

M. Preliminary odour assessment

CONFIDENTIAL

CAMBRIDGE WWTW RELOCATION PROJECT

Predicted Odour Impacts – Site selection

RFP# 907014

Prepared for:

AWG Land Holdings Limited

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BLACK & VEATCH

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1. Introduction

Black and Veatch have been instructed through Anglian Water Venture Holdings Limited (AVH) for the benefit of Anglian Water Services Limited in its role as Applicant of the Development Consent Order (DCO) for Cambridge wastewater treatment plant relocation (CWWTPR), to conduct preliminary odour modelling of the indicative layout of the proposed new (relocated) Cambridge wastewater treatment plant (WwTP). The potential site locations used for the relocated WwTP have been determined through a formal site location and selection process. As this process has not been concluded, the 3 most suitable sites were considered as part of the inception phase odour modelling and odour assessment study.

This report has been prepared to provide details of the predicted odour impacts at receptors.

2. Background

2.1 Understanding the Requirements

Good air quality considers dust, smoke, fumes or gases, steam, and smells or odour. The European Union (EU) Ambient Air Quality Directive is implemented and regulated in the UK through compliance with the National air quality objectives of the Air Quality Strategy. This sets the relevant limits and target values at a regional level based on local constraints.

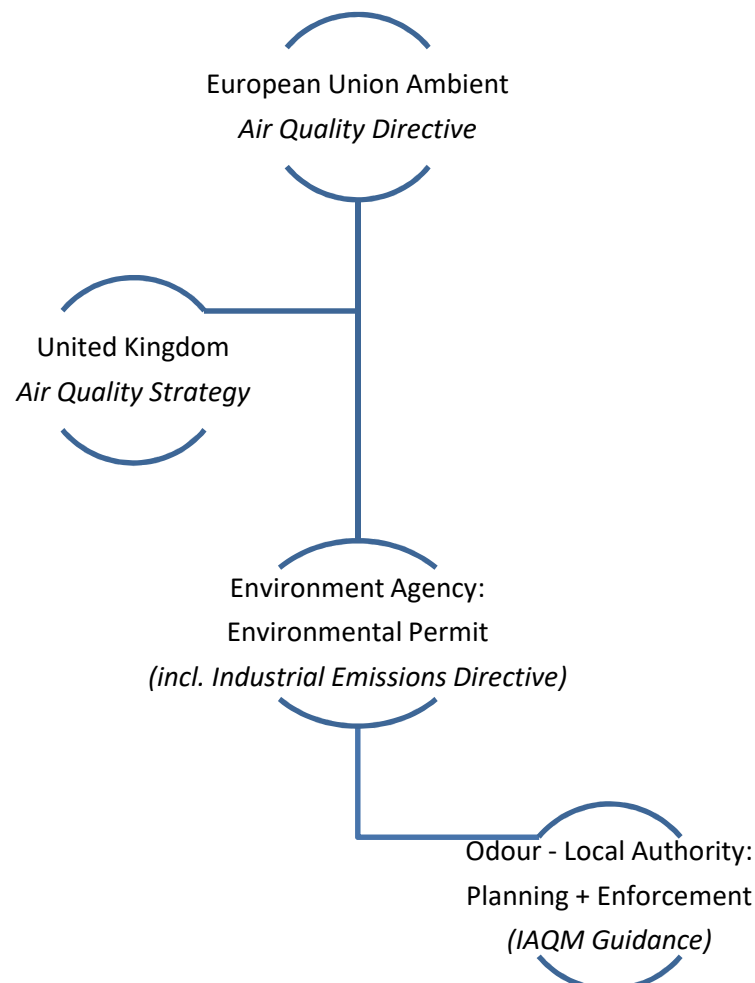


Figure 1: Delegated authority for odour requirements and enforcement

These requirements are delegated to the UK Environment Agency (EA), who issue and enforce Environmental Permits to ensure compliance with the Industrial Emissions Directive and other environmental protection directives (e.g. Water Framework Directive, Urban Wastewater Treatment Directive, etc.) and requirements associated with other EU, UK and local constraints. During the environmental permit application process, air quality modelling may be required, dependant on the site's activity (e.g. engines of certain size/type) and the local air quality (e.g. near Site of Special Scientific Interest).

Underpinned by these air quality and emission limits, local authorities enforce and (with the assistance of organisations such as the EA and the Institute of Air Quality Management (IAQM)) provide guidance towards planning for new developments to avoid creating odour pollution or nuisance. Included in the considerations of the National Planning Policy Framework is the effect of pollution on health, the natural environment and general amenity.

