer particle fraction $PM_{2.5}$ will be lower than $PM_{10}$. THC were modelled as benzene which represents a conservative approach because no objective or limit value exists for THC. Therefore, benzene was selected for modelling as a limit value is prescribed for this particular hydrocarbon pollutant as shown in Chapter 23 (Air Quality) of the ES Volume 1 (document reference 6.1.23). It should be noted however that the toxicity of benzene in air is of a different nature to THC, particularly as benzene is a documented carcinogen (Chilcott, 2007). Therefore, the equivalent level of carcinogenesis should not be inferred from the results presented here.

### 1.2.2. CONSTRUCTION STAGE

**Local Power Generation for HDD Operations**

1.2.2.1. Following consultation with the Environmental Health Officers ('EHO') for Havant Borough Council ('HBC') and Portsmouth City Council ('PCC'), all power generating locations were scoped in to the assessment.

1.2.2.2. Modelling was undertaken using information provided by the WSP Engineering and HVDC Cabling Teams, and specialist advice regarding HDD works.

#### Embedded Mitigation

1.2.2.3. Operation of the generators is subject to the embedded mitigation measures for air quality detailed in the CEMP regarding operation, efficiency and maintenance. Any generators are subject to the minimum EU Emissions Stage requirements from the local Environmental Health Department.

#### Generator Characteristics

1.2.2.4. The information in Table 1 was provided for the HDD drilling operations, corrected for percentage of oxygen in the exhaust (%$O_2$) and temperature. No corrections were required for differences in water content as dry exhaust gas figures were provided, or for pressure.

**Table 1 – Emissions data for the HDD drilling generator model**

| | Pump | Recycling* | Welfare** | PowerPack |
|---|---|---|---|---|
| **Exhaust Mass Flow ($m^3$/min)** | 31.8 | 30.3 | 13.0 | 37.3 |
| **Exit Velocity (m/s)** | 2.51 | 5.76 | 2.99 | 4.95 |
| **Exhaust Temperature (°C)** | 546.7 | 486.6 | 540.0 | 485.7 |
| **Exhaust Diameter (m)†** | 0.152 | 0.152 | 0.152 | 0.152 |
| **$NO_x$ (mg/$Nm^3$)** | 0.09 | 0.106 | 0.004 | 0.20 |
| **CO (mg/$Nm^3$)** | 0.07 | 0.042 | 0.056 | 0.07 |
| **Hydrocarbons (mg/$Nm^3$)** | 0.002 | 0.006 | 0.002 | 0.003 |
| **Particulate Matter (mg/$Nm^3$)** | 0.0055 | 0.0101 | 0.0003 | 0.0093 |

*** Emissions for the recycling plant were not supplied and so were derived from the data sheet for the PowerPack.**

**** Emissions for the Welfare generator were not supplied and so were derived from a standard 50kVA generator.**

**† The reference exhaust diameter for the PowerPack was used for all emission sources as no other information was supplied.**

1.2.2.5. Following consultation with a drilling specialist, air quality modelling was undertaken at four out of the six drilling predicted locations due to the availability of information on the equipment that would be used on-site and the fact that any appointed drilling contractor might sub-contract or hire specific equipment for the smaller drilling operations.

1.2.2.6. The operating hours of all of the generators was considered to be between the hours of 0700 and 1900, Monday to Sunday during the predicted periods of operation.

1.2.2.7. Due to the short-term, temporary nature of the operation of the diesel generators, the 1-hourly (99.08$^{th}$ percentile) and 24-hourly (90.41th percentile) were reported.

## Operation Stage Modelled Year

1.2.2.8. The operational modelled year was determined based on the meteorological data sensitivity testing. Model runs were undertaken for each of five years of meteorological data between 2014 and 2018. The worst-case year from the ADMS outputs was found to be 2014, so all of the results from this year are presented.

## Receptors

1.2.2.9. Receptors were selected within a 1.5 km radius of each of the supplied predicted generator locations. Receptors were identified using the Ordnance Survey AddressBase Plus dataset and modelled at a height above ground of 1.5 m, as shown in Plate 1.

