Cambridge Waste Water Treatment Plant Relocation Project
Anglian Water Services Limited

Appendix 7.2: Dispersion Model Results

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1 Traffic Dispersion Model Verification

1.1 Overview

1.1.1 Model verification is a process by which checks are carried out to determine the performance of a dispersion model at a local level, primarily by comparison of modelled results with monitoring data. The verification process benefits an assessment by investigating uncertainties and minimising them through informed refinement of model input parameters if deemed necessary.

1.1.2 Defra guidance (Defra and Devolved Administrations, 2022) provides a methodology for model verification including calculation methods and directions on the suitability of monitoring data.

1.1.3 Verification of model outputs has been undertaken using the 2019 Base Year traffic data and the outputs have been compared against monitored 2019 annual mean NO_2 concentrations at ambient monitoring sites representative of modelled receptors. Monitoring data from South Cambridgeshire District Council (SCDC) and Cambridgeshire County Council (CCC) has been reviewed and four diffusion tubes sites, all from SCDC, are considered representative.

1.1.4 There is no suitable ambient monitoring of PM_{10} and $PM_{2.5}$ within the study area. Therefore, model verification is undertaken for NO2 only and the adjustment factors derived have been applied to modelled PM_{10} and $PM_{2.5}$.

1.1.5 The location of each of the sites selected has been confirmed using street photography and aerial mapping.

1.1.6 Background concentrations for the grid squares where the diffusion tubes are located, and which have been used in the model verification have been taken from Defra, and are presented in Table 1-1. Further information on Defra's background pollutant data is presented in Chapter 7; Air Quality (App Doc Ref 5.2.7).

Table 1-1: Defra background pollutant map data for verification for 2019 (µg/m^3)

Site ID	Grid Square	NOx	NO_2
DT22	545_261	19.3	14.2
DT27	545_261	19.3	14.2
DT-28N	547_262	19.2	14.1
DT-32N	548_264	12.2	9.4

1.1.7 Table 1-2 presents the ambient air quality monitoring locations and 2019 annual mean NO2 concentrations of all sites included within the model verification. The location of each of the monitoring sites used in the model verification are indicated in Figure 7.1 (Book of Figures – Air Quality, App Doc Ref 5.3.7).

Table 1-2: Ambient air quality monitoring data (µg/m^3)

Site ID	X	Y	Height (m)	Monitored 2019 NO_2 concentration
DT22	545437	261904	2	15.9
DT27	545262	261871	2	16.8
DT-28N	547438	262301	2	23.0
DT-32N	548746	264699	2	21.6

Source: SCDC ASR 2021.

1.2 Results

1.2.1 Table 1-3 presents a comparison of the monitored and modelled concentrations of NOx and NO2 at the diffusion tube monitoring sites for the year 2019. The results show that there is systematic underprediction of NO2 concentrations at sites DT-28N and DT-32N whilst the model has a good correlation with monitored concentrations at sites DT22 and DT27.

1.2.2 Initially, NOx concentrations were predicted assuming all roads within the model were at ground level and the receptor points (the monitors for verification purposes) were elevated to two meters as shown above in Table 1-2. However, this resulted in modelled NO2 overpredictions in the region of 30-40% at monitoring locations 'DT22' and 'DT27' which are located lower than the elevation of the A14, whereas DT-28N and DT-32N are located at approximately the same elevation as nearby roads

1.2.3 In accordance with Defra TG22, the model inputs were revisited and sections of road along the A14 were elevated as required with heights determined using the LIDAR Composite 2020 1m Digital Terrain Model (Environment Agency, 2020).

Table 1-3: Model verification results (µg/m³)

Site ID	Monitored road NOx (µg/m³)	Modelled road NOx (µg/m³)	Monitored total NO_2 (µg/m³)	Modelled total NO_2 (µg/m³)	Total NO_2 % difference
DT22	3.1	3.9	15.9	16.3	2.8
DT27	4.8	3.6	16.8	16.2	-3.7
DT-28N	16.8	9.4	23.0	19.2	-16.7
DT-32N	22.9	13.8	21.6	16.9	-21.9

1.2.4 Figure 1.1 and Figure 1.2 presents a graphical comparison of the monitored and modelled concentrations of road NOx and total NO_2 at the verification sites. Following Defra TG22, modelled and measured road traffic concentrations have been compared to derive an adjustment factor to apply to the modelled results. As diffusion tubes only measure total NO_2, the road traffic NOx concentration measured by the diffusion tube were derived using Defra's spreadsheet-based method, which is available from Defra's Air Information Resource Website (Defra, 2020), for calculating annual mean NOx from NO_2.

1.2.5 Both the tabular and graphical presentation of results demonstrate that there are two model 'zones.' These zones include 1 – monitoring locations where sections of the A14 are elevated and 2 – monitoring in all other areas.

1.2.6 Following Defra guidance, two model adjustment factors have been calculated by comparing modelled and monitored road traffic NOx. The model adjustment factors are

- Zone 1: A14 Elevated: 1.04
- Zone 2: Other areas: 1.7

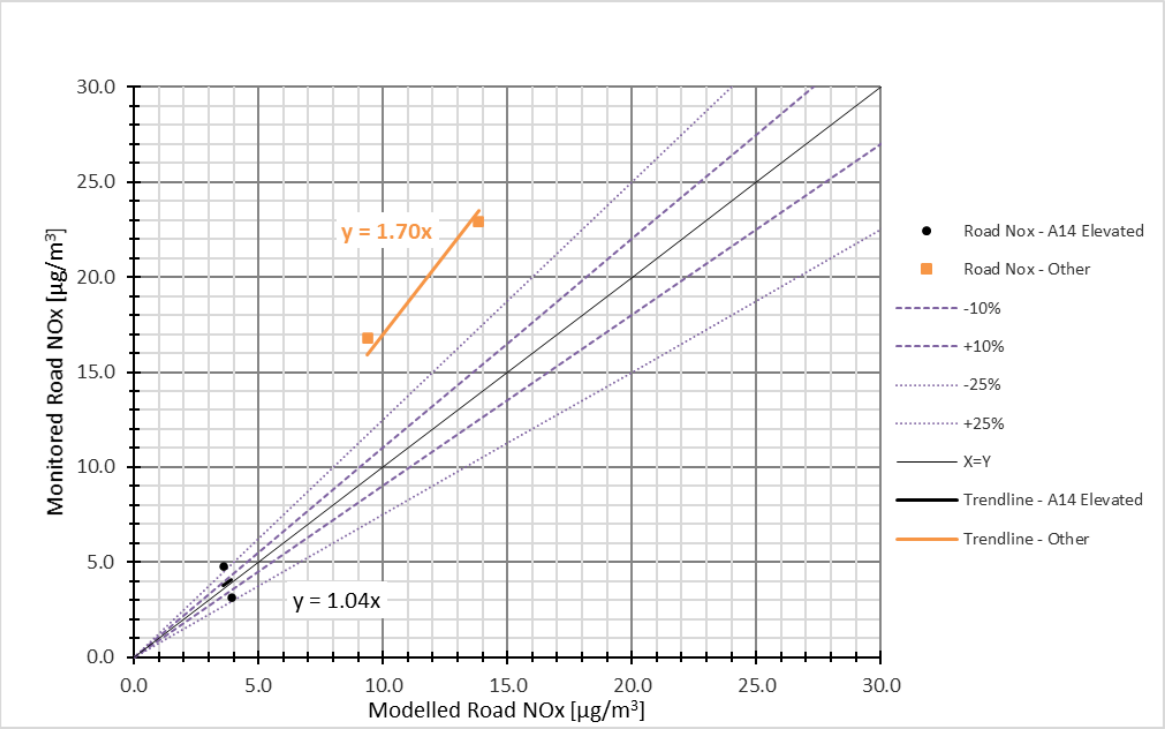

Figure 1.1: Unadjusted model verification (annual mean NOx (µg/m³)

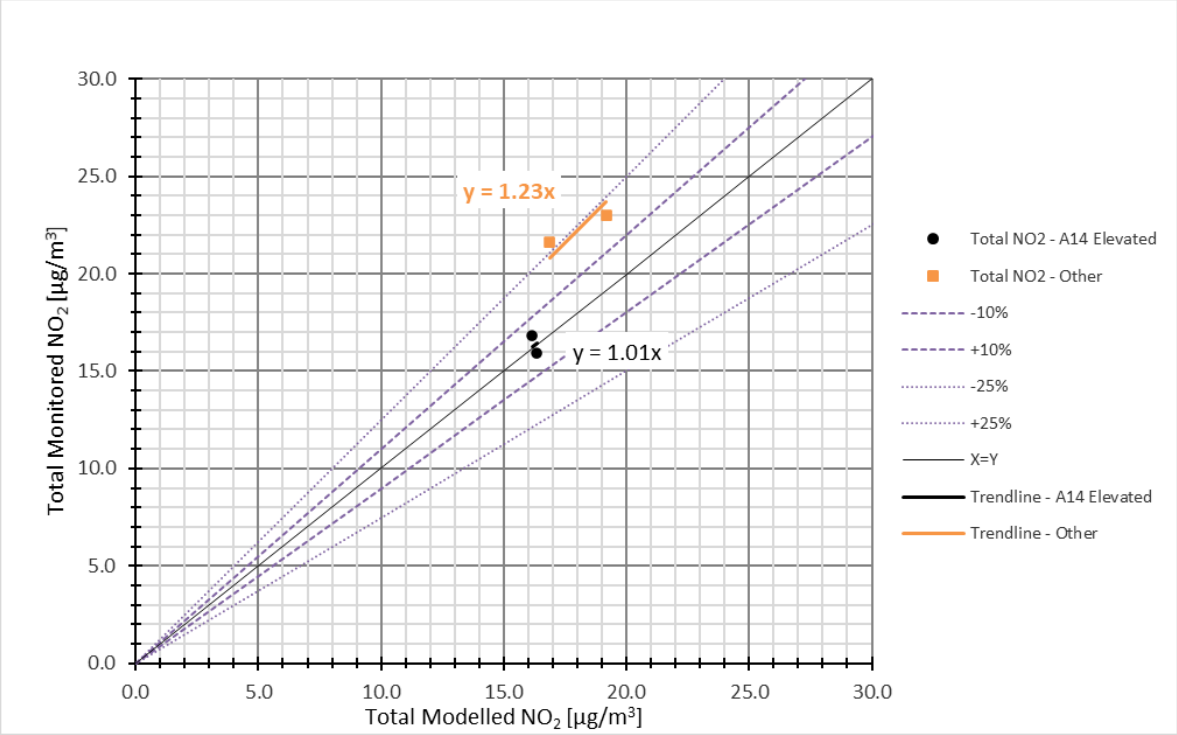

Figure 1.2: Unadjusted model verification (annual mean NO_2 (µg/m³))

1.2.7 Table 1-4 and Figure 1.3 present the adjusted modelled NO_2 with monitored NO_2 at the verification sites. The model predicts NO_2 concentrations within 4% of the monitored concentrations at all sites. The model is therefore performing well at these locations following adjustment.