Additional to air quality, consideration for operator safety under the Health and Safety at Work Act will also be required. This will include investigations such as HAZOP (hazard and operability) studies, DSEAR (dangerous substances and explosive atmospheres regulations) reviews, and COSHH (Control of Substances Hazardous to Health Regulations) assessments. For the gasses predominantly associated with sewage and waste, odour is generally perceived at lower concentrations than those which would be considered hazardous.

For wastewater treatment plants, requirements for odour control and ventilation design are subject to British Standard European Standard (BS EN) 12255-9: 2002.

2.2 Further Guidance Available

The National Planning Policy requires: *"Considerations will include the proximity of sensitive receptors, including ecological as well as human receptors, and the extent to which adverse emissions can be controlled through the use of appropriate and well-maintained and managed equipment and vehicles."* To assist in determining acceptable planning considerations several industry bodies have provided guidance documents relating to odour impact. The most relevant of these are:

- a) EA's [Guidance for developments requiring planning permission and environmental permits](#), provides guidance to clarify the interface between the EA and others as part of the planning and permitting process. It provides insights into what would typically be considered trigger/focus points (e.g. distance to receptor) and an indication of what would be deemed to be acceptable, e.g. *"New developments within 250m of an anaerobic digestion activity could mean people being exposed to odours. The severity of this will depend on a number of factors, including the size of the facility, the way it is operated and managed, the nature of the waste it takes and weather conditions. If the operator can demonstrate that they have taken all reasonable precautions to reduce odours, the development can go ahead, with minimal effect on those living nearby."* For the site selection process, this buffer zone or separation distance guidance has already been considered.

[EA H4 Odour Management Guidance](#) benchmark targets at site boundary or nearest receptors:

- Most offensive odours (septic effluent or sludge) = 1.5 OU_E/m³
- Moderately offensive odours (well aerated composting, fat frying) = 3 OU_E/m³
- Less offensive (coffee, bread) = 6 OU_E/m³

- b) EA's *H4 Odour Management* Guidance document, provides guidance on 'How to comply with your environmental permit'. It also provides benchmark values – referred to in this document as EA's H4 guidance.
- c) IAQM's *Guidance on the assessment of odour for planning* Version 1.1 – July 2018, is specifically aimed at the planning process – referred to in this document as the IAQM's guidance.
- d) UK Water Industry Research (UKWIR) have produced an *Odour Control in Wastewater Treatment* set of technical reference documents describing typical odour emission rates and best available techniques (BAT) considerations for odour mitigation and management.

2.3 Site Boundary or Receptors?

Environmental permits with odour specific conditions will typically contain two types of clauses, with more or less detail as appropriate to the site:

- The odour boundary condition: *"Emissions from the activities shall be free from odour at levels likely to cause pollution outside the site, as perceived by an authorised officer of the Agency, unless the operator has used appropriate measures, including, but not limited to, those specified in an approved odour management plan, to prevent or where that is not practicable to minimise the odour."*
- The requirement to comply with an odour management plan (OMP).

The EA H4 odour management guidance clarifies that the odour boundary refers to the 'site boundary'. However, should there be no receptors close to the boundary, permitting will revert to the nearest receptor(s). A warning is included as part of this guidance that should circumstances change (e.g. new development established closer to the site after permitting), the operator may be required to take action to reduce impacts.

The definition of Statutory Nuisance in England and Wales covers seven areas, which relate to odour (s.79(1) Environment Protection Act 1990): *"any dust, steam, smell or other effluvia arising on industrial, trade or business premises and being prejudicial to health or a nuisance;"*. The 1990 act contains no technical definitions of nuisance, such as maximum concentrations, frequencies or durations of odour in air and only the Court can decide whether a legal Nuisance is being caused.

2.4 'Likely to Cause Pollution' and 'Appropriate Measures'

Odour is subjective. Even the units of measurement are subjective: *Odour, expressed in OU_E/m³ or "odour units per cubic meter", is defined as the concentration of odour in one cubic meter of air at the panel detection threshold of the odour. 1 OU is the point at which 50% of the olfactometry panellists cannot smell the odour but 50% can.*

Whether an individual perceives odour as acceptable, objectionable or offensive would be partly based on their sensitivities but also partly determined through life experiences. Other annoyances such as dust, noise, traffic, etc. could amplify the perception of the acceptableness of odour. Not everyone will perceive pollution or nuisance at the same point, and yet not everyone that experiences the nuisance will complain.

