

# REPORT

## Boston Alternative Energy Facility

Appendix 14.4 Analysis of SO<sub>2</sub> and O<sub>3</sub> Concentrations  
to Justify Adoption of the Less Stringent Daily Mean  
NO<sub>x</sub> Critical Level for Protection of Vegetation

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## A14 Appendix 14.4: Analysis of SO<sub>2</sub> and O<sub>3</sub> Concentrations to Justify Adoption of the Less Stringent Daily Mean NO<sub>x</sub> Critical Level for Protection of Vegetation

### A14.1 Background

A14.1.1 Air pollution can impact upon vegetation and ecosystems. The long term (annual mean) concentration of nitrogen oxides (NO<sub>x</sub>) is most relevant for its impacts on vegetation as the effects, particularly through the nitrogen deposition pathway, are cumulative. This is reflected in the adoption of the long-term Critical Level in the EU Air Quality Directive as a limit value for vegetation<sup>1</sup>. However, higher concentrations of NO<sub>x</sub> for short periods (hours/days) may also have an adverse effect under certain conditions, even where the long-term concentrations are below the Critical Level. The World Health Organisation (WHO) guidelines<sup>2</sup> state the following with regard to the 24-hour Critical Level:

A14.1.2 “Experimental evidence exists that the CLE decreases from around 200 µg/m<sup>3</sup> to 75 µg/m<sup>3</sup> when in-combination with Ozone (O<sub>3</sub>) or Sulphur Dioxide (SO<sub>2</sub>) at or above their critical levels. In the knowledge that short-term episodes of elevated NO<sub>x</sub> concentrations are generally combined with elevated concentrations of O<sub>3</sub> or SO<sub>2</sub> 75 µg/m<sup>3</sup> is proposed for the 24 h mean<sup>3</sup>.”

A14.1.3 Institute of Air Quality Management (IAQM) guidance<sup>4</sup> recommends the use of the 200 µg.m<sup>-3</sup> threshold as the short-term Critical Levels of O<sub>3</sub> and SO<sub>2</sub> concentrations are typically low in the UK.

### A14.2 Relevant Representation Comments

A14.2.1 In its Relevant Representation (document reference 9.2), Natural England requested the following:

*“...that local, finer resolution or monitoring data is used to underpin the justification. And reassurance provided that O<sub>3</sub> and SO<sub>2</sub> will at no point exceed the CL<sub>e</sub> locally...”*

[REDACTED]

A14.2.2 In order to provide this justification, background Automatic Air Quality Monitoring Stations (AAQMS) and background data maps accessed from the Department for Environment, Food and Rural Affairs (Defra) data archive were reviewed to determine whether any exceedances of the O<sub>3</sub> or SO<sub>2</sub> Critical Levels may be exceeded within the study area.

### A14.3 Critical Levels

A14.3.1 Critical Levels for the protection of vegetation and ecosystems apply irrespective of habitat type and are based on the concentration of the relevant pollutants in air. Air quality values for NO<sub>x</sub>, SO<sub>2</sub> and O<sub>3</sub> and detailed in **Table A14.4-1** **Table A14.4-1**. The WHO recommends:

*“...that the 24-hour air quality guideline for all species be abandoned, in view of further evidence confirming that peak concentrations are not significant compared with the accumulated dose.”<sup>2</sup>*

**Table A14.4-1: Critical Levels for the protection of vegetation and ecosystems**

Pollutant	Concentration (µg.m <sup>-3</sup> )	Measured as
NO <sub>x</sub>	30	Annual Mean
	75 <sup>[1]</sup>	Daily Mean
	200 <sup>[1]</sup>	Daily Mean
SO <sub>2</sub>	20	Annual Mean
Ozone (O <sub>3</sub> ): protection of vegetation and ecosystems	Target value of 18,000 µg.m <sup>-3</sup> .h based on the Accumulated Ozone exposure over a Threshold of 40 ppb (80 µg.m <sup>-3</sup> ) (AOT40). to be calculated from 1 hour values from May to July. <sup>[2]</sup>	Average over five years
<sup>1</sup> World Health Organisation short-term guideline, if the CLe exceeds for both SO <sub>2</sub> and O <sub>3</sub> then 75 µg.m <sup>-3</sup> should be used as a threshold. If not, then it is most appropriate to use 200 µg.m <sup>-3</sup> .		
<sup>2</sup> May to July refers only to vegetation, if assessing forests then the 1-hour values between April and September should be used.		

A14.3.2 The AOT40 is calculated by identifying the accumulated excess of hourly ozone concentrations above 80 µg.m<sup>-3</sup> between 8:00 and 20:00 Central European Time (CET) in the months of May, June, July (vegetation growth season).

