Cambridge Waste Water Treatment Plant Relocation Project
Anglian Water Services Limited

Appendix 18.1: Odour Assessment Method and Effects Summary

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1 Assessment methodology

1.1.1 This appendix sets out information relating to the quantitative approach that has been undertaken to assess the impact of the proposed WWTP on odour during operation.

1.2 Model selection

1.2.1 A number of commercially available dispersion models are able to predict ground level concentrations arising from emissions to atmosphere from odour emission sources such as the proposed WWTP. A new generation dispersion model, AERMOD (executable version 21112), was used to inform the basis of the air quality assessment.

1.2.2 AERMOD was developed for the US Environment Protection Agency and designed to treat both surface and elevated sources in simple and complex terrain. Special features of AERMOD include its ability to treat the vertical heterogeneity nature of the planetary boundary layer, special treatment of surface releases, irregularly-shaped area sources and limitation of vertical mixing in the stable boundary layer.

1.2.3 AERMOD is a modelling system with three separate components:

- AERMOD (AERMIC Dispersion Model);
- AERMAP (AERMOD Terrain Pre-processor); and
- AERMET (AERMOD Meteorological Pre-processor).

1.2.4 AERMAP is a terrain pre-processor designed to simplify and standardise the input of terrain data for AERMOD. Input data include receptor terrain elevation data. For each receptor, the output includes a location and height scale, which is an elevation used for the computation of air-flow around hills.

1.2.5 AERMET is the meteorological pre-processor for AERMOD. Input data can come from hourly cloud cover observations, surface meteorological observations and twice-a-day upper air soundings. Output includes surface meteorological observations and parameters and vertical profiles of several atmospheric parameters.

1.3 Modelled receptors

1.3.1 Gridded receptors and sensitive ‘discrete’ receptors have been modelled at a height of 1.5m above ground level to best represent head/inhalation height.

Gridded receptors

1.3.2 Pollutant concentrations were modelled across a Polar grid with a 1km radius from the centre of the proposed WWTP. The contours of the modelling results Figure 18.1 (Book of Figures, Odour Contours, App Doc Ref 5.3.18.1) show that the maximum

impacts are located within this area and therefore the extent and resolution of the study area is appropriate.

Sensitive Receptors

1.3.3 Modelled discrete receptors have been chosen as they are expected to experience the greatest change in odour concentrations due to their proximity to the proposed WWTP and are presented in Table 1-1 and Figure 18.2 (Book of Figures, Odour receptors, App Doc Ref 5.3.18.2).

Table 1-1: Modelled discrete receptors

Receptor ID	Receptor name	National Grid reference X,Y	Receptor sensitivity
1	Gatehouse	550452, 260942	High
2	A14	549244, 260843	Low
3	Property east of Horningsea Road, Fen Ditton	548870, 260803	High
4	Biggin Abbey	548782, 261736	High
5	Quy Mill Hotel	550846, 259899	High
6	Fen Ditton Community Primary School	548714, 260454	High
7	Low Fen Drove Way PROW 85/14	549922, 261589	Low
8	Property to south of Horningsea	549278, 262141	High
9	Future residential property to north of the proposed WWTP	549821, 261567	High

1.4 Qualitative receptors

1.4.1 Receptors considered in the qualitative assessment presented in Table 1-2 and Figure 18.2 (Book of Figures, Odour Receptors, App Doc Ref 5.3.18.2).

1.4.2 Figure 18.2 (Book of Figures, Odour Receptors, App Doc Ref 5.3.18.2). These receptors also include those considered within the modelling assessment.