Van Harreveld¹ described the diminishing process from odour formation to complaint. The steps of his process have been listed, along with a brief commentary, in Table 1.

Table 1: Commentary on Van Harreveld odour formation process applicable to WwTW

Van Harreveld odour formation process	Commentary
Odour formed	The sewage and sludge received at a wastewater treatment works (WwTW) is associated with a variety of odorous gasses. Hydrogen Sulphide (H ₂ S) is probably the most easily recognised - smells like rotten eggs or flatulence – but Ammonia and Mercaptans have also been associated with odour complaints.
Transferred to air	The gasses are transferred to the air at the liquid-air surface, up to a saturation concentration if equilibrium can be established.
Released to atmosphere	Turbulent flow locations such as weirs, flumes and pumped pipe discharges, along with aeration of the liquid are some of the methods that amplify release of the gasses to the air and atmosphere.
Atmospheric dispersion	Sheltering/shielding/covering, air temperature, elevation (e.g. stack or ground level), and wind are some factors that may impact dispersion.
Exposure of receptor	Frequency, intensity, duration, character of the odour and location of the site in relation to its environment (similar or different) are some of the factors that will influence likelihood to proceed towards complaint.
Detection and perception	Differentiation between natures of smells are only possible if >1 OU _E /m ³ difference is detected, meaning that if a background odour exists in an area, the detection of other/different odours in the area will be harder. However, confusion between similar odours can also be perceived. Visual screening is used internationally to minimize odour perception associated with visual detection. Time of the day and activity context, relation to source, association with the odour are some of the factors that could influence detection and perception of the odour as a problem or not.
Appraisal by receptor	Perception of potential health impacts is an example of a trigger that will spur action.
Annoyance	Receptor factors such as attitude to status quo, economic relation to source, personal coping strategies, etc. are some factors that influence level of annoyance.
Nuisance	Cumulative impact of annoyance
Complaint	People with access to a complaint channel and legal instruments are more likely to complain. People will complain if they expect to see a result emanating from their complaint.

For the assessment of the level of odour 'likely to cause pollution' and to determine 'appropriate measures' for mitigation, the EA's H4 guidance recommends, with reference to Table 2 below, consideration of the following two steps:

Step 1: Is there serious pollution?

Step 2: Is the operator taking appropriate measures?

¹ Van Harreveld A.P., From Odorant Formation to Odour Nuisance: New Definitions for Discussing a Complex Process, Water Science and Technology, Vol.44, No.9, pp9-15 (2001)

Table 2 - Three levels of odour (Figure 1 from the Environment Agency guidance document: H4 odour management)

Unreasonable odour amounting to serious pollution is being or is likely to be caused (regardless of whether appropriate measures are being used). You must take further action or you may have to reduce or cease operations. The Environment Agency would not issue a permit if it considered that you were likely to be operating at this level.
Odour pollution is or is likely to be caused beyond boundary. Your duty is to use appropriate measures to minimise odour. You are not in breach if you are using appropriate measures. If appropriate measures are being used, residual odour will have to be tolerated by the community. For some activities appropriate measures will achieve no smell beyond the boundary.
No odour beyond the boundary or likely to be = no pollution = no action needed

The H4 guidance describes factors to take into consideration for establishing if receptors could perceive a potential odour as pollution or nuisance, including FIDOL (frequency, intensity, duration, offensiveness and location). It provides some benchmark maximum targets at receptors, but lacks clear definition as to what could be considered a reasonable odour position.

The IAQM guidance (2018) is specifically for use during planning and this has been used to inform Step 1 of the H4 process for this project.

As such, the odour modelling and odour assessment work completed during the inception phase considered all factors required in the EA's H4 guidance to establish a baseline position.

3. Methodology for Assessing Odour Impact

To ensure that a robust methodology was developed for assessing the potential to cause odour impact arising from the proposed new Cambridge WwTW relocation project (CWWTWRP), the methodology was developed considering the EA H4 odour management guidance and the IAQM guidance for assessment of odour for planning, as follows:

1. Baseline Conditions:

A baseline condition was defined for the use in the odour assessment. Although the design philosophy employed for the proposed new WwTP was to provide a "like for like" replacement for the existing Cambridge WwTP at a new site location, the following changes from the existing WwTP have been included in the baseline condition (Scenario 4A):

- (1) Covering and venting of air from the terminal pumping station (TPS) and inlet works through odour control units (OCUs). This will reduce the odour impact associated with potentially receiving sewage out of the network of unpredictable quality.
- (2) Improvements in the design configuration of the sludge treatment centre (STC) with all tanks in the STC being covered and either vented to OCU for treatment or, if the tanks remain under anaerobic conditions, connected to the biogas collection and utilisation system. This will reduce the odour impact of the STC.

