Odour Assessment:
Bicester Arc, Cherwell

April 2023

Experts in air quality
management & assessment

Document Control

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J10/12155A/10F1	28 April 2023	Draft	Laurence Caird (Technical Director)

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Contents

1 Introduction

1.1 This technical note describes the assessment of odour effects associated with Bicester Sewage Treatment Works (STW) on the proposed Bicester Arc development located to the north of the STW, which comprises office development across a number of phases. The STW has the potential to generate unpleasant odours which may adversely impact upon future users of the proposed development. The assessment has been carried out by Air Quality Consultants Ltd (AQC) on behalf of Peveril Securities Ltd. This assessment considers the entire development site and is thus provided to support the RMA planning applications for the development for all phases.

1.2 The development site is located approximately 180 m north of the STW; the location of the proposed development in relation to the STW is shown in Figure 1.

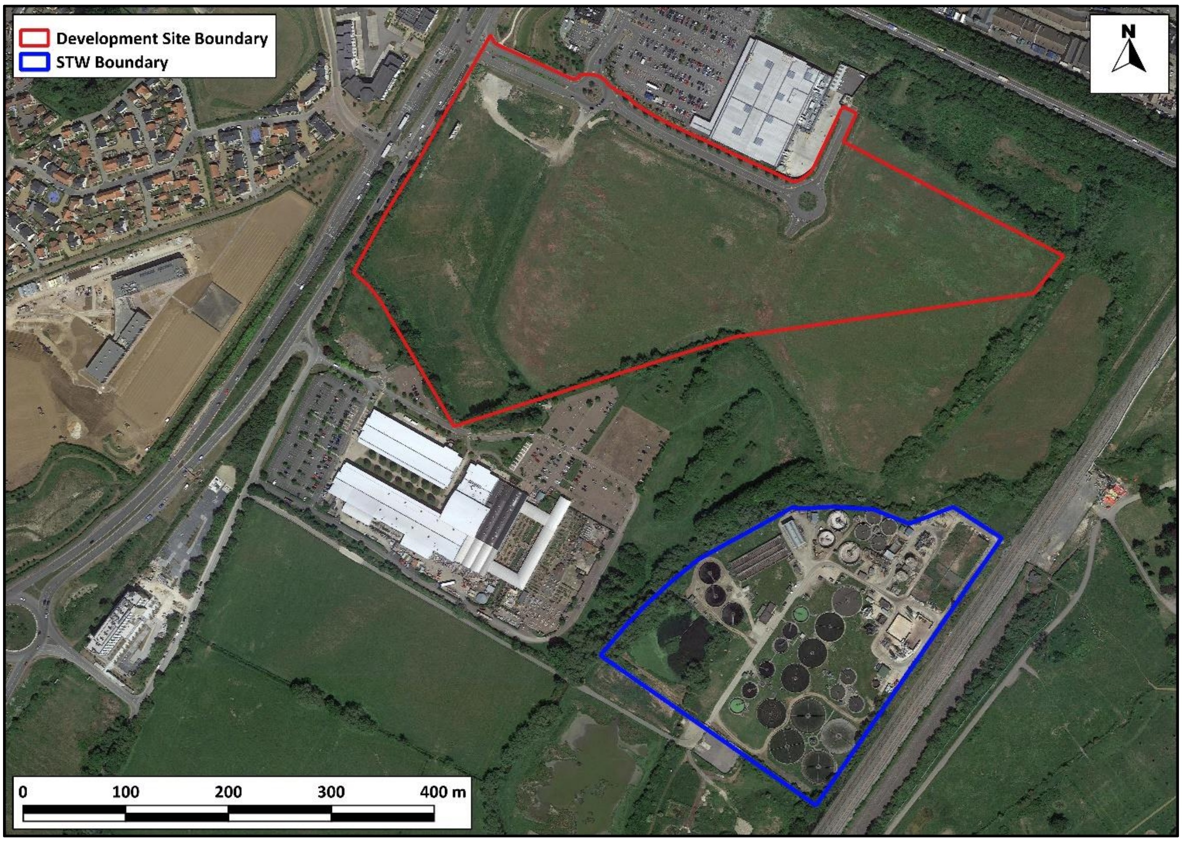

Figure 1: Location of Proposed Development (includes Phases 1 and 2) and Bicester STW

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1.3 This assessment identifies the potential odour effects associated with the STW and uses field odour surveys (sniff tests) undertaken by AQC and the results of odour dispersion modelling undertaken on behalf of Thames Water, by its approved odour consultants, Olfasense (Olfasense UK Ltd, 2022).

2 Odour in Legislation, Policy and Guidance

National Legislation

Environmental Protection Act

2.1 There are currently no statutory standards in the UK covering the release and subsequent impacts of odours. This is due to complexities involved with measuring and assessing odours against compliance criteria, and the inherently subjective nature of odours.