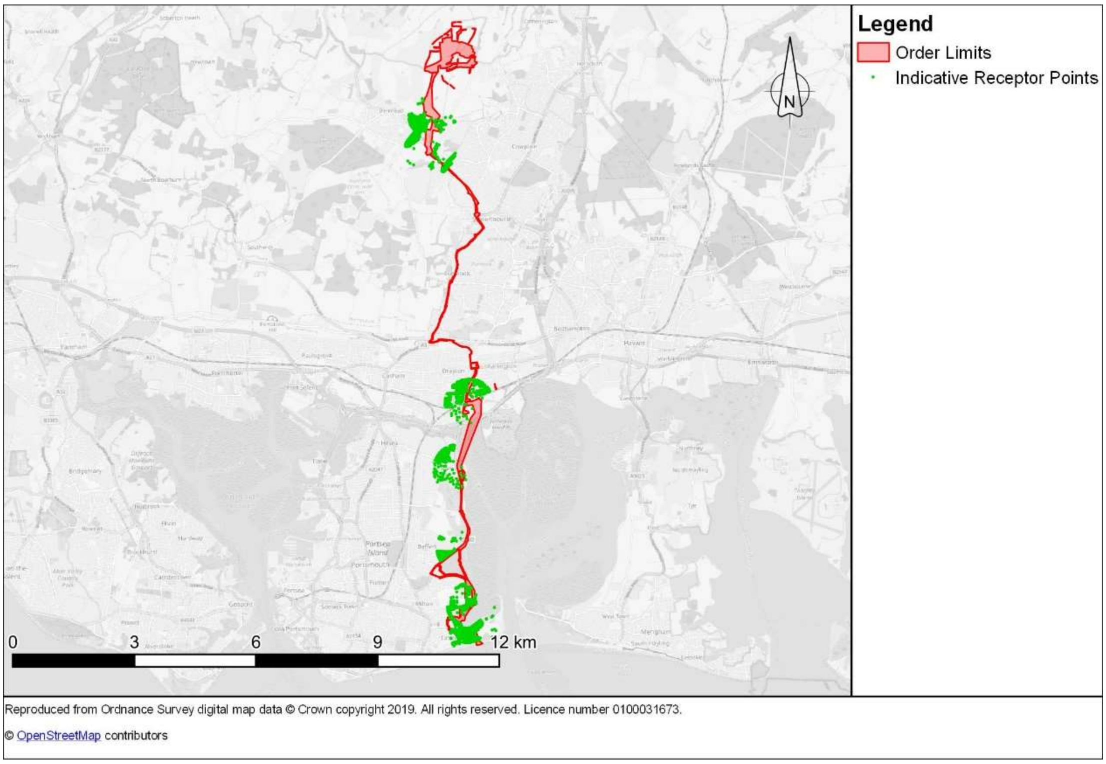


**Plate 1 - Indicative Receptors for Construction Local Power Generation Effects**

### 1.2.3. OPERATIONAL STAGE

**FOC Back-Up Power Generation**

#### Embedded Mitigation

1.2.3.1. Detailed information regarding the installation of the backup power generators at the FOC building was unavailable due to the stage of the design Therefore, the emission limits from the EU Stage VI Q emissions standards were used, as shown in Table 2. As a new generator installation after the construction year of 2026, the generator will be required to meet this standard as a minimum, barring the introduction of further, more stringent emissions standards during the intervening period.

#### Generator Characteristics

1.2.3.2. Specifications for the backup generators ranged from two 50 kVA generators up to two 200 kVA generators. Modelling was undertaken for two 200 kVA generators as a conservative approach.

1.2.3.3. The conditions for the EU Stage VI Q emissions standards i.e. the operating temperature, pressure and %$O_2$ were applied to the equipment being modelled.

**Table 2 - EU Stage IV Emissions Standards**

| Cat. | Net Power | Date (on sale) | CO | HC | $NO_x$ | PM |
|---|---|---|---|---|---|---|
| | kW | | g/kW | | | |
| **Q** | 130 ≤ P ≤ 560 | January 2014 | 3.5 | 0.19 | 0.4 | 0.025 |

1.2.3.4. The following additional data was used based on sample generator data sheets provided:

- Exhaust diameter – 0.15 m (assumed based on HDD generators);
- Exhaust mass flow – 35.8 $m^3$/min; and
- Exhaust temperature – 561 °C.

1.2.3.5. The operation of this facility is dependent on the occurrence of power outages that might affect its ability to boost or process the fibre-optic signal in the cables. Specialist advice was sought on the possibility of power outages and the likely longest repair time to restore mains electricity. The number of expected power outages in any 12-month period is expected on no more than six occasions and for a maximum period of 24-hours.

1.2.3.6. Mandatory testing of the generating units will also take place for a duration of 1-hour on one occasion per year.

1.2.3.7. Based on the predicted operation of the generators the model represented the generators running continuously for 8,760 hours (or 8,784 hours), and the ten highest 1-hour means (99.79$^{th}$ percentile) were reported.

### Operational Stage Modelled Year

1.2.3.8. In order that a robust assessment could be undertaken, five years of meteorological data between 2014 and 2018 were used for the assessment of permanent effects from the FOC backup generators. This ensures that predictions are based upon the worst dispersion conditions experienced between 2014 and 2018 which is a conservative approach. The measuring station at Thorney Island Airport was used, with missing cloud cover filled in from the station at Southampton International Airport. Modelling was undertaken for each of the five years for which meteorological data had been obtained and the worst-case concentrations reported.

### Receptors

1.2.3.9. Receptors were selected within a 1.5 km radius of each of the supplied predicted generator locations. Receptors were identified using the Ordnance Survey AddressBase Plus dataset and modelled at a height above ground of 1.5 m, as shown in Plate 2. Two 200 m transects were also modelled within the Langston Harbour SSSI, also shown in Plate 2.