(3) The proposed site will be more compact in nature than the existing WwTP site: approximately 24 hectares for the new, compared to approximately 48 hectares for the existing. The existing site includes several areas planted with trees around the site, which provides natural odour dispersion.

2. Receptors:

Receptors and their sensitivity were defined in line with the IAQM guidance. Table 3 below, (Table 7 from the IAQM guidance) indicates the requirements for determining a *Negligible* impact on receptors for a “normal operation” WwTW, as is expected as a worst-case position for the new CWWTWRP:

Table 3 – Proposed odour effect descriptors for impacts predicted by modelling for moderately offensive odours

Odour Exposure Level C_{98} OU _E /m ³	Receptor Sensitivity		
	Low	Medium	High
≥ 10	Moderate	Substantial	Substantial
5 to < 10	Slight	Moderate	Moderate
3 to < 5	Negligible	Slight	Moderate
1.5 to < 3	Negligible	Negligible	Slight
<1.5	Negligible	Negligible	Negligible

This should be read in association with the classification of Sensitivity of Receptors, as per Table 2 of the IAQM guidelines, included in Table 4 below:

Table 4 – Receptor sensitivity to odours

Sensitivity of Receptors	Surrounding Land Use
High	Surrounding land where: - users can reasonably expect enjoyment of a high level of amenity; and - people would reasonably be expected to be present here continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land. Examples may include residential dwellings, hospitals, schools/education and tourist/cultural.
Medium	Surrounding land where: - users would expect to enjoy a reasonable level of amenity, but wouldn't reasonably expect to enjoy the same level of amenity as in their home; or - people wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land. Examples may include places of work, commercial/retail premises and playing/recreation fields.
Low	Surrounding land where: - the enjoyment of amenity would not reasonably be expected; or - there is transient exposure, where the people would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land. Examples may include industrial use, farms, footpaths and roads.

3. Odour Modelling:

In line with IAQM guidance, odour modelling was used to establish the predicted odour exposure levels. The following approach has been used for the construction of the odour dispersion model and odour modelling, undertaken by *H&M Environmental Ltd*.

- AERMOD Version 9.8.3 has been employed for the odour modelling exercise. Its use for odour modelling has been accepted by the UK Environment Agency and it is confirmed as a suitable predictive modelling odour assessment tool by the Institute of Air Quality Management (IAQM) for the assessment of odour for planning purposes.
- The meteorological data used in the models are based on that from Cambridge Airfield and RAF Mildenhall MET data, compiled by following the best available technology (BAT) practices.
- The surface roughness for each site was determined based upon the current topography and land use around each site respectively. The topography of the Fens landscape is mostly flat, but as the land use around each site differs these surface roughness values differ between the sites.
- The layout utilised for the odour modelling was prepared by Black and Veatch during the inception phase of the project as an indicative WwTP layout to allow the confirmation of land size requirement. The layout is based on a conventional activated sludge treatment process and a sludge treatment centre (STC) utilising Anglian Water's HpH process followed by anaerobic digestion to simulate a "like for like" replacement of the existing Cambridge WwTP.
- As the proposed new relocated WwTP does not currently exist, all emission rates utilised are **estimated values** of what they may be at the proposed WwTP based upon the **measured values** at the existing Cambridge WwTP. Odour emission rates measured during a July 2019 odour survey carried out by Silsoe Odours² have been used. The survey was carried out in the summer, and would thus be representative of the maximum odour potential expected. These summer values were used for the entire modelling exercise and therefore a conservative design assumption. These emission rates were also compared with Anglian Water Asset Standard Emission Rates and the UKWIR documents and they correlated well.
- Validation of the modelling against actual measurements is not possible as the WwTW has not been constructed. However, as part of the Cambridge North Odour Assessment² sniff testing was carried out at the existing Cambridge WwTW, which correlated with the modelling results of the existing Cambridge WwTW. As the same modelling configuration, emissions and software were used, a comparable level of accuracy is expected for the proposed new WwTW.
- Modelling outputs contours were chosen to be comparable to the categories used in the IAQM guidelines, namely: 1.5, 3, 5, 10 OU_E/m³.
- Should any of the items change as more information becomes available, the odour model will require to be rerun, and the odour impact re-assessed.