Table 1-4: Adjusted model verification results (µg/m³)

Site ID	Monitored total NO_2	Modelled total NO_2	% difference
DT22	15.9	16.4	3.3
DT27	16.8	16.2	-3.3
DT-28N	23.0	22.6	-1.8
DT-32N	21.6	21.9	1.2

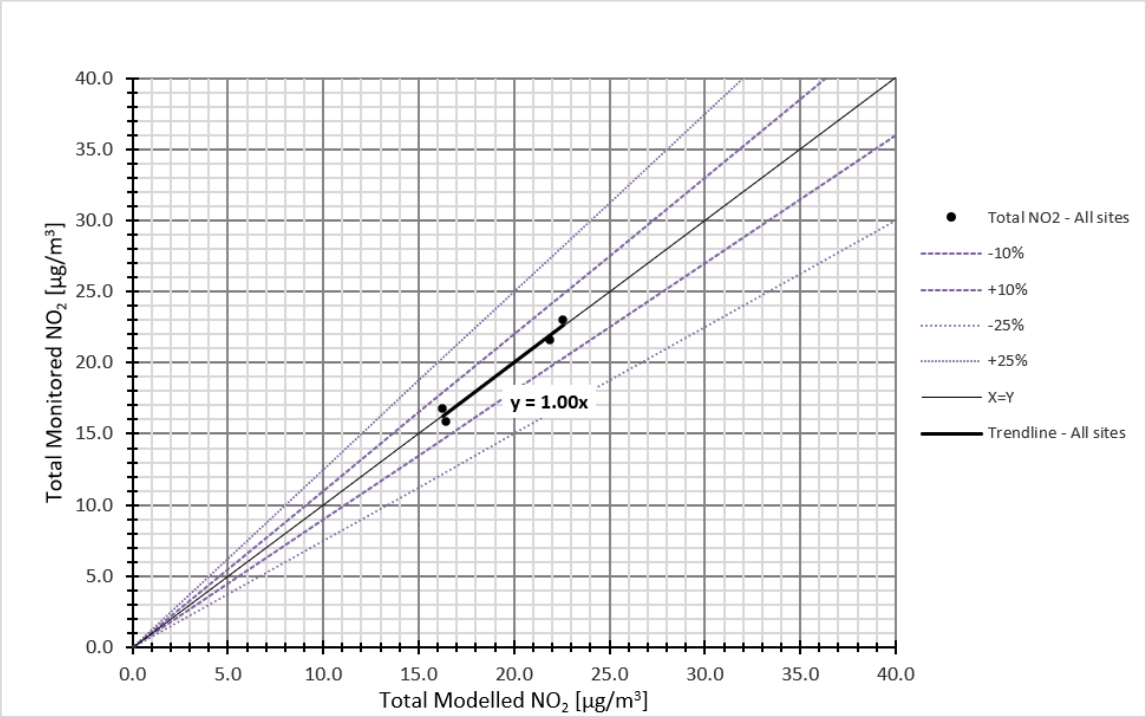

Figure 1.3: Adjusted model verification (annual mean NO_2 (µg/m³)

1.2.8 Table 1-5 presents further statistical parameters for describing model uncertainty.

1.2.9 The Root Mean Square Error (RMSE) is used to define the average error or uncertainty of the model. The results of the RMSE calculation in this case are concentrations of NO_2 measured in units of micrograms per metre cubed.

1.2.10 Fractional Bias (FB) is used to identify if the model shows a tendency to over or under predict and values can vary between +2 and -2 and have an ideal value of 0. Negative values suggest a model over-prediction and positive values suggest a model under-prediction.

1.2.11 The RMSE value shows that the model is predicting with an error of 0.5 µg/m^3 at most or 1.2% of the annual mean air quality objective of 40µg/m^3. This demonstrates that the model uncertainty is well within Defra TG22 recommended value of 25% and the desired value of 10%.

1.2.12 The FB value shows that the model has a very slight tendency to under-predict and the after adjustment value is close to 0, where 0 would indicate perfect representation of monitored concentrations. Care should be exercised when using this parameter as it demonstrates the model's performance as a whole and not at discrete locations.

Table 1-5: Description of model uncertainty

Zone	Statistical parameter	Before adjustment	After adjustment	Ideal value
A14 Elevated	RMSE	0.5	0.5	0
	FB	0.006	0.001	0
Other areas	RMSE	4.3	0.3	0
	FB	0.212	0.004	0

Note: FB values are shown to multiple decimal places to show value is not 0, as a value of 0 means the model outputs are perfectly representing monitored concentrations.

1.2.13 Overall, the modelled concentrations show a good agreement with the monitored concentrations at locations representative of the modelled human health and ecological receptors. On this basis, the modelled results are considered appropriate to allow a robust professional judgement of significance to be determined.

2 Construction Traffic Dispersion Model Results

2.1.1 This section presents the dispersion modelling results from the quantitative assessment of exhaust emission from construction traffic using the public highway.

2.2 Human health

2.2.1 Modelled NO_2, PM_{10} and $PM_{2.5}$ concentrations predicted at human health receptors experiencing the greatest impacts as a result of construction traffic associated with the proposed development are presented below in Table 2-1. These are the only receptor locations with relevant exposure within 200m of roads used by construction traffic that exceed the criteria for assessment (more than 500 Light Duty Vehicles (LDVs) or 100 Heavy Duty Vehicles (HDVs) per day on an annual average basis).

2.2.2 Pollutant contributions from road sources decline rapidly beyond the first 15m, after which locations are typically referred to as 'background' by Defra TG22 (Defra and Devolved Administrations, 2022).

2.2.3 Receptor HH1 is located approximately 5m below the elevation of the A14 and 80m to the south. There will be a two way increase of 320 LDVs and 474 HDVs per day using the section of the A14 between J33 and J34 on the peak day during the peak phase of construction.

2.2.4 Receptor HH2 is located approximately 7m below the elevation of the A14 and 25m to the south. There will be a two way increase of 311 LDVs and 528 HDVs per day using the section of the A14 between J32 and J33 on the peak day during the peak phase of construction.

2.2.5 The increases in annual mean concentrations of NO_2, PM_{10} and $PM_{2.5}$ are all less than 0.1µg/m^3. The negligible impacts are due to the Proposed Development's low construction traffic movements and the distance and elevation separation between the nearest road and the modelled receptors.

2.2.6 The modelled annual mean pollutant concentration are all less than the AQALs.

2.2.7 In accordance with the EPUK/IAQM significance criteria, effects are described as 'negligible' as the percentage increase is less than 1% of the relevant AQALs and the Do-Construction concentrations are less than 75% of the AQALs.

2.2.8 Where outdoor amenities are available, such as footpaths, playing fields and gardens, the short-term objective should be applied. However, as the annual NO_2 mean concentrations are not predicted to exceed 60µg/m^3, the short-term objective is not likely to be exceeded at these worst-case locations. Therefore, compliance with the short term NO_2 objective has not been considered further.

2.2.9 The predicted number of days where PM_{10} concentrations exceed the short-term objective of 50µg/m^3 are well below the allowance of 35 days at all receptors, with de minimis changes between the Do-Minimum and Do-Construction scenarios. Short term PM_{10} impacts are therefore concluded to be 'negligible'.

2.2.10 Therefore, in accordance with the significance criteria adopted for the assessment, there are no likely significant effects from construction traffic at assessed human health receptors.

Table 2-1: Construction traffic annual mean NO_2, PM_{10} and $PM_{2.5}$ predicted pollutant concentrations (µg/m³)

Pollutant	AQAL	Receptor ID	Receptor name	Distance to nearest road (m)	Annual mean concentration			Predicted pollutant concentration change	Magnitude of impact	Sensitivity of receptor	Effect
					2019 Base	2026 DM	2026 DC				
NO_2	40	HH1	Poplar Hall Farm	82m south of A14	18.5	12.8	12.9	<0.1	Negligible	Very Low	Negligible
		HH2	Property on Flack End	27m south of A14	16.7	11.7	11.7	<0.1	Negligible	Very Low	Negligible
PM_{10}	40	HH1	Poplar Hall Farm	82m south of A14	18.5	17.3	17.3	<0.1	Negligible	Very Low	Negligible
		HH2	Property on Flack End	27m south of A14	17.9	16.7	16.7	<0.1	Negligible	Very Low	Negligible
$PM_{2.5}$	20	HH1	Poplar Hall Farm	82m south of A14	11.3	10.3	10.3	<0.1	Negligible	Very Low	Negligible
		HH2	Property on Flack End	27m south of A14	11.5	10.5	10.5	<0.1	Negligible	Very Low	Negligible

Notes: DM – Do-Minimum; DC – Do-Construction; '<' denotes 'less than'

2.3 Ecology

Critical levels – atmospheric NOx

2.3.1 Table 2-2 presents the annual mean NOx concentrations at ecological receptors for comparison against the critical level of 30µg/m^3. The maximum annual change in NOx is less than 1% of the annual critical level. Therefore, in accordance with the significance criteria adopted for the assessment, there are no likely significant effects from construction traffic at assessed ecological receptors.

Critical loads - nitrogen deposition

2.3.2 Table 2-3 presents the maximum predicted nitrogen deposition rates at the modelled ecological receptors from construction traffic for comparison against the site-specific minimum critical loads.

2.3.3 At all modelled ecological receptors, the background nitrogen deposition is predicted to be above the minimum critical loads for the habitats identified. Therefore Base, Do-Minimum and Do-Construction model scenarios also predict total nitrogen deposition above the minimum critical loads.

2.3.4 There are no predicted increases in nitrogen deposition greater than 1% of the minimum nitrogen deposition critical loads applied to habitats at modelled ecological receptors E2, E3 and E4 at the location closest to the affected roads.

2.3.5 At modelled ecological receptor E1, there is a predicted change in nitrogen deposition above 1% of the minimum critical load. Receptor E1 is representative of the closest point of the Milton Road Hedgerows City Wildlife Site (WS) to the A14. At this location there is an expected 793 construction vehicles, of which 474 are HDVs, using the A14 to access the Proposed Development during the peak day of construction. The construction phase of the Proposed Development would be of short duration and temporary in nature, during which time the nitrogen deposition is predicted to be fractionally increased due to construction traffic movements.

2.3.6 Over the course of the construction phase, the increase in nitrogen deposition at receptor E1 is a small fraction (approximately 0.4%) of the existing Do-Minimum (no construction). The predicted Do-Construction nitrogen deposition of 51.7 kg/ha/yr remains less than the predicted base nitrogen deposition of 58.2 kg/ha/yr demonstrating that the slight increase in emissions due to construction phase traffic movements do not retard the overall reduction in nitrogen deposition between the base year and the assessed peak construction year.

2.3.7 Furthermore, the increase of 0.2 kg/ha/yr is mostly attributed to the inclusion of the ammonia contribution to nitrogen deposition. As discussed in the Air Quality Assessment Method (Appendix 7.1, App Doc Ref 5.4.7.1), the consideration of road traffic's ammonia contribution to nitrogen deposition is a relatively new recommendation that has been considered in this assessment to present a worst case approach. Without the inclusion of ammonia, the change in nitrogen deposition caused by the construction of the Proposed Development would be less than 0.1

kg/ha/yr and therefore less than 1% of the minimum critical load of 10 kg/ha/yr applied to the habitat.

2.3.8 Given the conservative assumptions (i.e. peak construction movements), the temporary nature of construction traffic, the low likelihood that nitrogen sensitive species would still be present adjacent to the A14 and that the Do-Construction nitrogen deposition in the peak construction year of 2026 is lower than the 2019 base year, it is unlikely that loss of a species/habitat would occur as a result of the minor temporary increase in nitrogen deposition. Therefore, there are no likely significant effects from construction traffic at assessed ecological receptors.

Critical loads – acidification

2.3.9 Table 2.4 presents the maximum predicted acid deposition rates at the modelled ecological receptors from construction traffic for comparison against the site-specific critical loads (CLMaxN). Sulphur species emitted from road traffic are de minimis and as such are considered within the background contribution only.

2.3.10 At all modelled ecological receptors, acid deposition is predicted to be below 1% of the acid deposition critical load applied to the habitats.

Therefore, in accordance with the significance criteria adopted for the assessment, there are no likely significant effects from construction traffic at assessed ecological receptors.

Table 2-2: Critical level results – Annual mean NOx concentration from construction traffic (µg/m³)

Receptor ID	Receptor name and designation	Annual NOx concentration				Change as % of CLE[(a)]	Total DC as % of CLE[(b)]	Total DM exceedance of CLE?	Total DC exceedance of CLE?	Significance
		Total Base NOx	Total DM NOx	Total DC NOx	Change NOx					
E1	Milton Road Hedgerows WS	63.5	34.0	34.2	0.2	1	114.1	Yes	Yes	Not Significant
E2	Kings Hedges Hedgerow WS	22.8	15.5	15.5	<0.1	<1	51.8	No	No	Not Significant
E3	Low Fen Drove Way Grasslands and Hedges CWS	100.0	48.7	48.7	<0.1	<1	162.4	Yes	Yes	Not Significant
E4	Wilbraham Fens SSSI	32.8	18.3	18.3	<0.1	<1	61.2	No	No	Not Significant

Notes: WS – City Wildlife Site; CWS – County Wildlife Site; LNR – Local Nature Reserve; SSSI – Site of Special Scientific Interest

CLE denotes critical level; '<' denotes less than

(a) CLE: Critical level for NOx (30µg/m³). Rounded to the nearest whole percent. Values rounded to 1% are considered 'not significant'.