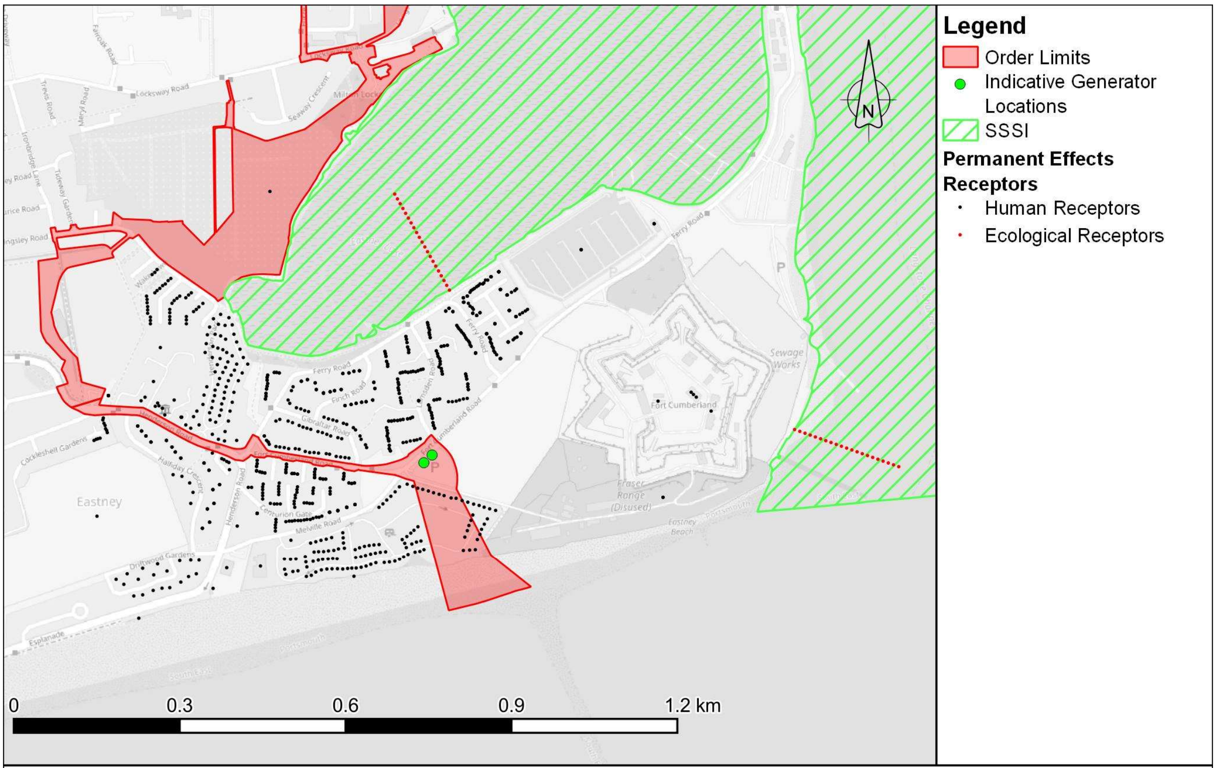




**Plate 2 - Permanent Effects Receptors**

### Buildings

1.2.3.10. Buildings were not included for the modelling of temporary construction effects resulting from the operation of diesel power.

1.2.3.11. For the modelling of the permanent effects from the operation of the FOC backup generators, a number of buildings were modelled according to the prevailing wind direction and presence of local sensitive receptors. These are shown in Plate 3 and Plate 4.