Table 1-2: Qualitative receptors

Receptor ID	Receptor name	National Grid reference X,Y	Receptor sensitivity
1	Gatehouse	550452, 260942	High
2	A14	549244, 260843	Low
3	Property east of Horningsea Road, Fen Ditton	548870, 260803	High
4	Biggin Abbey	548782, 261736	High
5	Quy Mill Hotel	550846, 259899	High
6	Fen Ditton Community Primary School	548714, 260454	High
7	Low Fen Drove Way PROW 85/14	549922, 261589	Low

Receptor ID	Receptor name	National Grid reference X,Y	Receptor sensitivity
8	Property to south of Horningsea	549278, 262141	High
9	Future residential property to north of the proposed WWTP	549821, 261567	High
10	Land to the south of the A14 used for non-arable farming activities	549230, 260741	Low
11	Property on Capper Road	550356, 266188	High
12	Cycleway	547234, 261854	Low
13	Commercial property on Cowley Road	547108, 261646	Medium
14	Golf driving range	547194, 261392	Medium
15	Milton Country Park	547759, 261891	Low
16	Property north of A14 near Milton Country Park	547436, 262237	High
17	Residential property on Fen Road	547781, 261081	High
18	Northern Bridge Farm	548160, 261465	High
19	Existing informal footpath/track	550419, 266431	Low
20	Footpaths within Landscape Management Plan	550007, 260949	Low
21	Property adjacent to Wildfowl Cottage	548572, 261994	High
22	Poplar Hall Farm	548517, 261376	High
23	Red House Close	548381, 261291	High
24	PROW 85/6, 85/8 and 162/1	548385, 261761	Low

1.5 Emissions data

1.5.1 The proposed WWTP does not currently exist, therefore all emission rates used to predict odour emissions from the proposed WWTP have been estimated from measurements taken at the existing Cambridge WWTP from a July 2019 odour survey carried out by Silsoe Odours Ltd (ARUP, 2019).

1.5.2 The application of odour emission rates from a survey carried out in a summer month is conservative as higher summer temperatures and reduced rainfall can cause reduced influent dilution and an increase in odour. Further information on how future climate has been considered is presented in Chapter 18; Section 2.2 and Section 3.2.

1.5.3 Table 1-3 presents the odour emission rates used within the modelling of the proposed WWTP based on individual structures and process areas. All odour control unit (OCUs) emissions are based on the calculated volumetric flow discharging from the OCU stack after treatment at 1000 ou_E/m^3.

Table 1-3: Emission rates modelled

No.	Structure/Process Area	$ou_E/m^2/s$	Comment/Source
1	TPS	N/A	Covered and odour controlled
2	Storm tanks	0.2	1% of tanks residual based on infrequent use (ARUP, 2019)
2a	Storm tanks return PS	N/A	Gravity return – no open structure
3-5	Inlet works including: Channel to Screens & Grit Removal Fine Screens & Screenings Handling Grit Removal Plant & Handling Plant	N/A	Covered and odour controlled
6	Screenings Skips	1	(ARUP, 2019)
7	Grit Skip	1	(ARUP, 2019)
8	PST dosing, mixing and distribution chamber	N/A	Covered and odour controlled Iron salts dosed
9	PST	1.9	The UK WIR Table 5.1 Emission rate for typical PSTs, as iron salt will reduce odour emission.
9a	PST collection chambers	0.42	Same as ASP division chamber
10	Secondary Feed-forward PS	0.42	Same as ASP division chamber
11	ASP Division/Selector chamber	0.42	(ARUP, 2019)
12	ASP Anoxic with MaBR	0.3	(ARUP, 2019)
13	ASP Aerobic	0.5	(ARUP, 2019)
14a	FTS distribution chambers	0.42	(ARUP, 2019)
14	Final settlement tanks	0.42	Average of rates from (ARUP, 2019)
14c	FST collection/tertiary mixing chamber	0.2	Less than FTS Iron salt dosing provides further odour mitigation. Not worse than storm tanks
14d	RAS/SAS PS	N/A	Direct pumped – no open tanks
15a	Tertiary distribution chamber	0.2	Same as FST collection
15	Tertiary treatment	0.1	Less than Tertiary distribution
15b	Tertiary sludge waste return PS	0.5	Not close to skips, no worse than ASP
16a	Washwater take-off PS	N/A	Direct pumped – no open tanks
16b	Flume + FE channel	0.1	Less or equal to tertiary
16c	FE sampling chamber	0.1	Less or equal to tertiary
17	Liquid import – Bauer coupling	16	Based on infrequent connection emission
19	Sludge tanks	N/A	Covered and odour controlled
20	Post/secondary digesters	N/A	Covered and odour controlled/gas extract
21	Storage Cake barn	0.8	UK WIR Table 5.1 sludge cake low emission as advanced digested
22	LTP anoxic/pre-settlement	0.42	Less than ASP mixing/division chamber
23	LTP aerobic reactor	0.42	Less than ASP mixing/division chamber
24	LTP FST	0.3	Less than ASP anoxic