(b) Values less than 100% are considered 'not significant'

Table 2-3: Critical load results - nitrogen deposition rates from construction traffic (kg/ha/yr)

Receptor ID	Receptor name and designation	APIS Habitat	BG N-dep	Nitrogen deposition			Change N-dep	Minimum CLO	Change as % of minimum CLO[d]	Total DC exceedance of minimum CLO?	Existing BG exceedance of minimum CLO?	Change as % of minimum CLO greater than 1%	Significance
				Total Base[a]	Total DM[b]	Total DC [c]							
E1	Milton Road Hedgerows WS	Hedgerows	33.9	58.2	51.5	51.7	0.2	10	2	Yes	Yes	Yes	Not Significant
E2	Kings Hedges Hedgerow WS	Hedgerows	33.9	35.9	35.3	35.3	<0.1	10	<1	Yes	Yes	No	Not Significant
E3	Low Fen Drove Way Grasslands and Hedges CWS	Calcareous grassland	18.9	46.0	39.3	39.3	<0.1	15	<1	Yes	Yes	No	Not Significant
E4	Wilbraham Fens SSSI	Fen, Marsh and Swamp	17.8	23.3	21.8	21.8	<0.1	15	<1	Yes	Yes	No	Not Significant

Notes: BG – background; CLO denotes critical load; '<' denotes less than

WS – City Wildlife Site; CWS – County Wildlife Site; LNR – Local Nature Reserve; SSSI – Site of Special Scientific Interest

(a) Total Base: Base scenario contribution added to APIS background.

(b) Total DM: Do-Minimum scenario contribution added to APIS background.

(c) Total DC: Do-Construction scenario contribution added to APIS background.

(d) Rounded to the nearest whole percent. Values rounded to 1% are considered 'not significant'.

Table 2.4: Critical load results - acid deposition rates from construction traffic (keq/ha/yr)

Receptor ID	Receptor name and designation	APIS Habitat	BG Acid deposition (N+S)	Acid deposition (N+S)			Change acid deposition	CLO (CLMaxN)	Change as % of CLO[(d)]	Total DC exceedance of CLO?	Existing BG exceedance of CLO?	Change as % of CLO greater than 1%	Significance
				Total Base[(a)]	Total DM[(b)]	Total DC [(c)]							
E1	Milton Road Hedgerows WS	Hedgerows	2.6	4.3	3.8	2.6	<0.1	10.783	<1	No	No	No	Not Significant
E2	Kings Hedges Hedgerow WS	Hedgerows	2.6	2.7	2.7	2.6	<0.1	10.783	<1	No	No	No	Not Significant
E3	Low Fen Drove Way Grasslands and Hedges CWS	Calcareous grassland	1.5	3.4	2.9	1.5	<0.1	4.856	<1	No	No	No	Not Significant
E4	Wilbraham Fens SSSI	Fen, Marsh and Swamp	1.4	1.8	1.7	1.4	<0.1	4.333	<1	No	No	No	Not Significant

Notes: BG – background; N – Nitrogen species; S – Sulphur species; CLO denotes critical load; '<' denotes less than

WS – City Wildlife Site; CWS – County Wildlife Site; LNR – Local Nature Reserve; SSSI – Site of Special Scientific Interest;

(a) Total Base: Base scenario contribution added to APIS background.

(b) Total DM: Do-Minimum scenario contribution added to APIS background.

(c) Total DC: Do-Construction scenario contribution added to APIS background.

(d) Rounded to the nearest whole percent. Values rounded to 1% are considered 'not significant'.

Arithmetic discrepancies may occur due to rounding of values.

3 Operational Traffic Dispersion Model Results

3.1 Overview

3.1.1 This section presents the dispersion modelling results from the quantitative assessment of exhaust emission from operational and decommissioning traffic using the public highway. Decommissioning traffic is associated with vehicles accessing the Existing Cambridge WWTP. Decommissioning of the Existing Cambridge WWTP would start when the Proposed WWTP is operational.

3.2 Human health

3.2.1 Modelled NO_2, PM_{10} and $PM_{2.5}$ concentrations predicted at modelled human health receptors experiencing the greatest impacts as a result of operational traffic associated with the Proposed Development are presented below in Table 3-1. These are the only receptor locations with relevant exposure within 200m of roads used by operational traffic that exceed the criteria for assessment (more than 500 LDVs or 100 HDVs per day on an annual average basis).

3.2.2 Pollutant contributions from road sources decline rapidly beyond the first 15m, after which locations are typically referred to as 'background' by Defra TG22 (Defra and Devolved Administrations, 2022).

3.2.3 There will be 138 LDVs and 257 HDVs per day using the section of the A14 between J33 and J34 during the operational phase near HH1.

3.2.4 There will be 46 LDVs and 111 HDVs per day using the section of the A14 between J32 and J33 during the operational phase near HH2. Traffic flows at these locations during operation are lower than the peak month of construction as assessed above.

3.2.5 The increases in annual mean pollutant concentrations are less than 0.1µg/m^3. The negligible impacts are due to the Proposed Development's low operational traffic movements and the distance and elevation between the nearest road and the modelled receptors.

3.2.6 The modelled annual mean pollutant concentrations are all less than the AQALs.

3.2.7 In accordance with the EPUK/IAQM significance criteria, effects are described as 'negligible' as the percentage increase is less than 1% of the relevant AQALs and the Do-Something concentrations are less than 75% of the AQALs.

3.2.8 Where outdoor amenities are available, such as footpaths, playing fields and gardens, the short-term objective should be applied. However, as the annual NO_2 mean concentrations are not predicted to exceed 60µg/m^3, the short-term objective is not likely to be exceeded at these worst-case locations. Therefore, compliance with the short term NO_2 objective has not been considered further.

3.2.9 The predicted number of days where PM_{10} concentrations exceed the short-term objective of 50µg/m^3 are well below the allowance of 35 days at all receptors, with

de minimis changes between the Do-minimum and Do-Something scenarios. Short term PM_{10} impacts are therefore concluded to be 'negligible'.

3.2.10 Therefore, in accordance with the significance criteria adopted for the assessment, there are no likely significant effects from operational traffic at assessed human health receptors.

Table 3-1: Operational traffic annual mean NO_2, PM_{10} and $PM_{2.5}$ predicted pollutant concentrations (µg/m³)

Pollutant	AQAL	Receptor ID	Receptor name	Distance to nearest road (m)	Annual mean concentration			Predicted pollutant concentration change	Magnitude of impact	Sensitivity of receptor	Effect
					2019 Base	2028 DM	2028 DS				
NO_2	40	HH1	Poplar Hall Farm	82m south of A14	18.5	11.9	11.9	<0.1	Negligible	Very Low	Negligible
		HH2	Property on Flack End	27m south of A14	16.7	10.9	10.9	<0.1	Negligible	Very Low	Negligible
PM_{10}	40	HH1	Poplar Hall Farm	82m south of A14	18.5	17.3	17.3	<0.1	Negligible	Very Low	Negligible
		HH2	Property on Flack End	27m south of A14	17.9	16.7	16.7	<0.1	Negligible	Very Low	Negligible
$PM_{2.5}$	20	HH1	Poplar Hall Farm	82m south of A14	11.3	10.3	10.3	<0.1	Negligible	Very Low	Negligible
		HH2	Property on Flack End	27m south of A14	11.5	10.5	10.5	<0.1	Negligible	Very Low	Negligible

Notes: DM – Do-Minimum; DS – Do-Something; '<' denotes 'less than'

3.3 Ecology

Critical levels – atmospheric NOx

3.3.1 Table 3-2 presents the annual mean NOx concentrations at ecological receptors for comparison against the critical level of 30µg/m^3. The maximum annual change in NOx is less than 1% of the annual critical level. Therefore, in accordance with the significance criteria adopted for the assessment, there are no likely significant effects from operational traffic at assessed ecological receptors.

Critical loads - nitrogen deposition

3.3.2 Table 3-3 presents the maximum predicted nitrogen deposition rates at the modelled ecological receptors from operational traffic for comparison against the site-specific minimum critical loads.

3.3.3 At all modelled ecological receptors, the background nitrogen deposition is predicted to be above the minimum critical loads for the habitats identified. Therefore Base, Do-Minimum and Do-Something model scenarios also predict total nitrogen deposition above the minimum critical loads.

3.3.4 There are no predicted increases in nitrogen deposition greater than 1% of the minimum nitrogen deposition critical loads applied to habitats at modelled ecological receptors at the location closest to the affected roads. Therefore, in accordance with the significance criteria adopted for the assessment, there are no likely significant effects from operational traffic at assessed ecological receptors.

Critical loads – acidification

3.3.5 Table 3.4 presents the maximum predicted acid deposition rates at the modelled ecological receptors from operational traffic for comparison against the site-specific critical loads (CLMaxN). Sulphur species emitted from road traffic are de minimis and as such are considered within the background contribution only.

3.3.6 At all modelled ecological receptors, acid deposition is predicted to be below 1% of the acid deposition critical load applied to the habitats.

Therefore, in accordance with the significance criteria adopted for the assessment, there are no likely significant effects from construction traffic at assessed ecological receptors.

Table 3-2: Critical level results – Annual mean NOx concentration from operational traffic (µg/m³)

Receptor ID	Receptor name and designation	Annual NOx concentration				Change as % of CLE[(a)]	Total DS as % of CLE[(b)]	Total DM exceedance of CLE?	Total DS exceedance of CLE?	Significance
		Total Base NOx	Total DM NOx	Total DS NOx	Change NOx					
E1	Milton Road Hedgerows WS	63.5	29.4	29.5	0.1	<1	98.2	No	No	Not Significant
E2	Kings Hedges Hedgerow WS	22.8	14.4	14.4	0.0	<1	48.1	No	No	Not Significant
E3	Low Fen Drove Way Grasslands and Hedges CWS	100.0	40.8	40.9	0.1	<1	136.4	Yes	Yes	Not Significant
E4	Wilbraham Fens SSSI	32.8	16.2	16.2	0.0	<1	54.0	No	No	Not Significant

Notes: WS – City Wildlife Site; CWS – County Wildlife Site; LNR – Local Nature Reserve; SSSI – Site of Special Scientific Interest

CLE denotes critical level; '<' denotes less than

(a) CLE: Critical level for NOx (30µg/m³). Rounded to the nearest whole percent. Values rounded to 1% are considered 'not significant'.

(b) Values less than 100% are considered 'not significant'

Table 3-3: Critical load results - nitrogen deposition rates from operational traffic

Receptor ID	Receptor name and designation	APIS Habitat	BG N-dep (kg/ha/yr)	Nitrogen deposition (kg/ha/yr)			Change N-dep	Minimum CLO	Change as % of minimum CLO[d]	Total DS exceedance of minimum CLO?	Existing BG exceedance of minimum CLO?	Change as % of minimum CLO greater than 1%	Significance
				Total Base[a]	Total DM[b]	Total DS [c]							
E1	Milton Road Hedgerows WS	Hedgerows	33.9	58.2	50.2	50.3	0.1	10	1	Yes	Yes	No	Not Significant
E2	Kings Hedges Hedgerow WS	Hedgerows	33.9	35.9	35.2	35.2	<0.1	10	<1	Yes	Yes	No	Not Significant
E3	Low Fen Drove Way Grasslands and Hedges CWS	Calcareous grassland	18.9	46.0	37.9	37.9	<0.1	15	<1	Yes	Yes	No	Not Significant
E4	Wilbraham Fens SSSI	Fen, Marsh and Swamp	17.8	23.3	21.5	21.5	<0.1	15	<1	Yes	Yes	No	Not Significant

Notes: CLO denotes critical load; '<' denotes less than

WS – City Wildlife Site; CWS – County Wildlife Site; LNR – Local Nature Reserve; SSSI – Site of Special Scientific Interest

(a) Total Base: Base scenario contribution added to APIS background.

(b) Total DM: Do-Minimum scenario contribution added to APIS background.

(c) Total DS: Do-Something scenario contribution added to APIS background.

(d) Rounded to the nearest whole percent. Values rounded to 1% are considered 'not significant'.

Table 3.4: Critical load results - acid deposition rates from operational traffic (keq/ha/yr)

Receptor ID	Receptor name and designation	APIS Habitat	BG Acid deposition (N+S)	Acid deposition (N+S)			Change acid deposition	CLO (CLMaxN)	Change as % of CLO[(d)]	Total DC exceedance of CLO?	Existing BG exceedance of CLO?	Change as % of CLO greater than 1%	Significance
				Total Base[(a)]	Total DM[(b)]	Total DS [(c)]							
E1	Milton Road Hedgerows WS	Hedgerows	2.6	4.3	3.8	3.8	<0.1	10.783	<1	No	No	No	Not Significant
E2	Kings Hedges Hedgerow WS	Hedgerows	2.6	2.7	2.7	2.7	<0.1	10.783	<1	No	No	No	Not Significant
E3	Low Fen Drove Way Grasslands and Hedges CWS	Calcareous grassland	1.5	3.4	2.8	2.8	<0.1	4.856	<1	No	No	No	Not Significant
E4	Wilbraham Fens SSSI	Fen, Marsh and Swamp	1.4	1.8	1.6	1.6	<0.1	4.333	<1	No	No	No	Not Significant

Notes: BG – background; N – Nitrogen species; S – Sulphur species; CLO denotes critical load; '<' denotes less than

WS – City Wildlife Site; CWS – County Wildlife Site; LNR – Local Nature Reserve; SSSI – Site of Special Scientific Interest;

(a) Total Base: Base scenario contribution added to APIS background.