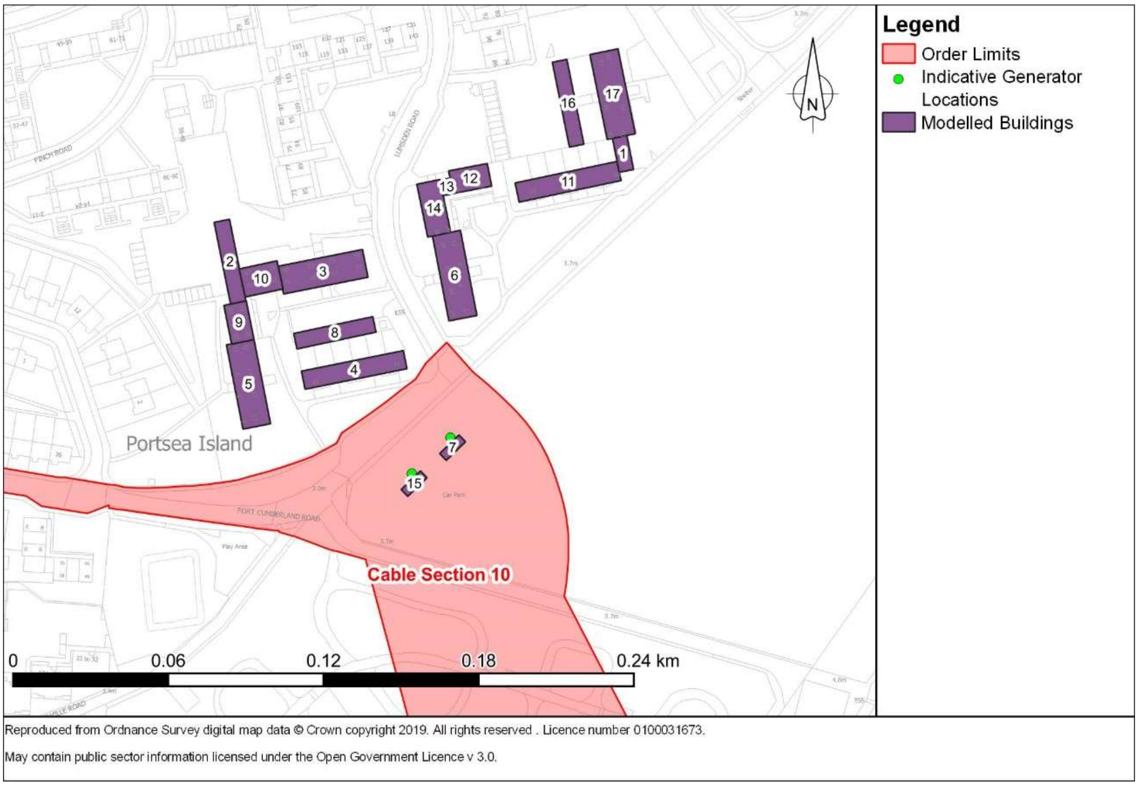


**Plate 3 - Locations of Modelled Buildings**

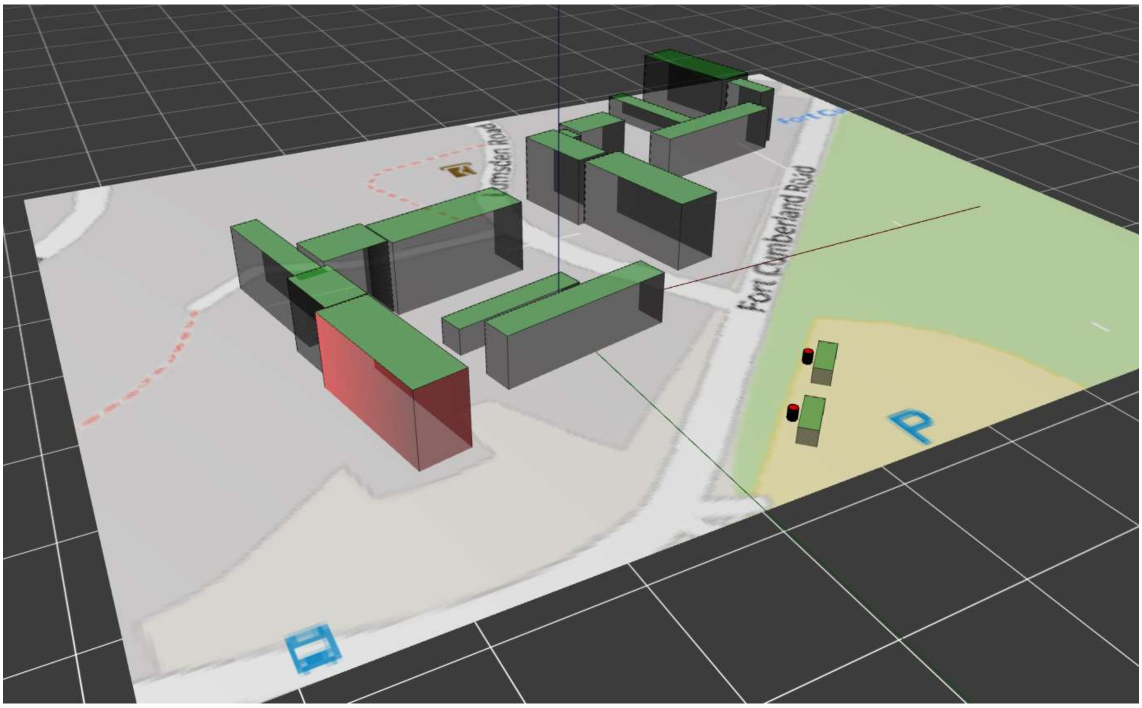




**Plate 4 - 3D Representation of Modelled Buildings**

## Results Processing

1.2.3.12. For the construction and operation stages, modelled concentration predictions for $NO_x$ were post processed according to the Environment Agency guidance note on the conversion ratios for $NO_x$ and $NO_2$ (Air Quality Modelling and Assessment Unit, 2006). Predicted concentrations for $NO_x$ were converted on the basis that the impacts are all short-term in nature, and so $NO_2$ was expressed as 35 % of the predicted $NO_x$ concentration.

## Ecological Effects

1.2.3.13. The effects on Langston Harbour SSSI have been modelled for the two 200 m transects perpendicular to the SSSI boundary within the areas affected by prevailing winds. The two particular SSSI units affected are shown in Table 3.

**Table 3 - Permanent Effects Affected SSSI Units**

| Unit ID | Unit Name | Habitat | Condition | N Dep Critical Load (kgN/ha/yr) | CLminN | CLmaxN |
|---|---|---|---|---|---|---|
| 1019415 | Eastney Lake | Littoral Sediment | Unfavourable - Recovering | 20 - 30 | - | - |
| 1007445 | Langston Harbour West | Littoral Sediment | Favourable | 20 - 30 | - | - |

1.2.3.14. Results processing was undertaken following the AQTAG06 guidance (Environment Agency AQMAU, 2006).

1.2.3.15. Deposition flux was determined using the formula:

Dry deposition Rate = Ground Level Concentration x Deposition Velocity

(µg/m²/s) (µg/m³) (m/s)

1.2.3.16. A deposition velocity of 0.0015 m/s was selected for $NO_2$ based on the recommended deposition velocity from AQTAG06 for grassland. Whilst the habitat of Langston Harbour SSSI is not grassland, the flat characteristics of the bay are more reflective of grassland than the alternative forest habitat in AQTAG06.

1.2.3.17. Dry deposition flux of N from $NO_2$ is converted from the units of µg/m²/s to kgN/ha/yr for N deposition using the conversion factor 95.9, and to keq/ha/yr for acidification using the conversion factor 6.84.

1.2.3.18. Changes in composition were reported in comparison to the background contribution to deposition which was obtained from the Air Pollution Information system (APIS) website (Centre for Ecology and Hydrology, 2019), and reported according to the IAQM ecological site assessment guidance (Holman, et al., 2019).

### 1.2.4. DECOMMISSIONING

1.2.4.1. Works for decommissioning are expected to be equivalent to those involved in construction. The methodology for assessing the air quality effects of decommissioning is the same as that described for the construction stage with updated data based on the numbers of receptors present should these change significantly over the lifetime of the infrastructure.

## 1.3. PREDICTED IMPACTS

### 1.3.1. CONSTRUCTION STAGE LOCAL POWER GENERATION

**Embedded Mitigation**

1.3.1.1. Mitigation is embedded in the Proposed Development design through the use of generators which conform to a minimum of EU Stage III emissions standards for non-road diesel engines.

**Description of Works**

1.3.1.2. Diesel will be the source of fuel burned in generators to provide power for the HDD and FOC installation activities described in Chapter 23 (Air Quality). It has been confirmed by the proposed HDD contractor that the shift pattern for construction activities will be 12 hours (0700-1900) working 7 days per week with all HDD combustion sources operating accordingly.

1.3.1.3. Exhaust gas pollutant concentrations were available from example manufacturer specifications for the specified power generation equipment. These pollutants are nitrogen oxides, carbon monoxide, particulate matter and total hydrocarbons.