² 'Cambridge North Odour Assessment' Draft 1 report prepared by ARUP on behalf of Brookgate Ltd, 12th August 2019

4. Consideration of mitigation measures:

Mitigation measures are not specifically explored or discussed in this report, as it is expected that the outputs from this odour study will inform the further design development before the actual planning application.

Mitigation measures considered will be in line with the [National Policy Statement for Waste Water](#) and may include:

- selecting processes and process technologies with a lower “odour potential”,
- flow handling techniques to prevent odour dispersion (e.g. diffused aeration causes less turbulence than surface aerators and thus less emissions dispersion and odour impact),
- the processes most likely to generate offensive odours will be contained or enclosed (extracting the odorous air to odour control units or the biogas system, as appropriate),
- processes with treated effluent (and thus unoffensive odours) will be located near the boundary and processes with higher odour risk nearer to the centre of the site, taking account of the site-specific constraints, architectural and bio-diversity features,
- enclosed/covered tanks connected to the odour control system (e.g. bio-scrubbers combined with activated carbon polishing units) designed to ensure high enough extraction rates are maintained to control fugitive leaks.
- Different odour control systems and configurations provide different treatment. Units to address the specific odour components of the area treated, as well as novel technologies can be employed.
- Odour control facilities are critical equipment and will be designed to operate continuously, day and night, in all conditions. Their power supply will be protected, and standby equipment will be brought on-line automatically should duty equipment fail.

4. Odour Modelling Results

4.1 Previously Reported

The sniff testing performed as part of the Cambridge North Odour Assessment³ reported to detect odours above 3 OU_E/m³ (and usually above 5 OU_E/m³), but not below 3 OU_E/m³. The EA’s H4 guidance recommended ≤3 OU_E/m³ as suitable criterion for moderately offensive odours (e.g. well operating WwTW) and ≤1.5 OU_E/m³ as criterion for most offensive odours (e.g. septic effluent or sludge). As the STC will be covered and extracted air treated in OCUs, and the new WwTW is expected to be well operating, a reference position of ≤3 OU_E/m³ for acceptable odour level could have been used. However, the more stringent IAQM guidelines were used and mitigation applied until all receptors were within the *negligible impact* classification for moderately offensive odours.

³ Cambridge North Odour Assessment’ Draft 1 report prepared by ARUP on behalf of Brookgate Ltd, 12th August 2019

4.2 Baseline Modelling Results

For the baseline scenario, a portion of Landbeach, as well as Punch and Oldfield Farms were slightly impacted for Site 1. The other Sites, 2 and 3, showed negligible impact on their closest receptors. Receptors further afield are not expected to be adversely impacted and thus not listed. *The baseline odour dispersion maps for each site is shown in Appendix A.*

The results of the impacts, assessed using the IAQM guidance, is shown for each site and its receptors in the tables below.

The resulting odour impact on the receptors associated with **Site 1**, based on the site-specific surface roughness of 0.25, are summarised in the following table.

Table 5 - Odour Impact on Receptors – Site 1

Receptor	Surrounding Land Use OR Character of Area	Nr of PE Affected	Sensitivity	Odour Exposure C_{98} OU_E/m^3	Impact
Landbeach area	Small Rural Village	c. 150-300	High	Mostly: >1.5, few dwellings: 1.5-3	Slight
Punch and Oldfield	Farms with homesteads	c. 10	High	1.5-3	Slight
Roman Road	Recreational (e.g. dog walking)	occasional	Low	3-5 (highest impacted section)	Negligible

The resulting odour impact on the receptors associated with **Site 2**, based on the site-specific surface roughness of 0.4, are summarised in the following table.

Table 6 - Odour Impact on Receptors – Site 2

Receptor	Surrounding Land Use OR Character of Area	Nr of PE affected	Sensitivity	Odour Exposure C_{98} OU_E/m^3	Impact
Evolution Business Park	Small industry	c.20-200	Medium	1.5-3	Negligible
Roman Road	Recreational (e.g. dog walking)	occasional	Low	1.5-3 (highest impacted section)	Negligible

The resulting odour impact on the receptors associated with **Site 3**, based on the site-specific surface roughness of 0.26, are summarised in the following table.