(b) Total DM: Do-Minimum scenario contribution added to APIS background.

(c) Total DS: Do-Something scenario contribution added to APIS background.

(d) Rounded to the nearest whole percent. Values rounded to 1% are considered 'not significant'.

Arithmetic discrepancies may occur due to rounding of values.

4 Operation - Energy plant dispersion model results

4.1 Overview

4.1.1 This section presents the dispersion modelling results from the quantitative assessment of energy plant stack emissions from the proposed WWTP, including a stack height determination.

4.1.2 Two scenarios have been modelled for the assessment of effects on human health and ecology:

- Scenario 1 (normal operation): One biogas boiler and two biogas CHPs operating at full load continuously all year
- Scenario 2 (abnormal operation): One biogas boiler, two biogas CHPs and one flare operating at full load

4.1.3 Scenario 2 has been compared to short term AQALs only as it would not occur for extended periods of time so would not operate for periods commensurate with the long term AQALs known as air quality objectives set for the protection of human health and critical levels and critical loads set for the protection of ecology.

4.1.4 For further information on scenarios refer to Section 4 of the Air Quality Assessment Methods (Appendix 7.1, App Doc Ref 5.4.7.1).

4.2 Stack Height Determination

4.2.1 The purpose of the stack height determination is to determine the minimum height necessary to ensure that emissions from a stack do not result in excessive ground level concentrations of air pollutants from atmospheric downwash, eddies or wakes which may be created by the source itself or nearby structures. A number of methods are available to determine an appropriate stack height, including simple equations and dispersion modelling. In this case, the stack height has been determined by dispersion modelling.

4.2.2 The stack height determination was undertaken for the Proposed WWTPs multiflue which, within the maximum design parameters, houses the flues for two boilers and two CHPs. As operation of one boiler alone results in less buoyancy and hence dispersion (the exit temperature is colder and the exit velocity is slower than when combined with CHP emissions) the stack height determination is based on the operation of one boiler only.

4.2.3 Maximum ground level concentrations were modelled with stack heights of 10m to 25m with 1m intervals. These took account of the emissions data presented in Section 4.3 of the Air Quality Assessment Methods (Appendix 7.1, App Doc Ref 5.4.7.1) for one boiler operating on biogas.

4.2.4 This stack height determination provides a recommended stack height based on an assessment of potential impacts on air quality only (and does not constitute design to fulfil the duties set out in the Construction (Design and Management) Regulations 2015). Figure 4.1 confirm that a stack height of 19m above finished ground level (of

28m AOD) is suitable to prevent excessive ground level concentrations of air pollutants from atmospheric downwash, eddies or wakes which may be created by the source itself or nearby structures. Figure 4.1, increasing the height of the stack decreases the predicted ground level concentrations. This is true of all modelled receptor locations to a lesser extent than at the maximum point of impact. This assessment has presented the results of a 19m stack. When the Proposed WWTP is operational, a final stack height greater than 19m (28m AOD to the stack tip) would have lower impacts than predicted in this assessment.

Table 4-1: Maximum modelled NO_2 process contributions (one boiler in operation) per stack height (µg/m³)

Averaging period	Stack height (m)															AQAL
	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
One hour 99.79th percentile	160.7	90.7	81.2	69.1	52.8	18.6	16.3	14.9	13.5	12.0	10.5	9.3	8.2	7.3	6.6	6.0	200
Annual average	22.2	21.0	19.0	15.8	10.7	5.7	3.5	2.8	2.4	2.1	1.8	1.6	1.4	1.2	1.1	0.9	40

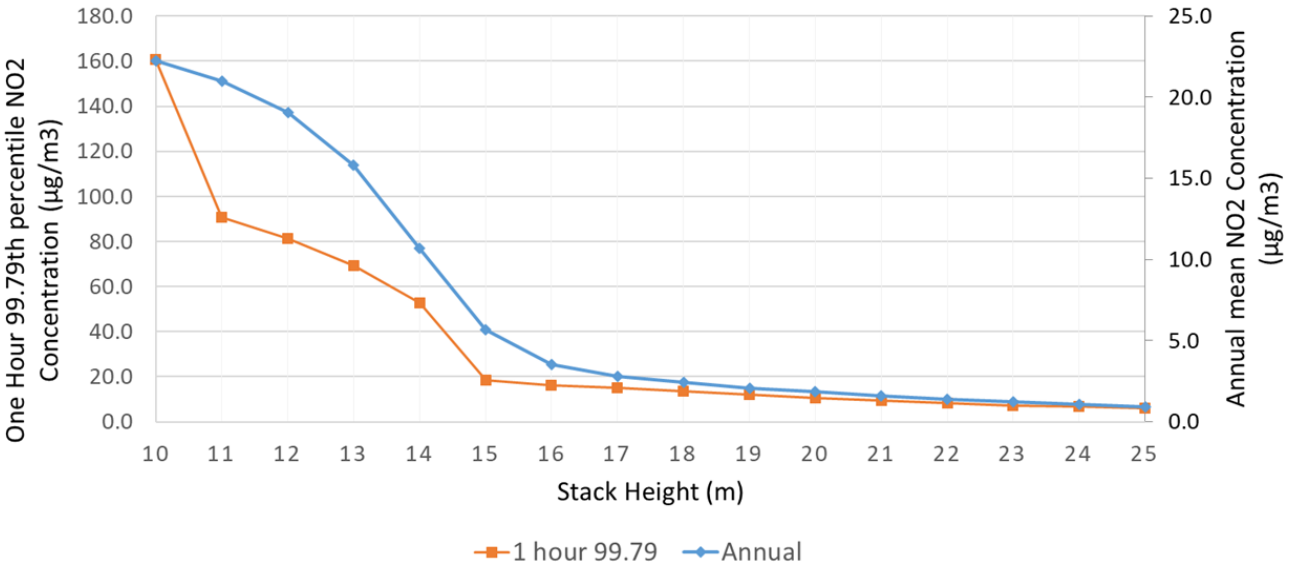

Figure 4.1: Maximum modelled NO_2 process contributions (one boiler in operation) per stack height (µg/m³)

4.3 Human health

4.3.1 Table 4-2 and Table 4-3 present the Proposed WWTP's energy plant maximum predicted long term and short term NO_2 and SO_2 concentrations for scenarios 1 and

2 for comparison against the AQALs. All predicted concentrations for these averaging periods are taken from the maximum offsite gridded receptor location[1].

4.3.2 The maximum predicted long term PC for scenario 1 is 8% of the AQAL corresponding to a 'medium' magnitude of impact. The maximum PEC is 31% of the AQAL corresponding to a 'very low' sensitivity of receptor. The maximum predicted long-term effects are therefore described as 'slight' in accordance with the IAQM/EPUK guidance adopted for this assessment. However, the annual mean AQAL only applies where members of the public have access, are regularly present and can be exposed for a significant portion of the averaging time of the AQAL. For the annual mean AQAL examples of 'relevant public exposure' include residential properties, schools, hospitals, care homes.

4.3.3 As the 'medium' magnitude of impact occurs approximately 35m south of the Proposed WWTP boundary there is no relevant exposure. On this basis, the overall reported effect is described as 'negligible.' Receptors with relevant exposure to the annual mean are presented in Table 4-4 and Table 4-5 as discussed below.

4.3.4 The maximum predicted short term PCs, which occur in scenario 2 and includes operation of the flare, are between 7% and 16% of the AQALs corresponding to a 'Negligible to Small' magnitude of impact. The maximum PEC ranges from 10% to 26% of the AQALs. The maximum predicted short-term effects are therefore described as 'negligible' in accordance with the IAQM/EPUK guidance adopted for this assessment.

4.3.5 Table 4-4and Table 4-5present the predicted long term and short term NO_2 and SO_2 concentrations at discrete human health receptors for scenario 1 and 2 for comparison against the AQALs.

4.3.6 The maximum long-term concentrations modelled at human health discrete receptors is predicted to be less than or equal to 1% of the AQAL and the impacts are therefore described as 'negligible'. The maximum predicted PEC at a human health discrete receptor is 27% of the AQAL at 'HH1' and 'HH6'. This corresponds to a 'very low' sensitivity of receptor and is primarily driven by the background concentration. The maximum predicted long-term effects are therefore described as 'negligible' in accordance with the IAQM/EPUK guidance adopted for this assessment.

4.3.7 The maximum short-term concentration modelled at human health discrete receptors is predicted to be less than 10% of the AQAL in both scenario 1 and 2. Therefore, impacts and effects are described as 'negligible'.

4.3.8 Therefore, in accordance with the significance criteria adopted for the assessment, there are no likely significant effects from the Proposed WWTP energy plant in both scenario 1 and 2 at assessed human health receptors.

[1] Maximum offsite gridded receptor refers to the location within the model domain where the maximum concentration for each averaging period is predicted excluding land within the Proposed WWTP boundary

Table 4-2: Scenario 1 – Modelled maximum results (µg/m³)

Pollutant	Averaging period	AQAL	PC	PC as % of AQAL	BG	PEC	PEC as % of AQAL	Magnitude of impact	Sensitivity of receptor	Effect
NO_2	99.79 %'ile of hourly averages	200	32.6	16	18.5	51.1	26	Small	Not Defined	Slight
	Annual average	40	3.2	8	9.3	12.5	31	Medium	Very Low	Negligible[(a)]
SO_2	99.9%'ile of 15 minute averages	266	29.2	11	2.2	31.4	12	Small	Not Defined	Slight
	99.73'ile of hourly averages	350	25.9	7	2.2	28.1	8	Negligible	Not Defined	Negligible
	99.18'ile of daily averages	125	15.0	12	2.2	17.2	14	Small	Not Defined	Slight

Note: PC = Process Contribution; PEC = Predicted Environmental Concentration (PC + BG); BG = Background Concentration; AQAL = Air Quality Assessment Level (equivalent to the ambient air quality objectives)

(a) Whilst a medium magnitude of impact coupled with a very low receptor sensitivity is equivalent of a slight effect, the impact is located at a location where the annual mean air quality objective does not apply. Therefore, the effect is reported as negligible.