## A14.4 Background Monitoring Data

A14.4.1 Two background AAQMS closest to the project boundary were identified using the Defra interactive monitoring network map<sup>5</sup>, these sites are Wicken Fen and Weybourne, located approximately 76 km east and 74 km south respectively. Hourly O<sub>3</sub> and SO<sub>2</sub> monitoring data from 2016 – 2020 were downloaded for Wicken Fen; SO<sub>2</sub> is not monitored at Weybourne so only O<sub>3</sub> data were obtained. The O<sub>3</sub> background monitoring results for Wicken Fen and Weybourne are shown in **Table A14.4-2** and **Table A14.4-3** respectively. The SO<sub>2</sub> background monitoring results for Wicken Fen are shown in **Table A14.4-4**.

**Table A14.4-2: Ozone AOT40 monitoring results for Wicken Fen**

Year	Vegetation Protection
	Ozone AOT40 ( $\mu\text{g.m}^{-3}.\text{h}$ )
2016	4,840
2017	4,009
2018	15,108
2019	1,172
2020	7,596
<b>Five-year Average</b>	<b>6,545</b>
Critical Level	Target value of 18,000 $\mu\text{g.m}^{-3}.\text{h}$ averaged over five years

**Table A14.4-3: Ozone AOT40 monitoring results for Weybourne**

Year	Vegetation Protection
	Ozone AOT40 ( $\mu\text{g.m}^{-3}.\text{h}$ )
2016	5,208
2017	5,319
2018	10,856
2019	5,000
2020	5,252
<b>Five-year Average</b>	<b>6,327</b>
Critical Level	Target value of 18,000 $\mu\text{g.m}^{-3}.\text{h}$ averaged over five years

<sup>5</sup> DEFRA, *Interactive Monitoring networks Map*, [Accessed 07/07/2021]

**Table A14.4-4: Annual mean SO<sub>2</sub> monitored concentrations for Wicken Fen**

Year	Annual Sulphur Dioxide Concentrations (µg.m <sup>-3</sup> )
2016	Low Data capture (<90%)
2017	1.06
2018	1.00
2019	0.94
2020	0.81
Critical Level	20 µg.m <sup>-3</sup>

A14.4.2 The results presented in tables **Table A14.4-2** and **Table A14.4-3** show that the concentrations of O<sub>3</sub> are well below the Critical Level of 18,000 µg.m<sup>-3</sup>.h for vegetation protection, with the highest concentrations recorded in 2018 and the lowest in 2019, at both monitoring sites.

A14.4.3 Annual SO<sub>2</sub> concentrations recorded at Wicken Fen (**Table A14.4-4**) are well below the Critical Level of 20 µg.m<sup>-3</sup>, with the highest value being 1.06 µg.m<sup>-3</sup> recorded in 2017. The results indicate concentrations have been gradually decreasing since 2017. Due to its location, Wicken Fen is remote from human activity, and therefore concentrations are likely to be lower.

A14.4.4 Background concentrations of SO<sub>2</sub> were obtained from the APIS website that provides mapped 5 km x 5 km background concentrations. The background concentrations for each designated site are detailed in Section 14.6.8, Table 14-14 of Chapter 14 Air Quality of the ES (document reference 6.2.14, APP-052). The SO<sub>2</sub> concentrations are summarised in **Table A14.4-5**.

**Table A14.4-5: Background Concentrations at Designated Ecological sites.**

Designated Site	SO <sub>2</sub> Background Concentrations (µg.m <sup>-3</sup> )
The Wash SPA, SAC, SSSI, Ramsar	0.88
Havenside LNR	1.29
South Forty Foot Drain LWS	1.29
Slippery Gowt Sea Bank LWS	0.88



A14.4.5 The background concentrations shown in **Table A14.4-5** are all well below the SO<sub>2</sub> Critical Level of 20 µg.m<sup>-3</sup>, and therefore it is unlikely that the Critical Level would be exceeded.

## A14.5 Conclusions

A14.5.1 The monitoring results from the AAQMSs show no recorded exceedances of the Critical Levels for O<sub>3</sub> or SO<sub>2</sub> and that the risk of exceedance is very low. This is supported by the SO<sub>2</sub> levels in the modelled background concentration maps from APIS. The AAQMSs were chosen as they are the closest, most representative stations to the study area with a high data capture. As neither O<sub>3</sub> nor SO<sub>2</sub> are likely to exceed the Critical Levels, a higher daily NO<sub>x</sub> threshold of 200 µg.m<sup>-3</sup> is considered to be the most appropriate for use, as referenced in IAQM guidance<sup>4</sup>.