2.2 It is recognised that odours have the potential to pose a nuisance for residents living near to an offensive source of odour. Determination of whether or not an odour constitutes a statutory nuisance in these cases is usually the responsibility of the local planning authority or the Environment Agency. The Environmental Protection Act 1990 (1990) outlines that a local authority can require measures to be taken where any:

"dust, steam, smell or other effluvia arising on an industrial, trade and business premises and being prejudicial to health or a nuisance…" or

"fumes or gases are emitted from premises so as to be prejudicial to health or cause a nuisance.."

2.3 Odour can also be controlled under the Statutory Nuisance provisions of Part III of the Environmental Protection Act.

Planning Policy

National Planning Policy Framework

2.4 The National Planning Policy Framework (NPPF) (2021a) sets out planning policy for England. It states that the purpose of the planning system is to contribute to the achievement of sustainable development, and that the planning system has three overarching objectives, one of which is an environmental objective:

"to protect and enhance our natural, built and historic environment; including making effective use of land, improving biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy"..

2.5 To prevent unacceptable risks from pollution, the NPPF states that:

"Planning policies and decisions should contribute to and enhance the natural and local environment by…preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air quality".

and

"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development".

2.6 The NPPF is supported by Planning Practice Guidance (PPG) (Ministry of Housing, Communities & Local Government, 2021b), which makes clear that *"Odour…can also be a planning concern, for example, because of the effect on local amenity"*. It also provides guidance on options for mitigating impacts, and states that *"Mitigation options will need to be locationally specific, will depend on the proposed development and need to be proportionate to the likely impact".*

Odour Guidance

Environment Agency Guidance

2.7 The Environment Agency has produced a horizontal guidance note (H4) on odour assessment and management (Environment Agency, 2011), which is designed for operators of Environment Agency-regulated processes (i.e., those which classify as Part A(1) processes under the Pollution Prevention and Control (PPC) regime). The H4 guidance document is primarily aimed at methods to control and manage the release of odours, but also contains a series of recommended assessment methods which can be used to assess potential odour impacts.

Institute of Air Quality Management Guidance

2.8 The latest UK guidance on odour was published by the Institute of Air Quality Management (IAQM) in 2018 (IAQM, 2018). The IAQM guidance sets out assessment methods which may be utilised in the assessment of odours for planning applications. It is the only UK odour guidance document which contains a method for estimating the significance of potential odour impacts.

2.9 The IAQM guidance endorses the use of multiple assessment tools for odours, stating that, "*best practice is to use a multi-tool approach where practicable".* This is in order to improve the robustness of the assessment conclusions. Some of the methods outlined in the IAQM guidance have been adopted in this odour assessment.

3 Assessment Approach

3.1 Odour impact assessment is a challenging and subjective science. There are a number of odour assessment methods and tools that have been developed which are widely used in the UK, including desk-based methods, such as complaints analysis and qualitative risk assessment, through to field odour testing (sniff testing) and dispersion modelling. Each has its advantages and disadvantages and not all assessment methods are appropriate in every case; for example, where a potentially odorous process is proposed rather than existing, then assessment methods such as sniff testing and odour sampling are less relevant than predictive methods such as odour risk assessment. The scale and location of odorous processes is also important in selecting appropriate assessment methodologies, with more simple methodologies often sufficient for small or remotely located processes.

3.2 The approach to assessing the odour effects from the STW has been to use the results of odour dispersion modelling undertaken by Thames Water's consultants Olfasense, as well as semi-quantitative on-site field odour assessments (sniff testing) undertaken by AQC.

Odour Sniff Testing

Sniff Test Methodology

3.3 This assessment uses the approach set out in the IAQM Guidance on the Assessment of Odours for Planning (IAQM, 2018), as set out below.

3.4 The observers undertaking the sniff-tests have had their olfactory acuity checked prior to carrying out the observations to demonstrate that their sense of smell is within the 'normal' range (i.e., is neither over- nor under-sensitive to odours). On the evening before, and on the day of the observations, the observers consumed no strong food or drinks. No strongly scented toiletries were worn. These protocols are recommended in a number of odour guidance documents, including those published by the IAQM (IAQM, 2018) and Environment Agency (Environment Agency, 2011).

3.5 The sniff tests conducted followed the procedure described in the IAQM guidance on assessment of odours for planning (IAQM, 2018). The tests aimed to identify key characteristics of all odours detected, in particular their 'FIDOR' factors (as described in IAQM and EA guidance), which were appraised and recorded using the guidance outlined in Table 1.

Table 1: Description of the FIDOR factors

Factor	Description
Frequency	The frequency with which odours are detected.
Intensity [a]	The degree to which an odour is detectable on a 0-6 scale where: 0 = No odour 1 = Very faint odour (there is probably some doubt as to whether the odour is actually present) 2 = Faint odour (the odour is present but cannot be described using precise words or terms) 3 = Distinct odour (the odour character is barely/just recognisable) 4 = Strong odour (the odour character is easily recognisable) 5 = Very strong odour (the odour is offensive; exposure to this level would be considered undesirable) 6 = extremely strong odour (the odour is offensive; an instinctive reaction would be to mitigate against further exposure)
Duration	The duration of exposure to detectable odours.
Offensiveness	The level of pleasantness or unpleasantness of odours, in relation to its Hedonic Tone. Hedonic Tone is scored on a scale of +4 to -4 where: +4 = Pleasant odours; 0 = Neutral odours; and -4 = Foul odours.
Receptor sensitivity	The sensitivity of the location where odours are detected, and/or the proximity of odour releases to an odour-sensitive location.