Sensitivity of receptor 'Not Defined' for short term AQAL in accordance with adopted impact assessment criteria

Percentages rounded to 0 decimal places to determine magnitude of impact effect sensitivity of receptor in accordance with adopted impact assessment criteria

Arithmetic discrepancies may occur due to rounding of values

Table 4-3: Scenario 2 – Modelled maximum results (µg/m³)

Pollutant	Averaging period	AQAL	PC	PC as % of AQAL	BC	PEC	PEC as % of AQAL	Magnitude of impact	Sensitivity of receptor	Effect
NO_2	99.79 %'ile of hourly averages	200	32.7	16	18.5	51.2	26	Small	Not Defined	Slight
SO_2	99.9%'ile of 15 minute averages	266	35.1	13	2.2	37.3	14	Small	Not Defined	Slight
	99.73'ile of hourly averages	350	32.1	9	2.2	34.3	10	Negligible	Not Defined	Negligible
	99.18'ile of daily averages	125	16.3	13	2.2	18.5	15	Small	Not Defined	Slight

Note: Only short term results have been presented for this scenario as the flare would not operate continuously all year

PC = Process Contribution; PEC = Predicted Environmental Concentration (PC + BC); BC = Background Concentration; AQAL = Air Quality Assessment Level (equivalent to the ambient air quality objectives)

Sensitivity of receptor 'Not Defined' for short term AQAL in accordance with adopted impact assessment criteria

Percentages rounded to 0 decimal places to determine magnitude of impact effect sensitivity of receptor in accordance with adopted impact assessment criteria

Arithmetic discrepancies may occur due to rounding of values

Table 4-4: Scenario 1 – Short term process contributions and long term process contributions and predicted environmental concentrations at human health discrete receptors (µg/m³)

Receptor ID	Receptor Name	NO_2 annual mean					NO_2 1 hour 99.79th		SO_2 99.9%'ile of 15 minute averages		SO_2 99.73'ile of hourly averages		SO_2 99.18'ile of daily averages	
		Max PC	Max PC as % of AQAL	BG	Max PEC	Max PEC as % of AQAL	Max PC	Max PC as % of AQAL	Max PC	Max PC as % of AQAL	Max PC	Max PC as % of AQAL	Max PC	Max PC as % of AQAL
AQAL		40					200		266		350		125	
HH1	Poplar Hall Farm	0.1	<1	10.5	10.6	27	2.7	1	3.6	1	2.1	1	0.6	<1
HH2	Property on Flack End	0.1	<1	10.0	10.1	25	0.8	<1	1.1	<1	0.6	<1	0.1	<1
HH3	Gatehouse	0.5	1	7.2	7.7	19	3.3	2	3.9	1	2.6	1	1.0	1
HH4	Fen Ditton Community Primary School	0.2	1	8.4	8.6	22	2.7	1	3.6	1	2.1	1	0.9	1
HH5	Property east of Horningsea Road, Fen Ditton	0.2	1	8.4	8.6	22	3.5	2	3.7	1	2.8	1	1.1	1
HH6	Biggen Abbey	0.1	<1	10.5	10.6	27	2.7	1	3.5	1	2.1	1	0.7	1
HH7	Quy Mill Hotel	0.1	<1	8.6	8.7	22	2.1	1	2.6	1	1.6	<1	0.4	<1
HH8	Fen Ditton Community Primary School	0.2	1	8.4	8.6	22	2.8	1	3.7	1	2.1	1	1.0	1
HH9	Low Fen Drove Way PROW 85/14	0.4	1	7.9	8.3	21	4.1	2	5.1	2	3.2	1	1.2	1
HH10	Property to south of Horningsea	0.2	1	7.3	7.5	19	2.5	1	3.2	1	1.9	1	0.6	<1
HH11	Proposed Bridleway	0.5	1	7.2	7.7	19	3.3	2	3.9	1	2.5	1	1.0	1
HH12	Future Residential	0.4	1	7.9	8.3	21	4.2	2	5.0	2	3.2	1	1.2	1
HH13	Property Horningsea Road, Fen Ditton	0.2	1	8.4	8.6	22	3.1	2	3.4	1	2.4	1	0.9	1

Note: PC = Process Contribution; PEC = Predicted Environmental Concentration (PC + BG); BG = Background Concentration; AQAL = Air Quality Assessment Level (equivalent to the ambient air quality objectives); '<' denotes less than

BC and PEC presented for annual mean NO_2 only to determine significance of effect. Significance for short-term averaging periods are based on PC only.

Magnitude of Impact of 1% or less for the long term AQAL (annual mean) and 10% or less for short term AQALs (daily, hourly, 15 minute) is negligible.

Percentages rounded to 0 decimal places to determine magnitude of impact effect sensitivity of receptor in accordance with adopted impact assessment criteria

Arithmetic discrepancies may occur due to rounding of values

Table 4-5: Scenario 2 - Short term process contributions at human health discrete receptors (µg/m³)

Receptor Number	Receptor Name	NO_2 1 hour 99.79th		SO_2 99.9%'ile of 15 minute averages		SO_2 99.73'ile of hourly averages		SO_2 99.18'ile of daily averages	
		Max PC	Max PC as % of AQAL	Max PC	Max PC as % of AQAL	Max PC	Max PC as % of AQAL	Max PC	Max PC as % of AQAL
AQAL			**200**		**266**		**350**		**125**
HH1	Poplar Hall Farm	3.1	2	4.2	2	2.8	1	1.0	1
HH2	Property on Flack End	1.0	1	1.8	1	0.9	<1	0.2	<1
HH3	Gatehouse	4.0	2	5.6	2	4.6	1	2.2	2
HH4	Fen Ditton Community Primary School	3.0	2	4.4	2	3.0	1	1.7	1
HH5	Property east of Horningsea Road, Fen Ditton	4.2	2	5.5	2	4.3	1	1.8	1
HH6	Biggen Abbey	3.0	2	4.1	2	2.7	1	1.1	1
HH7	Quy Mill Hotel	2.4	1	3.7	1	2.4	1	0.8	1
HH8	Fen Ditton Community Primary School	3.1	2	4.3	2	3.1	1	1.8	1
HH9	Low Fen Drove Way PROW 85/14	4.2	2	5.2	2	3.7	1	2.3	2
HH10	Property to south of Horningsea	2.7	1	3.6	1	2.4	1	1.0	1
HH11	Proposed Bridleway	3.9	2	5.8	2	4.6	1	2.4	2
HH12	Future Residential	4.3	2	5.0	2	3.9	1	2.1	2
HH13	Property Horningsea Road, Fen Ditton	3.5	2	4.7	2	3.7	1	1.5	1

Note: PC = Process Contribution; AQAL = Air Quality Assessment Level (equivalent to the ambient air quality objectives); '<' denotes less than

Only short term results have been presented for this scenario as the flare would not operate continuously all year

Magnitude of Impact of 10% or less for short term AQALs (daily, hourly, 15 minute) is negligible.

Percentages rounded to 0 decimal places to determine magnitude of impact effect sensitivity of receptor in accordance with adopted impact assessment criteria

Arithmetic discrepancies may occur due to rounding of values

4.3.10 Figure 4.2 to Figure 4-6 present contour plots of the long term and short term ground level PCs associated with scenario 1 and scenario 2.

4.3.11 Scenario 1 represents the worst case for long-term averaging periods (annual mean) as scenario 2 would not occur for extended periods of time so would not operate for periods commensurate with the long term AQALs.

4.3.12 Scenario 2 represents the worst case for short-term averaging periods (daily, hourly and 15 minute) as it includes the operation of the flare for periods commensurate with the short-term AQALs.

4.3.13 The contour plots show that the highest modelled offsite ground level concentrations from the energy plant are located within a very small area close to the proposed WWTP. At this location, the annual mean and daily air quality objectives would not apply as there is no relevant public exposure (see Chapter 7: Air quality, App Doc Ref 5.2.7).

4.3.14 The maximum modelled ground level concentrations from the energy plant are located within the proposed WWTP boundary. However, this assessment has not considered concentrations within the proposed WWTP boundary as the air quality objectives do not apply at these locations as there is no public exposure (see Chapter 7: Air quality, App Doc Ref 5.2.7).

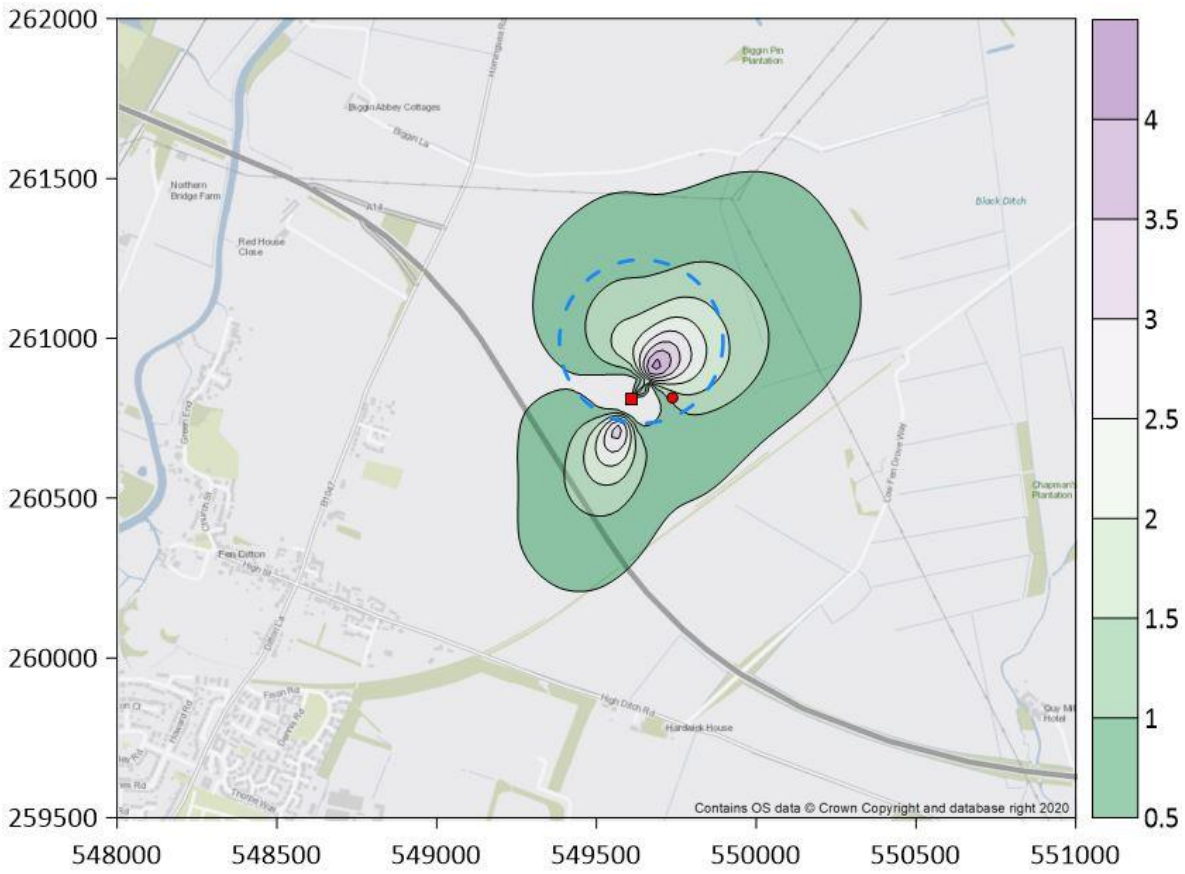

Figure 4.2: Scenario 1 - Contour plot of annual mean NO_2 PC at gridded receptors

Note: Results presented for the worst case meteorological year of 2018. The worst case meteorological year is determined by calculating the year with the maximum offsite concentration modelled across the gridded receptors. Contour interval = 0.5µg/m^3. minimum contour=0.5µg/m^3, maximum contour = 4µg/m^3. Proposed WWTP boundary outlined in blue, energy centre stack is red square, flare stack is red circle

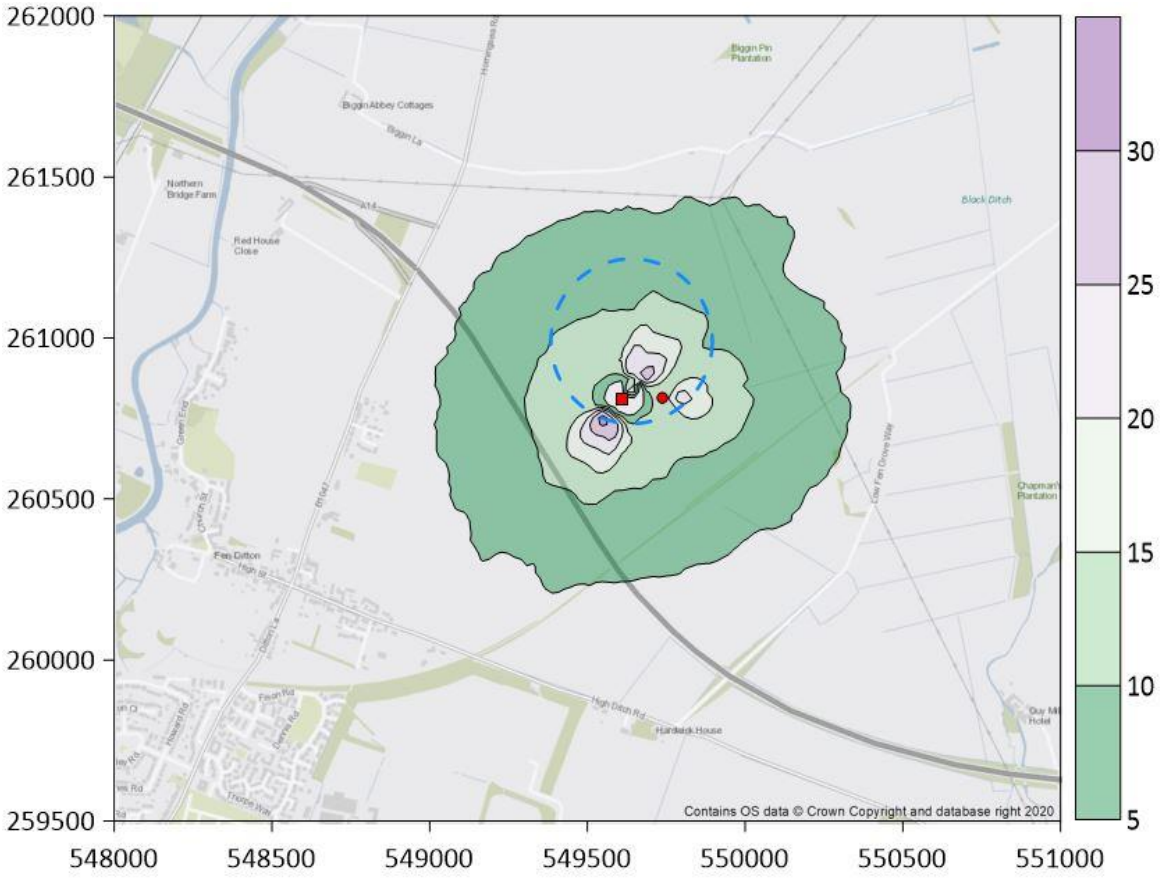

Figure 4.3: Scenario 2 - Contour plot of hourly mean (99.79th percentile) NO_2 PC at gridded receptors

Note: Results presented for the worst case meteorological year of 2020. The worst case meteorological year is determined by calculating the year with the maximum offsite concentration modelled across the gridded receptors. Contour interval = 5µg/m³. minimum contour=5µg/m³, maximum contour = 30µg/m³. Proposed WWTP boundary outlined in blue, energy centre stack is red square, flare stack is red circle.