No.	Structure/Process Area	$ou_E/m^2/s$	Comment/Source
26	On-site overnight storage/parking of empty sludge/water tankers	N/A	Not included in modelling

1.6 Terrain

1.6.1 The presence of elevated terrain can significantly affect (usually increase) ground level odour concentrations emitted from elevated sources such as the OCU by reducing the distance between the plume centre line and ground level. Terrain can also increase turbulence and, hence, plume mixing which can also reduce ground level concentrations. Therefore, Defra's Lidar data has been included in the dispersion model and modified to account for ground level changes associated with the proposed WWTP (see Chapter 2 of the ES).

1.7 Meteorological data

1.7.1 The most important meteorological parameters governing the atmospheric dispersion of odour are wind direction, wind speed and atmospheric stability as described below:

- Wind direction determines the sector of the compass into which odour is dispersed;
- Wind speed affects the distance which odour travel over time and can affect dispersion by increasing the initial dilution of odour and, in the case of point sources, inhibiting plume rise; and
- Atmospheric stability is a measure of the turbulence of the air, and particularly of its vertical motion. It therefore affects the spread of the plume as it travels away from the source. AERMOD uses a parameter known as the Monin-Obukhov length that, together with the wind speed, describes the stability of the atmosphere.

1.7.2 For meteorological data to be suitable for dispersion modelling purposes, parameters need to be measured on an hourly basis. These parameters include wind speed, wind direction, cloud cover and temperature. The year of meteorological data that is used for a modelling assessment can have a significant effect on odour concentrations therefore dispersion model simulations were performed for odour from the site using five years of data in line with IAQM (IAQM, 2018) and Environment Agency (Environment Agency, 2011) guidance.

1.7.3 Following consideration of the meteorological data available, data from the Cambridge City Airport meteorological station (with missing data supplemented from RAF Mildenhall[1]) was used as this is the most representative data available for

[1] No night-time data is available for Cambridge City Airport, so data for Mildenhall (the next closest meteorological site) has been patched into the data to provide night-time values. Substituting 1-hour blocks of missing data with another representative site's data follows best available practices [redacted].

the study area. The Cambridge City Airport meteorological station is located approximately 1.7km south of the proposed WWTP. Wind roses have been generated for each of the five years of meteorological data used in this assessment, as shown in Figure 1-1 below. The wind roses illustrate that in all meteorological years, there is a dominance of strong winds from the south west.