1.3.1.4. Pollutant concentrations have been predicted at the discrete receptors within 1.5 km of the expected locations of the diesel generators using the OS AddressBase Plus dataset. The relevant national air quality limits and objective values are prescribed in the national AQS as described in Chapter 23 (Air Quality).

**Impacts**

**Meteorological Sensitivity**

1.3.1.5. To test the sensitivity of the predicted concentrations in the construction stage to variable dispersion conditions, five years of meteorological data were tested to identify which year provides the most conservative dispersion conditions. The results of the meteorological sensitivity testing are presented for five years of hourly sequential data (2014 – 2018) for the main pollutant of concern which is $NO_x/NO_2$.

1.3.1.6. The top 10 annual mean and 99.79$^{th}$ percentile of hourly $NO_x$ concentrations, based on the discrete receptor results, are presented for each modelled year under the worst-case scenario emissions parameters in Table 4.

**Table 4 – Meteorological sensitivity modelling results based on ground level receptor grid results under 'Worst-Case' scenario emissions parameters**

| Ranked Value | $NO_x$ concentration (µg/m³) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2014 | | 2015 | | 2016 | | 2017 | | 2018 | |
| | Annual | Hourly* | Annual | Hourly* | Annual | Hourly* | Annual | Hourly* | Annual | Hourly* |
| **1** | 5.3 | 84.8 | 3.2 | 72.1 | 4.3 | 72.3 | 3.8 | 80.5 | 3.3 | 72.6 |
| **2** | 5.3 | 84.8 | 3.2 | 70.8 | 4.2 | 72.3 | 3.8 | 80.5 | 3.3 | 72.6 |
| **3** | 4.6 | 81.6 | 2.8 | 70.8 | 4.2 | 72.2 | 3.3 | 69.8 | 3.0 | 68.4 |
| **4** | 4.6 | 77.2 | 2.7 | 69.5 | 4.1 | 70.4 | 3.3 | 69.8 | 3.0 | 66.5 |
| **5** | 4.2 | 74.9 | 2.7 | 69.2 | 4.1 | 70.2 | 2.9 | 67.7 | 2.9 | 64.8 |
| **6** | 4.2 | 74.9 | 2.6 | 65.8 | 4.0 | 66.0 | 2.9 | 62.8 | 2.9 | 64.6 |
| **7** | 4.1 | 73.7 | 2.6 | 64.0 | 4.0 | 63.8 | 2.5 | 61.7 | 2.8 | 63.6 |
| **8** | 4.1 | 73.6 | 2.6 | 61.7 | 3.7 | 63.8 | 2.5 | 61.7 | 2.8 | 62.9 |
| **9** | 4.0 | 70.8 | 2.6 | 61.0 | 3.7 | 63.2 | 2.3 | 60.5 | 2.6 | 62.9 |
| **10** | 4.0 | 70.2 | 2.6 | 61.0 | 3.6 | 63.0 | 2.3 | 58.1 | 2.6 | 62.1 |

* 99.79th percentile of hourly means. Bold value indicates year with highest concentration

1.3.1.7. A review of the results in Table 4 for the top 10 ranked discrete receptors in each year shows that most of the highest annual mean and all of the 99.79th percentile hourly mean $NO_x$ concentrations occur in 2014, thus demonstrating that this year yields the most conservative dispersion conditions of the years tested. .

1.3.1.8. As such, hourly sequential data for 2014 from the Thorney Island meteorological station were used within all subsequent model scenario runs.

### Impact Assessment

1.3.1.9. The results of the dispersion modelling are presented in tabular format for the likely construction phase scenario. Impacts are considered on human receptors as identified by the discrete receptor locations included in the model.

1.3.1.10. A summary of the predicted annual and short-term $NO_2$, CO, THC, $PM_{10}$ and $PM_{2.5}$ results at the modelled discrete receptors are presented in Table 5, Table 6 and Table 7 show the maximum predicted concentration for each pollutant and averaging period and an interpretation of the magnitude of impact following the IAQM Planning guidance (Moorcroft, et al., 2017).

**Table 5 - Do-Something Scenario results for modelled receptors (annual average)**

| Statistic | $NO_2$ | THC | $PM_{10}$ | $PM_{2.5}$** |
|---|---|---|---|---|
| **Maximum Annual Mean PC (µg/m³)** | 5.3 | 0.2 | 0.4 | 0.4 |
| **Maximum Annual Mean PEC (PC + Background) (µg/m³)** | 17.3 | 0.6 | 14.0 | 11 |
| **AQAL (µg/m³)** | 40 | 5* | 40 | 25*** |
| **Change relative to AQAL (%)** | 13% | 5% | 1% | 2% |
| **IAQM impact magnitude** | Moderate | Negligible | Negligible | Negligible |

* Annual average AQLA for benzene

** The exhaust gas concentrations provided by generator manufacturers did not differentiate between $PM_{10}$ and $PM_{2.5}$. PM results are therefore assessed against the $PM_{10}$ and $PM_{2.5}$ objectives.

*** Target value

1.3.1.11. Table 5 shows that the annual average objectives for $NO_2$, THC, $PM_{10}$ and $PM_{2.5}$ will not be exceeded during construction at any of the sensitive receptors. The largest predicted increase relative to the AQAL is 13 % for $NO_2$ and the largest receptor concentration inclusive of background will be 17.3 µg/m³ for $NO_2$. Although this is a **moderate** impact in accordance with the IAQM criteria, it is 43 % of the annual mean objective.