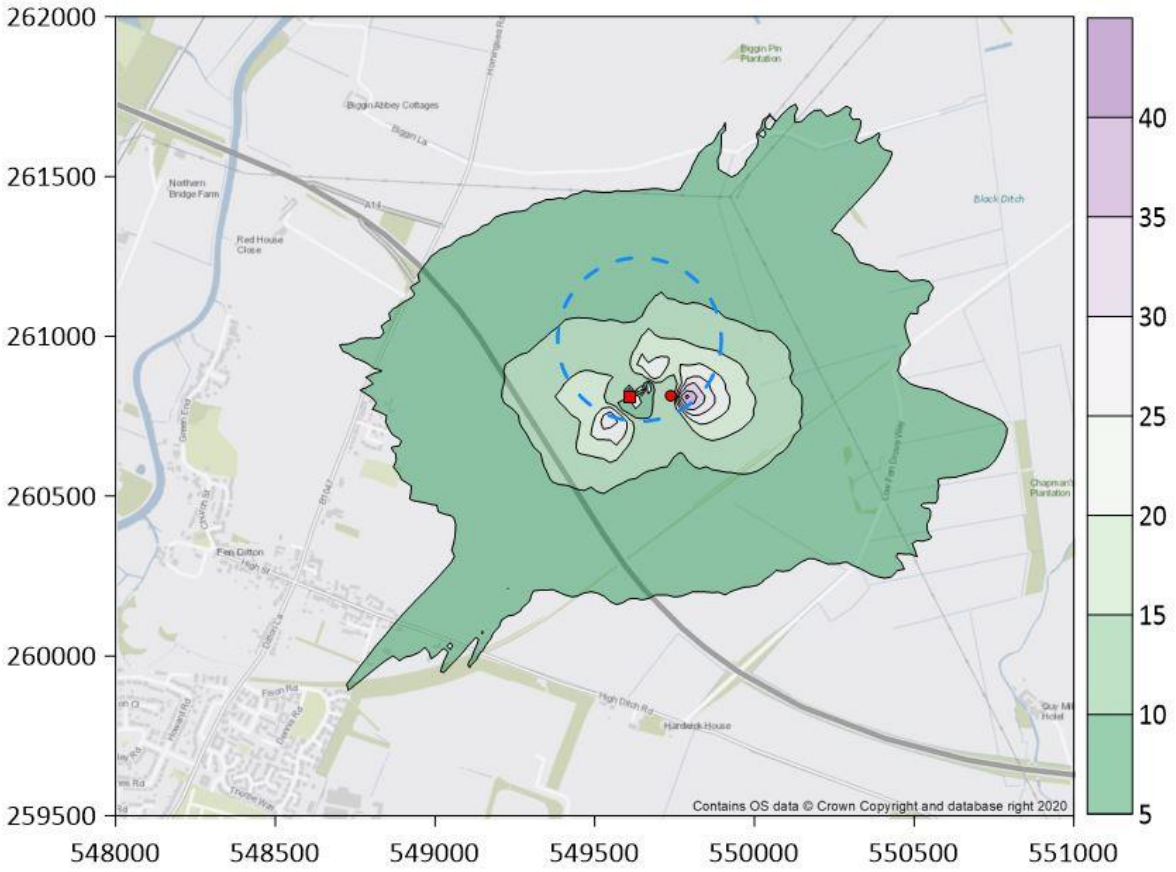

Figure 4.4: Scenario 2 - Contour plot of 15 minute (99.9th percentile) SO_2 PC at gridded receptors

Note: Results presented for the worst case meteorological year of 2019. The worst case meteorological year is determined by calculating the year with the maximum offsite concentration modelled across the gridded receptors. Contour interval = 5µg/m^3. minimum contour=5µg/m^3, maximum contour = 40µg/m^3. Proposed WWTP boundary outlined in blue, energy centre stack is red square, flare stack is red circle

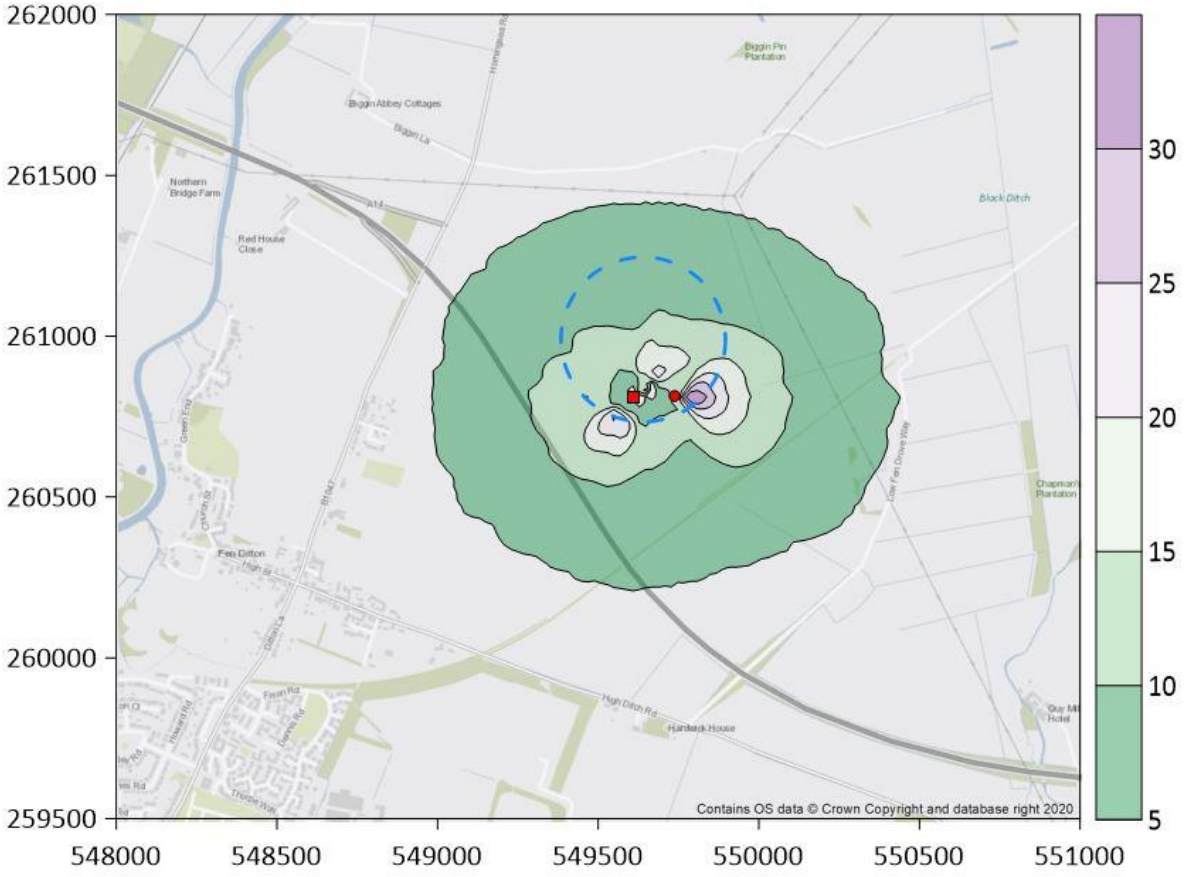

Figure 4.5: Scenario 2 - Contour plot of hourly mean (99.73rd percentile) SO_2 PC at gridded receptors

Note: Results presented for the worst case meteorological year of 2018. The worst case meteorological year is determined by calculating the year with the maximum offsite concentration modelled across the gridded receptors. Contour interval = 5µg/m³. minimum contour=5µg/m³, maximum contour = 30µg/m³. Proposed WWTP boundary outlined in blue, energy centre stack is red square, flare stack is red circle.

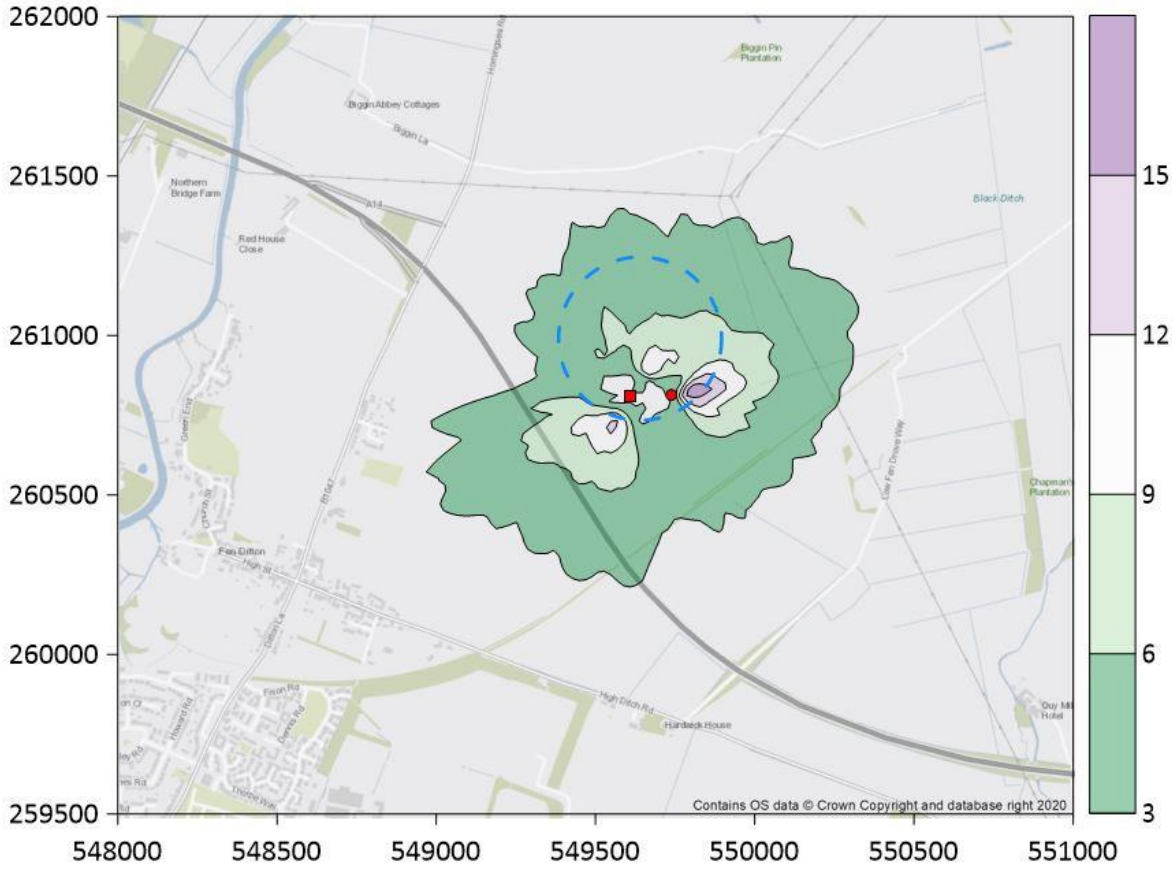

Figure 4-6: Scenario 2 - Contour plot of daily (99.18th percentile) SO_2 PC at gridded receptors

Note: Results presented for the worst case meteorological year of 2018. The worst case meteorological year is determined by calculating the year with the maximum offsite concentration modelled across the gridded receptors. Contour interval = 3µg/m^3. minimum contour=3µg/m^3, maximum contour = 15µg/m^3. Proposed WWTP boundary outlined in blue, energy centre stack is red square, flare stack is red circle

4.4 Ecology

4.4.1 Assessment of ecology only considers scenario 1 only as critical levels and critical loads are assessed against long term impacts only which scenario 2 does not represent. Scenario 2 is only for comparison with short term AQALs pertaining to human health impacts.