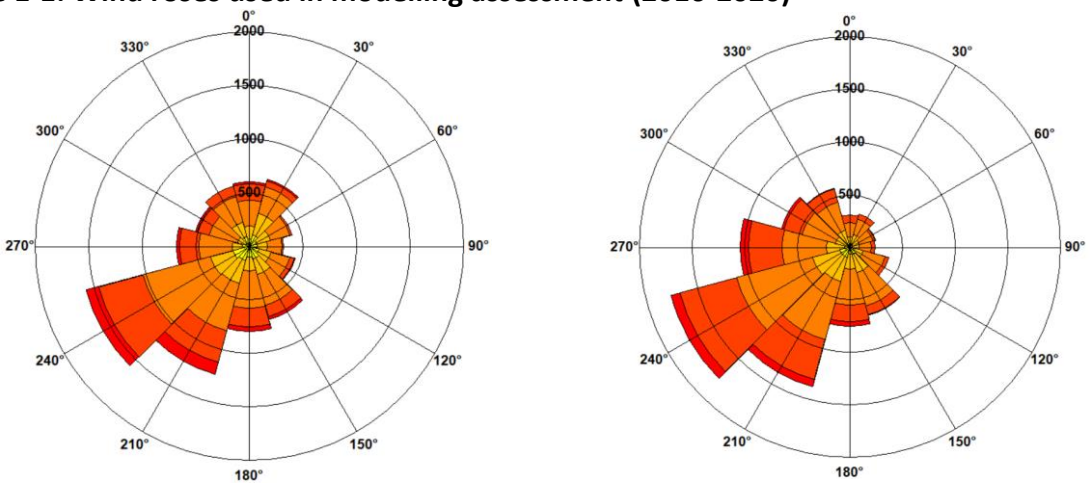
1.7.4 A sensitivity test was run using the patched meteorological data from the Cambridge City Airport and Numerical Weather Prediction data. The odour modelling results correlated and therefore use of the meteorological data is robust. The meteorological data at the existing Cambridge WWTP was also compared to that from the Cambridge City Airport, which confirmed that the data was representative of the area.

1.7.5 The land surrounding the meteorological site has been assumed to be cultivated agricultural land with the following parameters modelled:

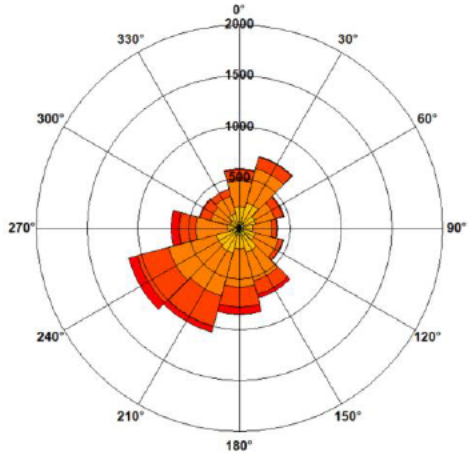
- Albedo: 0.28
- Bowen Ratio: 0.75
- Surface Roughness: 0.2

1.7.6 Further information relating to the choice of applied meteorological data and surface roughness is provided in the Odour Impact Assessment (Appendix 18.2, Application Document Reference 5.4.18.2).

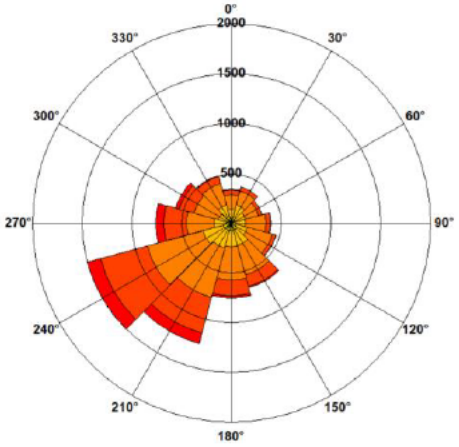
Figure 1-1: Wind roses used in modelling assessment (2016-2020)



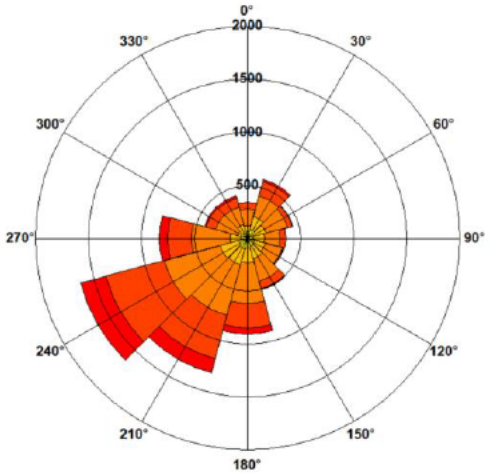
2016 **2017**



2018



2019



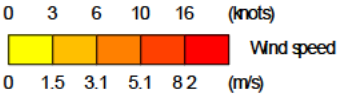
2020

Number around the outside of the wind rose shows direction in degrees.