**Table 6 – Do-Something Scenario results for modelled receptors (24-hour $PM_{10}$ and max 8-hour CO)**

| Statistic (PC and PEC as µg/m$^3$) | CO | $PM_{10}$ |
|---|---|---|
| **Max. Percentile PC (*90.4$^{th}$ daily $PM_{10}$ and max daily 8-hour running mean CO*)** | 5.0 | 1.8 |
| **Exceedance days** | - | 0 |
| **AQAL** | 10,000 | 50 |
| **IAQM impact magnitude** | Negligible | Negligible |

1.3.1.12. Table 6 shows that the highest 8-hour running mean CO concentration is 5.0 µg/m$^3$ which is less than 1% of the AQLA. The 90.4$^{th}$ percentile daily mean $PM_{10}$ concentration is predicted to be 1.8 µg/m$^3$ which is **negligible** in comparison to the AQAL.

**Table 7 – Do-Something Scenario results for top 10 modelled receptors (1-hour $NO_2$)**

| Statistic (µg/m$^3$) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **X** | 467836 | 467836 | 467810 | 467804 | 467834 | 467834 | 467853 | 467799 | 467866 | 467844 |
| **Y** | 99194 | 99194 | 99175 | 99173 | 99199 | 99199 | 99072 | 99172 | 99068 | 99075 |
| **Max. Percentile PC** (*99.79$^{th}$ hourly $NO_2$*) | 84.8 | 84.8 | 81.6 | 77.2 | 74.9 | 74.9 | 73.7 | 73.6 | 70.8 | 70.2 |
| **AQAL (µg/m$^3$)** | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| **Change relative to AQAL (%)** | 42 | 42 | 41 | 39 | 37 | 37 | 37 | 37 | 35 | 35 |
| **IAQM impact magnitude** | **Moderate** | | | | | | | | | |

1.3.1.13. Table 7 shows that the highest 1-hour $NO_2$ concentration is 84.8 µg/m$^3$ which is 42 % of the AQAL. The top ten 1-hour $NO_2$ concentrations range from 35-42 % of the AQAL. These are **moderate** impacts in accordance with the IAQM criteria.

### Significance

1.3.1.14. The IAQM impact assessment process provides impact descriptor guidance to inform the significance judgement which varies depending on the pollutant and averaging period assessed. Negligible impacts are predicted for THC, $PM_{10}$ and $PM_{2.5}$ and moderate impacts for both annual average and 1-hour $NO_2$ in accordance with the IAQM criteria. However, the predicted maximum annual average $NO_2$ concentration is under half of the objective and exceedances of the 1-hour objective are unlikely even assuming conservative operating hours and the temporary nature of the works as described in Chapter 23 (Air Quality).

1.3.1.15. Therefore, the effect of changes in local air quality as a result of construction phase local power generation is assessed as a **minor adverse significant** effect.

## 1.3.2. OPERATIONAL STAGE LOCAL POWER GENERATION

### Embedded Mitigation

1.3.2.1. Due to detailed emissions information not being available, the emissions from the EU Stage VI Q emissions standards were used, as shown in Table 2. As a new generator installation after the construction year of 2026, the generator will be required to meet this standard at a minimum, barring the introduction of further, more stringent emissions standards during the intervening period.

### Description of Works

1.3.2.2. Diesel will be the source of fuel burned in generators to provide back-up power for the landfall activities described in Chapter 23 (Air Quality). The generators will operate between the hours of 0700 and 1900 daily.

1.3.2.3. The pollutants considered in the quantitative assessment of local air quality are those for which exhaust gas concentrations were available from example manufacturer specifications. These are the same as those for the construction phase local power generation assessment.

1.3.2.4. Pollutant concentrations have been predicted at the discrete receptors described in within 1.5 km of the predicted generator locations using the OS AddressBase Plus dataset. The relevant national air quality limits and objective values are prescribed in the national AQS as described in Chapter 23 (Air Quality).

### Impacts

### Meteorological Sensitivity

1.3.2.5. To test the sensitivity of the predicted concentrations in the operational phase to variable dispersion conditions, five years of meteorological data were tested to identify which year provides the most conservative dispersion conditions. The results of the meteorological sensitivity testing are presented for five years of hourly sequential data (2014 – 2018) for the main pollutant of concern which is $NO_x/NO_2$.

1.3.2.6. The top 10 annual mean and 99.79th percentile of hourly $NO_x$ concentrations, based on the discrete receptor results, are presented for each modelled year under the worst-case scenario emissions parameters.

**Table 8 – Meteorological sensitivity modelling results based on ground level receptor grid results under 'Worst-Case' scenario emissions parameters**

| Ranked Value | $NO_x$ concentration (µg/m$^3$) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2014 | | 2015 | | 2016 | | 2017 | | 2018 | |
| | Annual | Hourly* | Annual | Hourly* | Annual | Hourly* | Annual | Hourly* | Annual | Hourly* |
| **1** | 1.8 | 9.3 | 1.7 | 9.6 | 1.6 | 9.4 | 1.6 | 9.5 | 1.7 | 9.4 |
| **2** | 1.7 | 8.9 | 1.7 | 8.8 | 1.5 | 8.9 | 1.6 | 9.1 | 1.6 | 9.0 |
| **3** | 1.7 | 8.8 | 1.5 | 8.6 | 1.5 | 8.7 | 1.6 | 8.6 | 1.6 | 9.0 |
| **4** | 1.6 | 8.7 | 1.4 | 8.6 | 1.5 | 8.7 | 1.4 | 8.4 | 1.6 | 8.8 |
| **5** | 1.5 | 8.6 | 1.4 | 8.4 | 1.5 | 8.5 | 1.3 | 8.3 | 1.6 | 8.7 |
| **6** | 1.5 | 8.4 | 1.3 | 8.3 | 1.3 | 8.4 | 1.3 | 8.3 | 1.4 | 8.5 |
| **7** | 1.4 | 8.3 | 1.3 | 8.3 | 1.3 | 8.3 | 1.2 | 7.9 | 1.4 | 8.0 |
| **8** | 1.4 | 8.1 | 1.3 | 7.8 | 1.3 | 7.7 | 1.2 | 7.7 | 1.4 | 8.0 |
| **9** | 1.4 | 7.8 | 1.2 | 7.8 | 1.2 | 7.7 | 1.2 | 7.6 | 1.4 | 7.7 |
| **10** | 1.4 | 7.8 | 1.2 | 7.8 | 1.2 | 7.5 | 1.0 | 7.6 | 1.3 | 7.7 |