Critical levels – Atmospheric NOx and SO_2

4.4.2 Table 4.6 presents the annual mean NOx concentrations at ecological receptors for scenario 1 for comparison against the critical level of 30µg/m^3. The maximum predicted change in annual mean NOx concentration is less than or equal to 1% of the critical level at all receptors with the exception of receptor E6, Low Fen Drove Way Grasslands and Hedges Local Nature Reserve. At receptor E6 the predicted environmental concentration (process contribution plus background concentration) does not exceed the critical level of 30µg/m^3 and the effect is therefore negligible in accordance with the adopted impact assessment criteria.

4.4.3 Table 4.7 presents the annual mean SO_2 concentrations at ecological receptors for scenario 1 for comparison against the critical level of 20µg/m^3. The maximum predicted change in annual mean SO_2 concentration is less than or equal to 1% of the critical level at all receptors. The critical level for SO_2 is reduced to 10ug/m^3 where bryophytes and lichens are present. Assuming these species are present and conservatively applying this lower critical level would increase the process contribution as percentage of the critical level, however the predicted environmental concentrations would not exceed the critical level of 10µg/m^3.

4.4.4 Therefore, in accordance with the significance criteria adopted for the assessment, there are no likely significant effects from the Proposed WWTP energy plant at assessed ecological receptors.

Critical loads - Nitrogen Deposition

4.4.5 Table 4.8 presents the maximum predicted nitrogen deposition rates at the modelled ecological receptors from the Proposed WWTP energy plant for comparison against the site-specific minimum critical loads.

4.4.6 At all modelled ecological receptors, total nitrogen deposition is predicted to be less than or equal to 1% of the respective minimum nitrogen deposition critical load applied to the habitats.

4.4.7 Therefore, in accordance with the significance criteria adopted for the assessment, there are no likely significant effects from the Proposed WWTP energy plant at assessed ecological receptors.

Critical loads – Acidification

4.4.8 Table 4.9 presents the maximum predicted acid deposition rates at the modelled ecological receptors from the Proposed WWTP energy plant for comparison against the site-specific critical loads.

4.4.9 At all modelled ecological receptors, acid deposition is predicted to be below 1% of the acid deposition critical load (CLMaxS and CLMaxN) applied to the habitats.

Therefore, in accordance with the significance criteria adopted for the assessment, there are no likely significant effects from the Proposed WWTP energy plant at assessed ecological receptors.

Table 4.6: Scenario 1 - Critical level results – Annual mean NOx concentration from energy plant (µg/m³)

Receptor ID	Receptor name and designation	Max annual mean PC	PC as % Annual mean CLE[(a)]	BG	PEC	PEC as % of CLE [(b)]	Significance
E5	Allicky Farm Pond CWS	0.4	1	8.7	9.1	30	Not Significant
E6	Low Fen Drove Way Grasslands and Hedges CWS	1.0	3	12.1	13.1	44	Not Significant
E7	Stow-cum-Quy Fen SSSI	0.3	1	7.8	8.1	27	Not Significant
E8	Wilbraham Fens SSSI	0.1	<1	10.6	10.7	36	Not Significant
E9	Ditton Meadows WS	0.1	<1	11.0	11.1	37	Not Significant

Notes: Receptors E1 and E2 are further than 2km from the proposed WWTP energy plant and are therefore outside the study area. Receptor E3 is a different location at the Low Fen Drove Way Grasslands and Hedges CWS. This LNR is captured in this section as E6 which is the maximum point of impact from the energy plant. Receptor E4 is a different location at the Wilbraham Fens SSSI. This SSSI is captured in this section as E8 which is the maximum point of impact from the energy plant.

PC - Process Contribution; CLE – Critical level; BG – background concentration; PEC – predicted environmental concentration (PC + BG)

WS – City Wildlife Site; CWS – County Wildlife Site; LNR – Local Nature Reserve; SSSI – Site of Special Scientific Interest; '<' denotes less than

Arithmetic discrepancies may occur due to rounding of values

(a) CLE: Critical level for NOx (30µg/m³). Rounded to the nearest whole percent. Values rounded to 1% are considered 'not significant'.

(b) Values less than 100% are considered 'not significant'

Table 4.7: Scenario 1 - Critical level results – Annual mean SO_2 concentration from energy plant (µg/m³)

Receptor ID	Receptor name and designation	Max annual mean PC	PC as % Annual mean CLE [(a)]	BC	PEC	PEC as % of CLE [(b)]	Significance
E5	Allicky Farm Pond CWS	0.1	<1	0.9	1.0	5	Not Significant
E6	Low Fen Drove Way Grasslands and Hedges CWS	0.3	1	1.1	1.4	7	Not Significant
E7	Stow-cum-Quy Fen SSSI	0.1	<1	0.8	0.9	5	Not Significant
E8	Wilbraham Fens SSSI	0.1	<1	0.9	1.0	5	Not Significant
E9	Ditton Meadows WS	0.1	<1	1.3	1.4	7	Not Significant

Notes: Receptors E1 and E2 are further than 2km from the proposed WWTP energy plant and are therefore outside the study area. Receptor E3 is a different location at the Low Fen Drove Way Grasslands and Hedges CWS. This LNR is captured in this section as E6 which is the maximum point of impact from the energy plant. Receptor E4 is a different location at the Wilbraham Fens SSSI. This SSSI is captured in this section as E8 which is the maximum point of impact from the energy plant.

PC = Process Contribution; WS – City Wildlife Site; CWS – County Wildlife Site; LNR – Local Nature Reserve; SSSI – Site of Special Scientific Interest; '<' denotes less than

Arithmetic discrepancies may occur due to rounding of values

(a) CLE: Critical level for SO_2 (20µg/m³). Rounded to the nearest whole percent. Values rounded to 1% are considered 'not significant'.

(b) Values less than 100% are considered 'not significant'

Table 4.8: Scenario 1 - Critical load results - nitrogen deposition rates from energy plant

Receptor ID	Designation	APIS Habitat	Minimum nitrogen deposition CLO (kg/ha/yr)	Ground level concentration of NO_2 (PC) (µg/m^3)	PC Nitrogen deposition (dry) (kg/ha/yr)	% PC of minimum nitrogen deposition CLO[(a)]	Significance
E5	Allicky Farm Pond CWS	Fen, Marsh and Swamp	15	0.3	<0.1	<1	Not Significant
E6	Low Fen Drove Way Grasslands and Hedges CWS	Calcareous grassland	15	0.7	0.1	1	Not Significant
E7	Stow-cum-Quy Fen SSSI	Calcareous grassland	15	0.2	<0.1	<1	Not Significant
E8	Wilbraham Fens SSSI	Fen, Marsh and Swamp	15	0.1	<0.1	<1	Not Significant
E9	Ditton Meadows WS	Coastal and Floodplain Grazing Marsh	20	0.1	<0.1	<1	Not Significant

Note: Receptors E1 and E2 are further than 2km from the proposed WWTP energy plant and are therefore outside the study area. Receptor E3 is a different *location at the Low Fen Drove Way Grasslands and Hedges CWS. This LNR is captured in this section as E6 which is the maximum point of impact from the energy plant. Receptor E4 is a different location at the Wilbraham Fens SSSI. This SSSI is captured in this section as E8 which is the maximum point of impact from the energy plant.*

PC = Process Contribution; CLO -Critical Load; WS – City Wildlife Site; CWS – County Wildlife Site; LNR – Local Nature Reserve; SSSI – Site of Special Scientific Interest; '<' denotes less than

Arithmetic discrepancies may occur due to rounding of values

(a) Values rounded to 1% are considered 'not significant'.

Table 4.9: Scenario 1 - Critical load results - acid deposition rates from energy plant (keq/ha/yr)

Receptor ID	Designation	APIS Habitat	Acid deposition CLO		PC Acid deposition		PC acid deposition as a % of: (a)			Significance
			CLMaxS	CLMaxN	N	S	N+S	CLMaxS	CLMaxN	
E6	Low Fen Drove Way Grasslands and Hedges CWS	Calcareous grassland	4.0	4.856	0.007	0.034	0.042	1	1	Not Significant
E7	Stow-cum-Quy Fen SSSI	Calcareous grassland	4.0	4.856	0.002	0.009	0.011	<1	<1	Not Significant
E8	Wilbraham Fens SSSI	Fen, Marsh and Swamp	4.11	4.333	0.001	0.004	0.004	<1	<1	Not Significant
E9	Ditton Meadows WS	Coastal and Floodplain Grazing Marsh	4.0	4.0	0.001	0.004	0.004	<1	<1	Not Significant

Note: Receptors E1 and E2 are further than 2km from the proposed WWTP energy plant and are therefore outside the study area. Receptor E3 is a different location at the Low Fen Drove Way Grasslands and Hedges CWS. This LNR is captured in this section as E6 which is the maximum point of impact from the energy plant. Receptor E4 is a different location at the Wilbraham Fens SSSI. This SSSI is captured in this section as E8 which is the maximum point of impact from the energy plant.

BG – background; PC = Process Contribution; N – Nitrogen species; S – Sulphur species; CLO - critical load; '<' denotes less than

WS – City Wildlife Site; CWS – County Wildlife Site; LNR – Local Nature Reserve; SSSI – Site of Special Scientific Interest; '<' denotes less than

(a) Values rounded to 1% are considered 'not significant'.

Arithmetic discrepancies may occur due to rounding of values. Values that have been presented to at least 1 significant figure to show value is not 0 and is not an indication of model accuracy.

5 Operation - Combined traffic and energy plant dispersion model results

5.1 Overview

5.1.1 This section presents the combined dispersion modelling results from the quantitative assessment of

- exhaust emissions from operational and decommissioning traffic using the public highway. Decommissioning traffic is associated with vehicles accessing the Existing Cambridge WWTP. Decommissioning of the Existing Cambridge WWTP would start when the Proposed WWTP is operational.
- energy plant stack emissions from the Proposed WWTP.

5.1.2 Only NO_2 concentrations for human health and NOx concentrations, nitrogen deposition and acid deposition (including NO_2, NH_3 and SO_2) for ecology have been considered in this section as only these parameters are considered in both the assessment of energy plant and traffic emissions.

5.2 Human health

5.2.1 The combined impacts of the energy plant and traffic associated with operation of the Proposed Development have been assessed to determine the air quality effect at modelled human health receptors.

5.2.2 Table 5-1 presents the predicted annual mean NO_2 concentrations modelled at the human health discrete receptors from the operation of the Proposed Development.

5.2.3 The results show that the combined impact of the Proposed Development is predicted to result in maximum annual NO_2 concentrations at receptors which are well below the annual mean NO_2 objective of 40µg/m^3. As the annual NO_2 mean concentrations are not predicted to exceed 60µg/m^3, the short-term objective is also not likely to be exceeded at these worst-case locations as a result of combined operation.

5.2.4 The maximum increase in annual NO_2 concentrations from the combined impact of operation traffic and the energy centre where the AQAL applies is predicted at receptor HH3 and HH12, with an increase of 0.4µg/m^3.

5.2.5 Annual mean NO_2 concentrations are predicted to increase by 0.5µg/m^3 at receptors HH9 and HH11, however only the short term AQALs apply at these locations and, even when considered, the impact and effect would be ‘negligible’.

5.2.6 The combined impact across all modelled human health receptors is ‘negligible’ in accordance with the EPUK/IAQM significance criteria as the percentage increase is 1% or less of the annual NO_2 objective and the Do-Something concentration is less than 75% of the objective. Therefore, in accordance with the significance criteria adopted for the assessment, there are no likely significant effects from the combined

effects associated with energy plant and road traffic movements during the operation on the Proposed Development at assessed human health receptors.