Rose petals show direction in which wind is blowing from.

Numbers within chart (ie 500 to 2000) show number of hours per year.

Colours represent wind speed with below scale.



Notes on scale

1.8 Modelled Buildings

The movement of air over and around buildings generates areas of flow circulation which can lead to increased ground level concentrations in the building wakes, a process known as downwash. AERMOD includes a building effects module, known as BPIP Prime, which is used to calculate the dispersion of pollution from sources near large structures. The buildings likely to have a dominant effect (ie with the greatest dimensions likely to promote turbulence) are included within the model.

2 Summary of odour effects at sensitive receptors

2.1.1 This section summaries the likely odour effects by phase of the Proposed Development at the identified receptors.

2.2 Construction and decommissioning

Table 2-1: Qualitative odour risk matrix and effects during construction and decommissioning

Area within Proposed Development	Works description	Potential impact	Source odour potential	Receptor reference	Distance	Direction	Pathway	Odour Exposure risk	Receptor sensitivity	Likely Odour Effect
Proposed WWTP	Testing and commissioning of proposed WWTP	Odour emission from transportation of seed sludge and commencement of biological processes with the proposed WWTP. Short term duration - up to 12 months	Medium	Low Fen Drove Way PROW 85/14	400	Downwind	Moderately Effective	Low	Low	Negligible
				A14	160	Upwind	Moderately Effective	Low	Low	Negligible
				Land to the south of the A14 used for non-arable farming activities	190	Upwind	Moderately Effective	Low	Low	Negligible
				Gatehouse	550	Downwind	Ineffective	Negligible	High	Negligible
				Property to south of Horningsea	950	Upwind	Ineffective	Negligible	High	Negligible
				Quy Mill Hotel	1350	Upwind	Ineffective	Negligible	High	Negligible
Waterbeach Pipeline	Connection to pumping station	Odour emission from short term tie in works - Short term duration - up to 4 weeks	Small	Property on Capper Road	80	Upwind	Highly Effective	Negligible based on short term duration of impact	High	Negligible
	Testing and commissioning of completed pipeline	Odour emission from short term testing and commissioning		Whilst information is not currently available, it is conservatively assumed that the testing and commissioning of the completed pipeline would have a small odour source potential for a short duration	Not applicable as completed pipeline is underground.	Not applicable as completed pipeline is underground.	Ineffective as pipeline is underground	Negligible based on short term duration of impact	High	Negligible
Existing Cambridge WWTP	Odour release from breaking open existing sewer Connection of the Waterbeach pipeline to existing sewer	Odour emission from short term tie in works. Short term duration - up to 4 weeks	Small	Cycleway	-	Adjacent	Highly Effective	Low	Low	Negligible
				Commercial property Cowley Road	20	Upwind	Highly Effective	Low	Medium	Negligible
				Golf driving range	100	Upwind	Moderately Effective	Negligible	Medium	Negligible
				Milton Country Park	350	Downwind	Moderately Effective	Negligible	Low	Negligible
				Property north of A14 near Milton Country Park	520	Downwind	Ineffective	Negligible	High	Negligible
				Residential property on Fen Road	300	Upwind	Moderately Effective	Negligible	High	Negligible
				Northern Bridge Farm	840	Downwind	Ineffective	Negligible	High	Negligible
			Small	Cycleway	--	Adjacent	Highly Effective	Low	Low	Negligible