* 99.79$^{th}$ percentile of hourly means. Bold value indicates year with highest concentration

1.3.2.7. A review of the results for the top 10 ranked discrete receptors in each year shows that most of the highest annual mean and all of the 99.79th percentile hourly mean $NO_x$ concentrations occur in 2014, thus demonstrating that this year yields the most conservative dispersion conditions of the years tested.

1.3.2.8. As such, hourly sequential data for 2014 from the Thorney Island meteorological station were used within all subsequent model scenario runs.

### Impact Assessment

1.3.2.9. The results of the dispersion modelling are presented in tabular format for the likely construction phase scenario. Impacts are considered on human receptors as identified by the discrete receptor locations included in the model.

1.3.2.10. A summary of the predicted annual and short-term $NO_2$, CO, THC, $PM_{10}$ and $PM_{2.5}$ results at the modelled discrete receptors are presented in Table 5, Table 6 and Table 7 show the maximum predicted concentration for each pollutant and averaging period and an interpretation of the magnitude of impact following the IAQM Planning guidance (Moorcroft, et al., 2017).

**Table 9 – Do-Something Scenario results for modelled receptors (annual average)**

| Statistic | $NO_2$ | THC | $PM_{10}$ | $PM_{2.5}$** |
|---|---|---|---|---|
| **Maximum Annual Mean PC (µg/m³)** | 1.8 | 1.2 | 0.2 | 0.2 |
| **Maximum Annual Mean PEC (*PC + Background*) (µg/m³)** | 13.8 | 1.6 | 13.7 | 10 |
| **AQAL (µg/m³)** | 40 | 5* | 40 | 25*** |
| **Change relative to AQAL (%)** | 4% | 24% | 0.4% | 1% |
| **IAQM impact magnitude** | Negligible | Moderate | Negligible | Negligible |

* Annual average AQLA for benzene

** The exhaust gas concentrations provided by generator manufacturers did not differentiate between $PM_{10}$ and $PM_{2.5}$. PM results are therefore assessed against the $PM_{10}$ and $PM_{2.5}$ objectives.

*** Target value

1.3.2.11. Table 9 shows that the annual average objectives for $NO^2$, THC, PM10 and $PM_{2.5}$ will not be exceeded during construction at any of the sensitive receptors. The largest predicted increase relative to the AQAL is 24 % for THC and 4 % for $NO_2$. largest receptor concentration inclusive of background will be 17.3 µg/m³ for $NO_2$. Although this is a **moderate** impact in accordance with the IAQM criteria, it is just 24 % of the annual mean objective and no exceedances are likely.

**Table 10 – Do-Something Scenario results for modelled receptors (24-hour $PM_{10}$ and max 8-hour CO)**

| Statistic (PC and PEC as µg/m3) | CO | PM10 |
|---|---|---|
| **Max. Percentile PC (90.4th daily PM10 and max daily 8-hour running mean CO)** | 22.1 | 0.5 |
| **Exceedance days** | - | 0 |
| **AQAL** | 10,000 | 50 |
| **IAQM impact magnitude** | Negligible | Negligible |

1.3.2.12. Table 10 shows that the highest 8-hour running mean CO concentration is 22.1 µg/m$^3$ which is less than 1 % of the AQLA. The 90.4$^{th}$ percentile daily mean $PM_{10}$ concentration is predicted to be 0.5 µg/m$^3$ which is **negligible** in comparison to the AQAL.

**Table 11 – Do-Something Scenario results for top 10 modelled receptors (1-hour $NO_2$)**

| Statistic (µg/m³) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **X** | 467810 | 467804 | 467797 | 467799 | 467805 | 467786 | 467815 | 467792 | 467836 | 467836 |
| **Y** | 99175 | 99173 | 99089 | 99172 | 99086 | 99093 | 99083 | 99171 | 99194 | 99194 |
| **Max. Percentile PC** (*99.79th hourly $NO_2$*) | 9.3 | 8.9 | 8.8 | 8.7 | 8.6 | 8.4 | 8.3 | 8.1 | 7.8 | 7.8 |
| **AQAL (µg/m³)** | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| **Change relative to AQAL (%)** | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **IAQM impact magnitude** | Negligible | | | | | | | | | |

1.3.2.13. Table 11 shows that the highest 1-hour $NO_2$ concentration is 84.8 µg/m³ which is 42 % of the AQAL. The top ten 1-hour $NO_2$ concentrations range from 35-42 % of the AQAL. These are **moderate** impacts in accordance with the IAQM criteria.

### 1.3.3. ECOLOGICAL SITE ASSESSMENT

1.3.3.1. The results for the calculations of $NO_x$ concentrations for the Eastney Lake unit of the Langston Harbour SSSI are shown in Table 12.