Table 5-1: Annual mean NO_2 predicted concentrations (µg/m³) – combined traffic and energy plant operational impact

Receptor ID	Receptor name	NO_2 average concentration (µg/m³)			Predicted pollutant concentration change (µg/m³)	Magnitude of impact	Sensitivity of receptor	Effect
		2019 Base	2028 DM	2028 DS				
HH1	Poplar Hall Farm	18.5	11.9	12.1	0.2	Negligible	Very Low	Negligible
HH2	Property on Flack End	16.7	10.9	10.9	0.1	Negligible	Very Low	Negligible
HH3	Gatehouse	11.1	7.7	8.1	0.4	Negligible	Very Low	Negligible
HH4	Fen Ditton Community Primary School	15.6	10.3	10.3	0.1	Negligible	Very Low	Negligible
HH5	Property east of Horningsea Road, Fen Ditton	14.4	9.6	9.8	0.2	Negligible	Very Low	Negligible
HH6	Biggen Abbey	18.5	11.9	12.1	0.2	Negligible	Very Low	Negligible
HH7	Quy Mill Hotel	16.4	9.9	10.0	0.1	Negligible	Very Low	Negligible
HH8	Fen Ditton Community Primary School	13.2	9.2	9.4	0.2	Negligible	Very Low	Negligible
HH9	Low Fen Drove Way PROW 85/14	12.1	8.3	8.8	0.5	Negligible	Very Low	Negligible
HH10	Property to south of Horningsea	12.7	8.5	8.6	0.1	Negligible	Very Low	Negligible
HH11	Proposed Bridleway	11.0	7.6	8.1	0.5	Negligible	Very Low	Negligible
HH12	Future Residential	12.2	8.4	8.8	0.4	Negligible	Very Low	Negligible
HH13	Property Horningsea Road, Fen Ditton	18.0	11.2	11.3	0.1	Negligible	Very Low	Negligible

Notes: DM – Do-Minimum; DS – Do-Something; '<' denotes 'less than'

5.3 Ecology

5.3.1 Assessment of ecology considers impacts from the energy plant 'scenario 1' only as critical levels and critical loads are assessed against long term impacts only which scenario 2 does not represent.

Critical levels – Atmospheric NOx and SO_2

5.3.2 Table 5-2 presents the annual mean NOx concentrations at ecological receptors for scenario 1 for comparison against the critical levels of 30µg/m^3. The annual mean change in NOx concentrations is less than 1% of the annual critical level at all receptors with the exception of E3.

5.3.3 At modelled ecological receptor E3, there is a combined predicted change in NOx concentration above 1% of the critical level of 30µg/m^3. Receptor E3 is 8m north of the A14 and is representative of the closest point of the Low Fen Drove Way Grasslands and Hedges Country Wildlife Site (CWS) to the A14.

5.3.4 In the opening year, the increase in NOx concentrations at receptor E3 is a small fraction (approximately 1%) of the existing Do-Minimum. The predicted Do-Something NOx concentration of 41.3µg/m^3 remains less than the predicted base NOx concentration of 100µg/m^3 and the change in concentration between the Do-Minimum and Do-Something is an order of magnitude lower than the improvement between the base year and opening year. This demonstrates that the small increase in NOx concentration caused by the Proposed Development do not retard the overall reduction in NOx concentrations between the base year and the opening year and no species loss would be expected as a result of the minor increase in NOx. Furthermore, receptor E3 is located immediately adjacent to the A14 which is the main contributor to the elevated NOx concentrations. It is unlikely that ecological species sensitive to high concentrations of NOx would be present at this location.

5.3.5 Therefore, there are no likely significant effects caused by the Proposed Development's construction traffic at assessed ecological receptors.

Critical loads - nitrogen deposition

5.3.6 Table 5-3 presents the maximum predicted nitrogen deposition rates at the modelled ecological receptors from energy plant and operational road traffic for comparison against the site-specific minimum critical loads

5.3.7 At all modelled ecological receptors, total nitrogen deposition is predicted to be above the minimum critical load in the Base, Do-Minimum and Do-Something scenarios.

5.3.8 There are no predicted increases in nitrogen deposition greater than 1% of the minimum nitrogen deposition critical load applied to the habitat.

5.3.9 There is very little increase between nitrogen deposition predicted for impacts modelled with traffic and energy plant in isolation and in the combined scenarios. The largest change in nitrogen deposition is located at receptors adjacent to the A14. The nitrogen deposition process contribution from the energy plant at all modelled

ecological receptors is 0.1 kg/ha/yr or less. Therefore, when combining the contribution of energy plant emissions with road emissions, the resultant nitrogen deposition is within 0.1 kg/ha/yr or less of the values when assessed in isolation.

5.3.10 Therefore, in accordance with the significance criteria adopted for the assessment, there are no likely significant effects caused by the Proposed Development's construction traffic at assessed ecological receptors.

Critical loads – acidification

5.3.11 Table 5.4 presents the maximum predicted acid deposition rates at the modelled ecological receptors from energy plant and operational road traffic for comparison against the site-specific critical loads (CLMaxN). Sulphur species emitted from road traffic are de minimis and as such are considered within the background contribution only.

5.3.12 At all modelled ecological receptors, acid deposition is predicted to be below 1% of the acid deposition critical load applied to the habitats.

5.3.13 Therefore, in accordance with the significance criteria adopted for the assessment, there are no likely significant effects caused by the Proposed Development's construction traffic at assessed ecological receptors.

Table 5-2: Critical level results – Annual mean NOx concentration from operational traffic and energy plant (µg/m³)

Receptor ID	Receptor name and designation	Annual mean NOx concentration				Change as % of CLE[(a)]	Total DS as % of CLE	Total DM exceedance of CLE?	Total DS exceedance of CLE?	Significance
		2019 Base	2028 DM	2028 DS	Change NOx					
E1	Milton Road Hedgerows WS	63.5	29.4	29.5	0.1	<1	98	No	No	Not Significant
E2	Kings Hedges Hedgerow WS	22.8	14.4	14.5	0.1	<1	48	No	No	Not Significant
E3	Low Fen Drove Way Grasslands and Hedges CWS	100.0	40.8	41.3	0.5	2	138	Yes	Yes	Not Significant
E4	Wilbraham Fens SSSI	32.8	16.2	16.2	<0.1	<1	54	No	No	Not Significant
E5	Allicky Farm Pond CWS	13.2	9.2	9.6	0.4	1	32	No	No	Not Significant
E6	Low Fen Drove Way Grasslands and Hedges CWS	23.6	14.1	15.1	1.0	3	50	No	No	Not Significant
E7	Stow-cum-Quy Fen SSSI	11.5	8.2	8.5	0.3	1	28	No	No	Not Significant
E8	Wilbraham Fens SSSI	18.2	11.2	11.3	0.1	<1	38	No	No	Not Significant
E9	Ditton Meadows WS	63.5	29.4	29.5	0.1	<1	98	No	No	Not Significant

Notes: DM – Do-Minimum; DS – Do-Something; CLE - critical level '<' denotes 'less than'

WS – City Wildlife Site; CWS – County Wildlife Site; LNR – Local Nature Reserve; SSSI – Site of Special Scientific Interest; '<' denotes less than

(a) CLE: Critical level for NOx (30µg/m^3)

Table 5-3: Critical load results - nitrogen deposition rates from operational traffic and energy plant (kg/ha/yr)

Notes: BG – background; CLO denotes critical load; '<' denotes less than

Rec-eptor ID	Receptor name and designation	APIS Habitat	BG N-dep kg/ha/yr	Nitrogen deposition kg/ha/yr			Change N-dep	Minimum CLO	Change as % of minimum CLO[(d)]	Total DS exceedance of minimum CLO?	Existing BG exceedance of minimum CLO?	Change as % of minimum CLO greater than 1%	Significance
				Total Base[(a)]	Total DM[(b)]	Total DS [(c)]							
E1	Milton Road Hedgerows WS	Hedgerows	33.9	58.2	50.2	50.3	0.1	10	1	Yes	Yes	No	Not Significant
E2	Kings Hedges Hedgerow WS	Hedgerows	33.9	35.9	35.2	35.2	<0.1	10	<1	Yes	Yes	No	Not Significant
E3	Low Fen Drove Way Grasslands and Hedges CWS	Calcareous grassland	18.9	46.0	37.9	38.0	0.1	15	1	Yes	Yes	No	Not Significant
E4	Wilbraham Fens SSSI	Fen, Marsh and Swamp	17.8	23.3	21.5	21.5	<0.1	15	<1	Yes	Yes	No	Not Significant
E5	Allicky Farm Pond CWS	Fen, Marsh and Swamp	17.9	18.4	18.2	18.3	0.1	15	1	Yes	Yes	No	Not Significant
E6	Low Fen Drove Way Grasslands and Hedges CWS	Calcareous grassland	18.9	20.9	20.3	20.4	0.1	15	1	Yes	Yes	No	Not Significant
E7	Stow-cum-Quy Fen SSSI	Calcareous grassland	17.9	18.3	18.1	18.2	0.1	15	1	Yes	Yes	No	Not Significant
E8	Wilbraham Fens SSSI	Fen, Marsh and Swamp	17.8	18.5	18.2	18.3	0.1	15	1	Yes	Yes	No	Not Significant
E9	Ditton Meadows WS	Coastal and Floodplain Grazing Marsh	33.9	58.2	50.2	50.3	0.1	10	1	Yes	Yes	No	Not Significant

WS – City Wildlife Site; CWS – County Wildlife Site; LNR – Local Nature Reserve; SSSI – Site of Special Scientific Interest; '<' denotes less than

(a) Total Base: Base scenario contribution added to APIS background.

(b) Total DM: Do-Minimum scenario contribution added to APIS background.

(c) Total DS: Do-Something scenario contribution added to APIS background.

(d) Rounded to the nearest whole percent. Values rounded to 1% are considered 'not significant'.

Table 5.4: Critical load results - acid deposition rates from operational traffic and energy plant (keq/ha/yr)

Receptor ID	Receptor name and designation	APIS Habitat	BG Acid deposition (N+S)	Acid deposition (N+S)			Change acid deposition	CLO (CLMaxN)	Change as % of CLO[(d)]	Total DC exceedance of CLO?	Existing BG exceedance of CLO?	Change as % of CLO greater than 1%	Significance
				Total Base[(a)]	Total DM[(b)]	Total DS [(c)]							
E1	Milton Road Hedgerows WS	Hedgerows	2.6	4.3	3.8	3.8	<0.1	10.8	<1	No	No	No	Not Significant
E2	Kings Hedges Hedgerow WS	Hedgerows	2.6	2.7	2.7	2.7	<0.1	10.8	<1	No	No	No	Not Significant
E3	Low Fen Drove Way Grasslands and Hedges CWS	Calcareous grassland	1.5	3.4	2.9	2.9	<0.1	4.9	<1	No	No	No	Not Significant
E4	Wilbraham Fens SSSI	Fen, Marsh and Swamp	1.4	1.8	1.7	1.7	<0.1	4.3	<1	No	No	No	Not Significant
E6	Low Fen Drove Way Grasslands and Hedges CWS	Calcareous grassland	1.5	1.6	1.6	1.6	<0.1	4.9	<1	No	No	No	Not Significant
E7	Stow-cum-Quy Fen SSSI	Calcareous grassland	1.4	1.4	1.4	1.4	<0.1	4.9	<1	No	No	No	Not Significant
E8	Wilbraham Fens SSSI	Fen, Marsh and Swamp	1.4	1.4	1.4	1.4	<0.1	4.3	<1	No	No	No	Not Significant
E9	Ditton Meadows WS	Coastal and Floodplain Grazing Marsh	1.5	1.5	1.5	1.5	<0.1	4.0	<1	No	No	No	Not Significant

Notes: Receptor E5, ' Allicky Pond CWS' Is not sensitive to acid deposition

BG – background; N – Nitrogen species; S – Sulphur species; CLO denotes critical load; '<' denotes less than

WS – City Wildlife Site; CWS – County Wildlife Site; LNR – Local Nature Reserve; SSSI – Site of Special Scientific Interest;

(a) Total Base: Base scenario contribution added to APIS background.

(b) Total DM: Do-Minimum scenario contribution added to APIS background.

(c) Total DS: Do-Something scenario contribution added to APIS background.

(d) Rounded to the nearest whole percent. Values rounded to 1% are considered 'not significant'.

Arithmetic discrepancies may occur due to rounding of values.

6 References

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