Area within Proposed Development	Works description	Potential impact	Source odour potential	Receptor reference	Distance	Direction	Pathway	Odour Exposure risk	Receptor sensitivity	Likely Odour Effect
Existing Cambridge WWTP	Draining and cleaning of waste water storage tanks and equipment	Odour emission from draining and cleaning. Short term duration - up to 12 months		Commercial property Cowley Road	-	Adjacent	Highly Effective	Low	Medium	Negligible
				Golf driving range	50	Upwind	Highly Effective	Low	Medium	Negligible
				Milton Country Park	150	Downwind	Highly Effective	Low	Low	Negligible
				Property north of A14 near Milton Country Park	360	Downwind	Moderately Effective	Negligible	High	Negligible
				Residential property on Fen Road	300	Upwind	Moderately Effective	Negligible	High	Negligible
				Northern Bridge Farm	300	Downwind	Moderately Effective	Negligible	High	Negligible
				Existing informal footpath/track	-	Adjacent	Highly Effective	Low	Low	Negligible
Proposed WWTP	Draining and cleaning of tanks	Odour emission from draining and cleaning. Short term duration - up to 12 months	Small	Footpaths within LMP	-	Adjacent	Highly Effective	Low	Low	Negligible
				Byway (85/14) section of LFDW	400	Downwind	Moderately Effective	Negligible	Low	Negligible
				A14	160	Upwind	Moderately Effective	Negligible	Low	Negligible
				Land to the south of the A14 used for non-arable farming activities	190	Upwind	Moderately Effective	Negligible	Low	Negligible
				Gatehouse	550	Downwind	Ineffective	Negligible	High	Negligible
				Property to the south of Horningsea	950	Upwind	Ineffective	Negligible	High	Negligible
				Quy Mill Hotel	1350	Upwind	Ineffective	Negligible	High	Negligible
				Future residential property to north of the proposed WWTP	300	Downwind	Moderately Effective	Negligible	High	Negligible

2.3 Operation

Table 2-2: Qualitative odour risk matrix and odour effects during operation

Area within Proposed Development	Works description	Potential impact	Source odour potential	Receptor reference	Distance	Direction	Pathway	Odour Exposure Risk	Receptor sensitivity	Likely Odour Effect
Proposed WWTP	Operation of the proposed WWTP- abnormal operations, accidents or emergencies	Odour emission from biogas release to air	Medium	Low Fen Drove Way PROW 85/14	400	Downwind	Moderately Effective	Negligible	Low	Negligible
				Proposed footpath/cycleways	-	Adjacent	Highly Effective	Low	Medium	Negligible
				A14	160	Upwind	Moderately Effective	Negligible	Low	Negligible
				Land to the south of the A14 used for non-arable farming activities	190	Upwind	Moderately Effective	Negligible	Low	Negligible
				Gatehouse	550	Downwind	Ineffective	Negligible	High	Negligible
				Property to south of Horningsea	950	Upwind	Ineffective	Negligible	High	Negligible
				Quy Mill Hotel	1350	Upwind	Ineffective	Negligible	High	Negligible
	Deliveries of waste water and sludge by vehicle Accidental spills and leaks- sludge movements	Short term odour release from deliveries Odour emission from sludge tanker spill within the proposed WWTP	Small	Low Fen Drove Way PROW 85/14	400	Downwind	Moderately Effective	Negligible	Low	Negligible
			Small	Proposed footpath/cycleways	-	Adjacent	Highly Effective	Low	Low	Negligible
			Small	A14	160	Upwind	Moderately Effective	Negligible	Low	Negligible
			Small	Land to the south of the A14 used for non-arable farming activities	190	Upwind	Moderately Effective	Negligible	Low	Negligible
			Small	Gatehouse	550	Downwind	Ineffective	Negligible	High	Negligible
			Small	Property to south of Horningsea	950	Upwind	Ineffective	Negligible	High	Negligible
			Small	Quy Mill Hotel	1350	Upwind	Ineffective	Negligible	High	Negligible
	Accidental spills and leaks- sludge movements	Odour emission from sludge tanker spill along access road / Horningsea junction	Small	Property at the south of Horningsea	830	Downwind	Ineffective	Negligible	High	Negligible
				Property at the north of Fen Ditton (Horningsea Rd)	420	Upwind	Ineffective	Negligible	High	Negligible
				Biggin Abbey	480	Upwind	Ineffective	Negligible	High	Negligible
				Fen Ditton Community Primary School	670	Upwind	Ineffective	Negligible	High	Negligible
	Operation of the outfall	Odour emission from release of cleaned	Small	PROW 85/6, 85/8 and 162/1	-	Adjacent	Highly Effective	Low	Low	Negligible
				A14	-	Adjacent	Highly Effective	Low	Low	Negligible