**Table 12 – NOx Concentrations for the Eastney Lake SSSI Transect**

| ID | NOx PC (Annual) | NOx Background (Defra) | NOx PEC | % Change | IAQM Impact |
|---|---|---|---|---|---|
| **SSSI1_0** | 0.11 | 15.95 | 16.05 | 0.69 | Negligible |
| **SSSI1_10** | 0.10 | 15.95 | 16.05 | 0.62 | Negligible |
| **SSSI1_20** | 0.09 | 15.95 | 16.04 | 0.56 | Negligible |
| **SSSI1_30** | 0.09 | 15.95 | 16.04 | 0.56 | Negligible |
| **SSSI1_40** | 0.08 | 15.95 | 16.03 | 0.5 | Negligible |
| **SSSI1_50** | 0.08 | 15.95 | 16.03 | 0.5 | Negligible |
| **SSSI1_60** | 0.08 | 15.95 | 16.02 | 0.5 | Negligible |
| **SSSI1_70** | 0.07 | 15.95 | 16.02 | 0.44 | Negligible |
| **SSSI1_80** | 0.07 | 15.95 | 16.01 | 0.44 | Negligible |
| **SSSI1_90** | 0.06 | 15.95 | 16.01 | 0.37 | Negligible |
| **SSSI1_100** | 0.06 | 15.95 | 16.01 | 0.37 | Negligible |
| **SSSI1_110** | 0.06 | 15.95 | 16.00 | 0.38 | Negligible |
| **SSSI1_120** | 0.05 | 15.95 | 16.00 | 0.31 | Negligible |
| **SSSI1_130** | 0.05 | 15.95 | 16.00 | 0.31 | Negligible |
| **SSSI1_140** | 0.05 | 15.95 | 16.00 | 0.31 | Negligible |
| **SSSI1_150** | 0.05 | 15.95 | 15.99 | 0.31 | Negligible |
| **SSSI1_160** | 0.04 | 15.95 | 15.99 | 0.25 | Negligible |
| **SSSI1_170** | 0.04 | 15.95 | 15.99 | 0.25 | Negligible |
| **SSSI1_180** | 0.04 | 15.95 | 15.99 | 0.25 | Negligible |
| **SSSI1_190** | 0.04 | 15.95 | 15.99 | 0.25 | Negligible |
| **SSSI1_200** | 0.04 | 15.95 | 15.98 | 0.25 | Negligible |

1.3.3.2. The results for the calculations of $NO_x$ concentrations for the Langston Harbour West unit of the Langston Harbour SSSI are shown in Table 13e 13.

**Table 13 - $NO_x$ Concentrations for the Langston Harbour West SSSI Transect**

| ID | NOx PC (Annual) | NOx Background (Defra) | NOx PEC | % Change | IAQM Impact |
|---|---|---|---|---|---|
| **SSSI2_0** | 0.04 | 13.81 | 13.85 | 0.29 | Negligible |
| **SSSI2_10** | 0.04 | 13.81 | 13.85 | 0.29 | Negligible |
| **SSSI2_20** | 0.04 | 13.81 | 13.85 | 0.29 | Negligible |
| **SSSI2_30** | 0.04 | 13.81 | 13.85 | 0.29 | Negligible |
| **SSSI2_40** | 0.04 | 13.81 | 13.85 | 0.29 | Negligible |
| **SSSI2_50** | 0.04 | 13.81 | 13.85 | 0.29 | Negligible |
| **SSSI2_60** | 0.03 | 13.81 | 13.85 | 0.22 | Negligible |
| **SSSI2_70** | 0.03 | 13.81 | 13.85 | 0.22 | Negligible |
| **SSSI2_80** | 0.03 | 13.81 | 13.85 | 0.22 | Negligible |
| **SSSI2_90** | 0.03 | 13.81 | 13.85 | 0.22 | Negligible |
| **SSSI2_100** | 0.03 | 13.81 | 13.85 | 0.22 | Negligible |
| **SSSI2_110** | 0.03 | 13.81 | 13.85 | 0.22 | Negligible |
| **SSSI2_120** | 0.03 | 13.81 | 13.84 | 0.22 | Negligible |
| **SSSI2_130** | 0.03 | 13.81 | 13.84 | 0.22 | Negligible |
| **SSSI2_140** | 0.03 | 13.81 | 13.84 | 0.22 | Negligible |
| **SSSI2_150** | 0.03 | 13.81 | 13.84 | 0.22 | Negligible |
| **SSSI2_160** | 0.03 | 13.81 | 13.84 | 0.22 | Negligible |
| **SSSI2_170** | 0.03 | 13.81 | 13.84 | 0.22 | Negligible |
| **SSSI2_180** | 0.03 | 13.81 | 13.84 | 0.22 | Negligible |
| **SSSI2_190** | 0.03 | 13.81 | 13.84 | 0.22 | Negligible |
| **SSSI2_200** | 0.03 | 13.81 | 13.84 | 0.22 | Negligible |

1.3.3.3. The $NO_x$ concentration results shown in Table 12 and Table 12 show that the $NO_x$ PEC along the entire length of both transects within the Langston Harbour SSSI are below the limit value of 30 µg/m³ for the protection of vegetation, and below 70 % of the long term average limit value according to the IAQM designed site assessment guidance (Holman, et al., 2019). All of the predicted PC changes are less than 1% of the background concentration.

**Significance**

1.3.3.4. All of the predicted changes for permanently operating generator emissions range from negligible to moderate according to the IAQM impact assessment criteria, which would return a moderate to major significance according to Chapter 23 (Air Quality). However, given the conservative approach to the assessment adopted, and temporary, short-term nature of operational emissions from the FOC backup generators, it is determined that the overall significance for diesel generator operation should be **negligible adverse**.

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