Table 7 - Odour Impact on Receptors – Site 3

Receptor	Surrounding Land Use OR Character of Area	Nr of PE affected	Sensitivity	Odour Exposure C_{98} OU_E/m^3	Impact
Snout Corner Fen Track	Recreational (e.g. dog walking)	occasional	Low	1.5-3	Negligible
Disused railway and Low Fen Drove Way	Recreational (e.g. dog walking)	occasional	Low	1.5-3	Negligible
A14	Major Road	1,000s	Low	1.5-3	Negligible

5. Conclusions

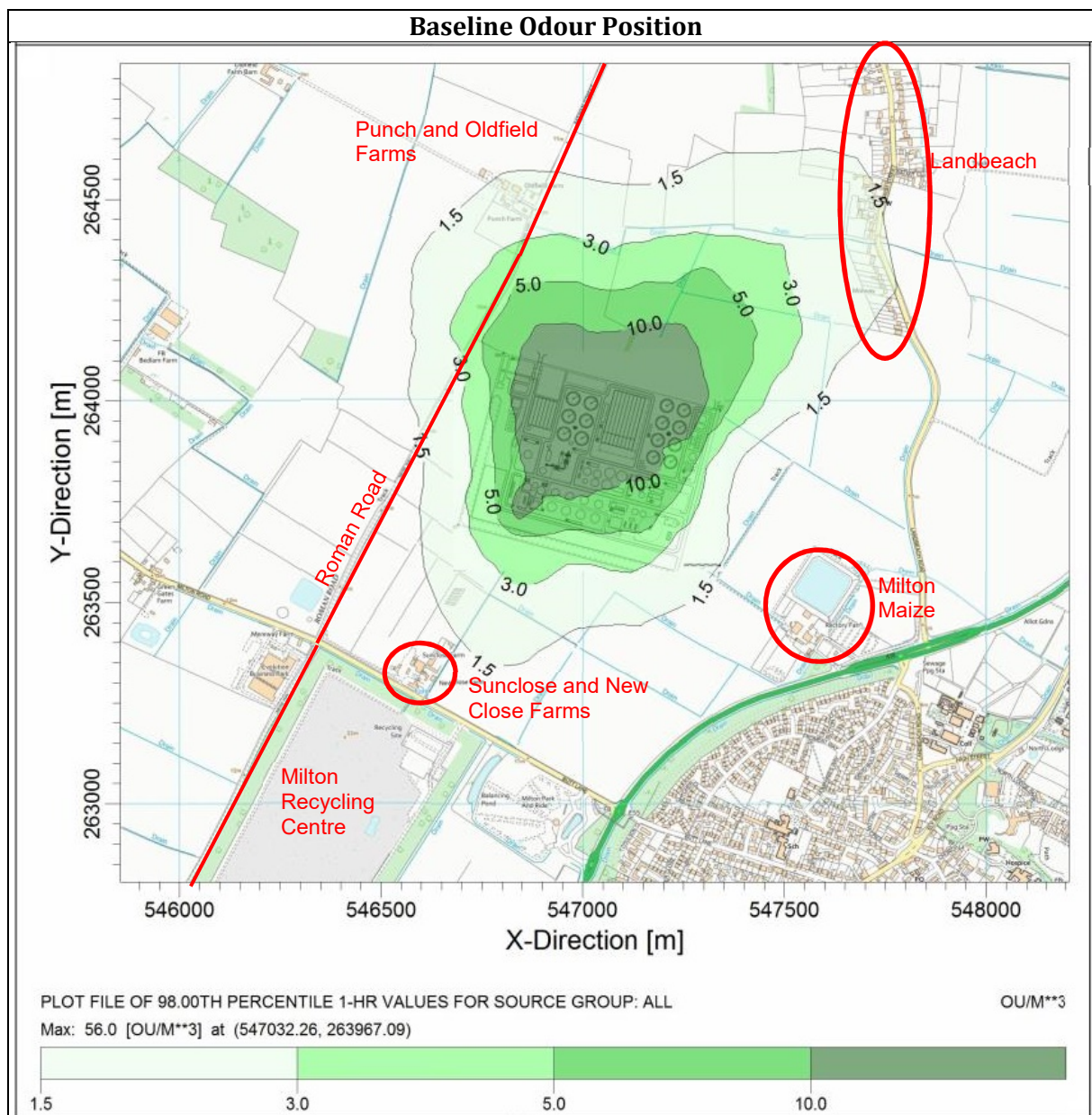
On an 'inception phase site design and layout used as common baseline' basis, using the IAQM guidance, Site 2 and 3 would cause negligible impact on its receptors, whereas Site 1 would require mitigation measures to reduce the baseline scenario from *slight impact* to *negligible impact* ($<1.5 \text{ OU}_E/\text{m}^3$).