Area within Proposed Development	Works description	Potential impact	Source odour potential	Receptor reference	Distance	Direction	Pathway	Odour Exposure Risk	Receptor sensitivity	Likely Odour Effect
		effluent into water cycle		Users of the River Cam	-	Adjacent	Highly Effective	Low	Low	Negligible
				Biggin Abbey	300	Downwind	Moderately Effective	Negligible	High	Negligible
				Property adjacent to Wildfowl Cottage	300	Downwind	Moderately Effective	Negligible	High	Negligible
				Northern Bridge Farm	240	Upwind	Moderately Effective	Negligible	High	Negligible
				Red House Close	300	Upwind	Moderately Effective	Negligible	High	Negligible
				Poplar Hall Farm	230	Upwind	Moderately Effective	Negligible	High	Negligible
Waterbeach transfer pipeline	Sewer air valves	Short term odour release from sewer air valves	Small	Whilst information on the location of sewer air valves is not yet available, this assessment assumed a high sensitivity of receptor.	-	Assumed adjacent	Highly Effective	Negligible based on low intensity, low odour unpleasantness (waste in the pipeline has not had time to decompose) and short-term duration of impact.	High	Negligible
Existing Cambridge WWTP	Presence of vent in location of existing Cambridge WWTP	Inttermittent odour release from 10m high vent stack	Small	Cycleway	--	Adjacent	Highly Effective	Low	Low	Negligible
				Commercial property Cowley Road	-	Adjacent	Highly Effective	Low	Medium	Negligible
				Golf driving range	50	Upwind	Highly Effective	Low	Medium	Negligible
				Milton Country Park	150	Downwind	Highly Effective	Low	Low	Negligible
				Property north of A14 near Milton Country Park	360	Downwind	Moderately Effective	Negligible	High	Negligible
				Residential property on Fen Road	300	Upwind	Moderately Effective	Negligible	High	Negligible
				Northern Bridge Farm	300	Downwind	Moderately Effective	Negligible	High	Negligible
				Existing informal footpath/track	-	Adjacent	Highly Effective	Low	Low	Negligible

Table 2-3:Summary of odour effects during operation (modelled)

Receptor ID	Receptor reference	Location relative to proposed WWTP	Potential impact	Modelled concentration*	Magnitude of impact	Receptor sensitivity	Magnitude of effect
1	Gatehouse	550m east	Odour emission from normal operation of the proposed WWTP	0.39	Negligible	High	Negligible
2	A14	160m south west		1.24	Very Small	Low	Negligible
3	Property east of Horningsea Road, Fen Ditton	950m south west		0.33	Negligible	High	Negligible
4	Biggin Abbey	880m north west		0.49	Negligible	High	Negligible
5	Quy Mill Hotel	1350m south west		0.12	Negligible	High	Negligible
6	Fen Ditton Community Primary School	820m south west		0.25	Negligible	High	Negligible
7	Low Fen Drove Way PROW 85/14	400m north west		1.46	Very Small	Low	Negligible
8	Property to south of Horningsea	950m north		0.46	Negligible	High	Negligible
9	Future residential property to north of the proposed WWTP	340m north		1.47	Very Small	High	Negligible

** 98th percentile of 1-hour mean odour concentrations (ou_E/m^3) based on summer emission rates. Odour modelling based on highly conservative assumptions including, but not limited to, no reductions in emissions rates or predicted concentrations for seasonal variation (emission rates are expected to be lower in colder seasons). See Odour Impact Assessment Report,(Appendix 18.2, App Doc Ref 5.4.18.2) for further information regarding model parameters.*

Get in touch

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You can view all our DCO application documents and updates on the application on The Planning Inspectorate website:

https://infrastructure.planninginspectorate.gov.uk/projects/eastern/cambridge-waste-water-treatment-plant-relocation/