It is recommended that a further odour modelling and odour assessment study be conducted during the design phase following site selection, to ensure the layout and other assumptions are updated to match the specifics of the site.

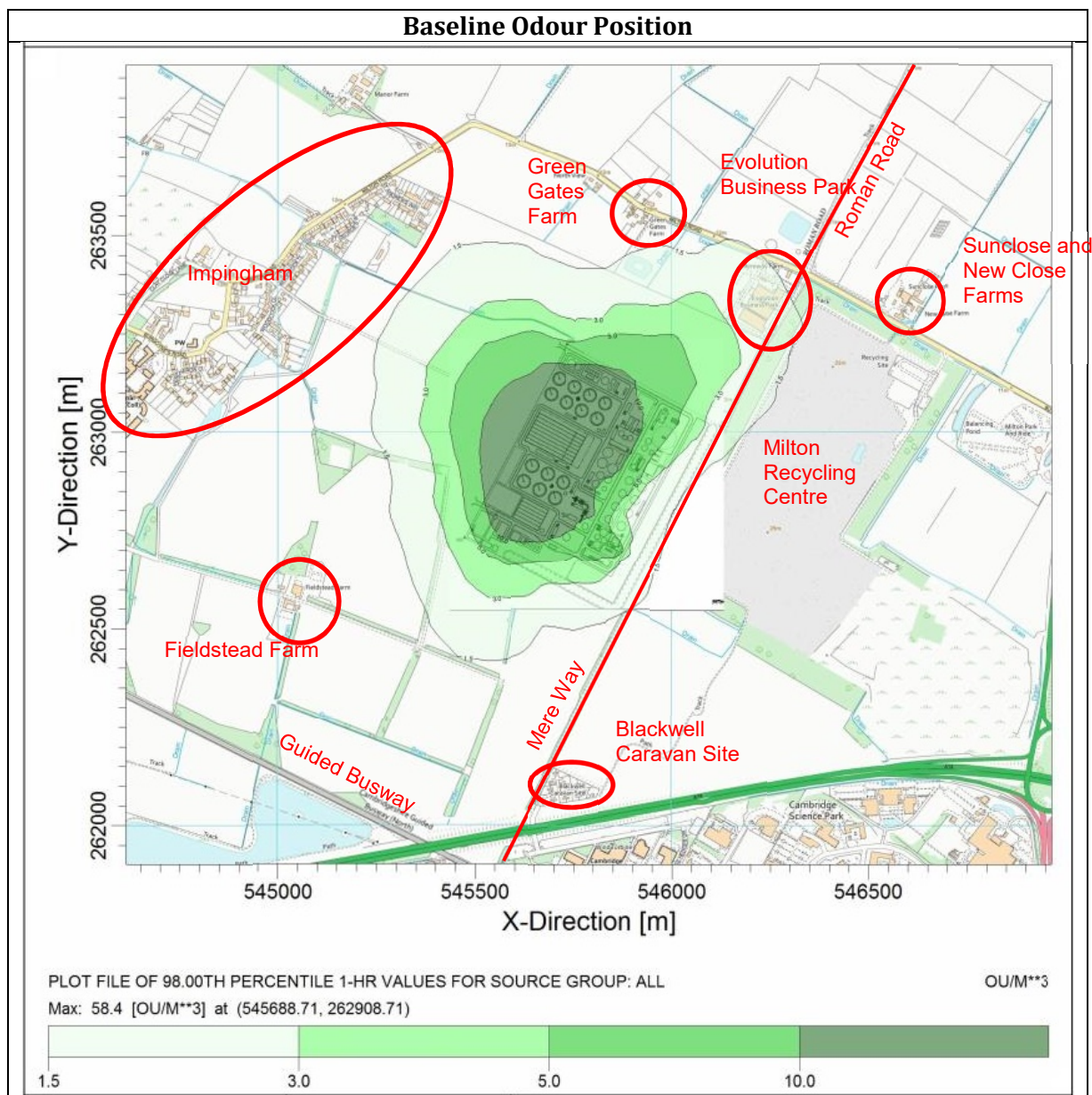
APPENDICES

Appendix A: Modelling Results: Baseline

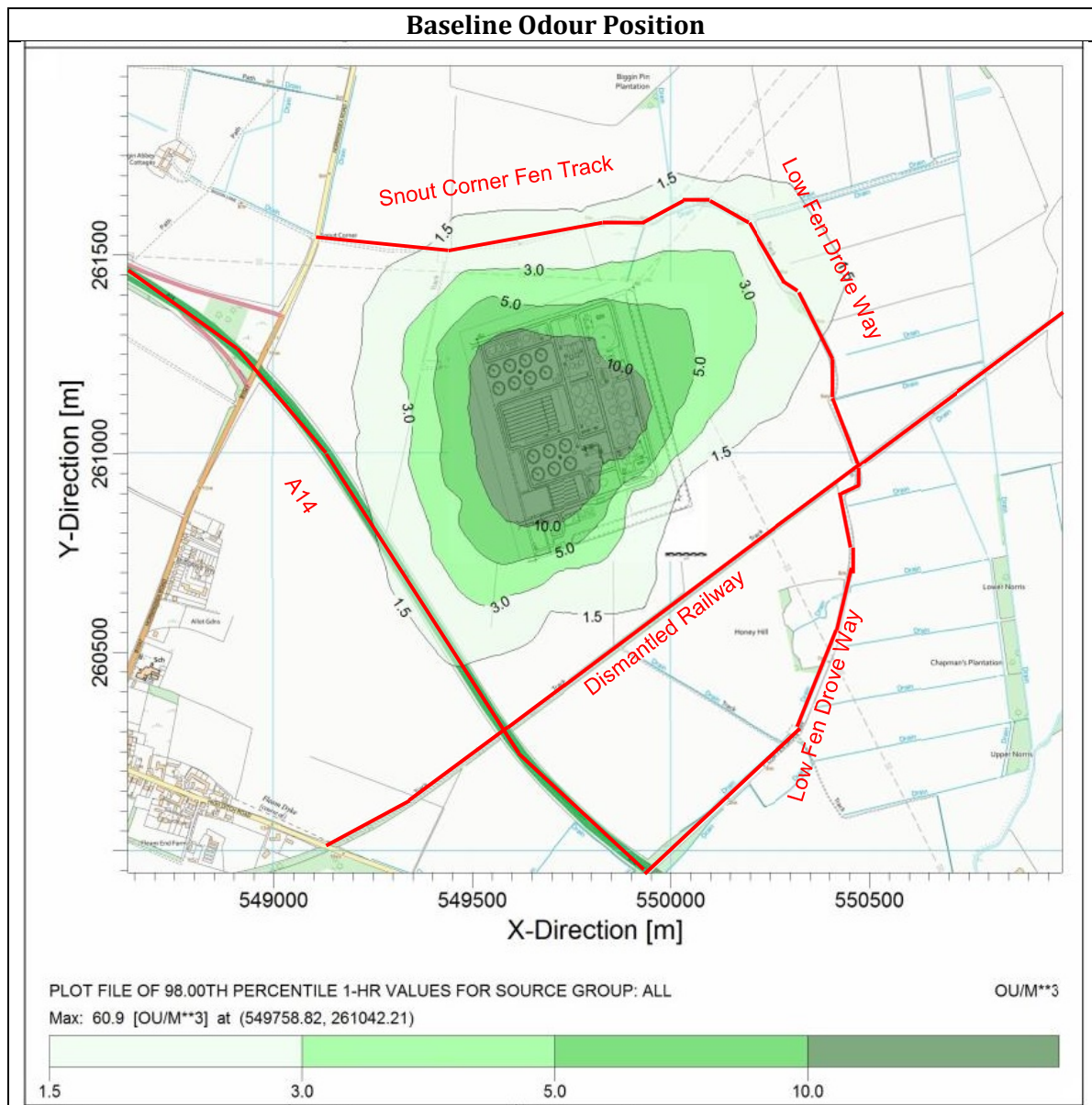
A.1 Site 1 - Scenario 4A - Proposed WwTW with the TPS, Inlet and STC covered and air treated in OCU – MET surface roughness 0.25



A.2 Site 2 - Scenario 4A - Proposed WwTW with the TPS, Inlet and STC covered and air treated in OCU – MET surface roughness 0.4



A.3 Site 3 - Scenario 4A - Proposed WwTW with the TPS, Inlet and STC covered and air treated in OCU, compared to Scenario 4B: Proposed WwTW with the TPS, Inlet, PSTs and STC covered and air treated in OCU – MET surface roughness 0.26



- End -