[a] Intensity scale has been taken from the IAQM guidance (IAQM, 2018), and is based upon the VDI 3940 scale. Odours of intensity of 4 or greater are considered to have significant potential for annoyance. Odours of intensity of 2 or less are so faint that the character of the odour cannot be described and annoyance is unlikely.

3.6 Four site visits were carried out to undertake the sniff testing, with a total of six surveys completed across the four days. During each site visit, the sniff test surveys started at the most distant location downwind of the odour source and were then carried out along a transect running across the site towards the odour source. At each location, the odour detected during each of 30 observations was recorded. Based on 5-10 seconds between each observation, each test lasted for a total of approximately three to five minutes. The intensity was noted using the criteria set out in Table 1, and, where relevant, a description of the odour was recorded. The sniff test locations are shown in Figure 2, Figure 3,Figure 4 and Figure 5 in Section 4 of this report.

Assessment of Odour Impacts

3.7 The IAQM guidance (IAQM, 2018) includes an approach to determine the impacts of odours based on the results of sniff testing. This involves a two-stage process; the first stage is to identify the odour exposure at a sniff test location and the second stage is to combine the odour exposure with the sensitivity of the location to determine an odour impact for each location.

3.8 The matrix shown in Table 2 is transposed from the IAQM guidance and shows how the odour exposure at each sniff-test location is estimated. The matrix requires two parameters to be calculated; first the average odour intensity during the sniff test (I_{mean}), which is the average odour intensity from the 30 observations made during each test; and the second is the percentage odour time ($t_{I\geq4}$), which is the percentage of time during each sniff test when an odour intensity of 4 or higher was recorded by the observer.

Table 2: Matrix to Assess Odour Exposure at each Sniff-Test Location

Average Intensity (I_{mean})	Percentage odour time ($t_{I\geq4}$) during the test				
	≤10%	11-20%	21-30%	31-40%	≥41%
6	Large	Very Large	Very Large	Very Large	Very Large
5	Medium	Large	Large	Very Large	Very Large
4	Small	Medium	Medium	Large	Large
3	Small	Medium	Medium	Medium	Medium
2	Small	Small	Medium	Medium	Medium
1	Small	Small	Small	N/A	N/A

Notes: I_{mean} should be rounded to the nearest whole number.

The following overriding considerations affect the scoring of the odour annoyance impact: if I_{mean} = 0, or if I_{mean} = 1, and $t_{I>4}$ = 0%, then the odour effect can for practical purposes be considered negligible.

3.9 This process identifies the odour exposure during each test. To extrapolate this to estimate the total odour exposure at a given location, the results of multiple sniff tests can be combined, applying professional judgement, and taking account of factors such as the frequency of wind conditions and the variability of the odour source being assessed.

3.10 Once the overall odour exposure at a given location has been estimated, the odour impact can be determined using the data presented in Table 3 which is also transposed from the IAQM guidance. The table combines the overall odour exposure with the sensitivity of the location to determine the odour impact. The IAQM guidance provides a description and examples of low, medium and high sensitivity receptors. The receptor sensitivity principally relates to the perceived level of amenity that would be expected by users of a particular land use, where land uses such as industry and farms are considered to be of low sensitivity, commercial premises and recreation facilities are considered to be of medium sensitivity, and residential properties, schools and hospitals are considered to be of high sensitivity to odours.

Table 3: Determination of Odour Impact at each Sniff-Test Location

Overall Odour Exposure [a]	Low and Medium Sensitivity Receptors
Very Large	Substantial Adverse
Large	Moderate Adverse
Medium	Slight Adverse
Small	Negligible

[a] Determined using the matrix in Table 2.

A further application of professional judgement then needs to be applied to conclude the significance of the odour effect on, or from, the development as a whole, taking into account the possibly different magnitudes of effects that occur at different receptors.

3.11 Table 3 can be used to identify the potential odour impacts at an individual location, but the guidance advises that the overall significance of odour effects on a development is determined using professional judgement, taking account of the significance of impacts at all locations. The professional experience of the consultants who completed this assessment are summarised in A1.

Odour Dispersion Modelling

Dispersion Model

3.12 The odour dispersion modelling was undertaken by Thames Water's approved consultants Olfasense (Olfasense UK Ltd, 2022) to identify the impact that recent upgrades to the STW have had on offsite odour impacts. The results of this modelling study have been used in this assessment when determining the overall significance of effects. The odour emission rates used in the modelling, as set out in the Olfasense report (Olfasense UK Ltd, 2022), have been reproduced in Appendix A2 for reference.

Model Outputs

3.13 The model was run to predict the 98th percentile of 1-hour odour concentrations across the grid of receptors. The predicted 98th percentiles of 1-hour odour concentrations have been compared to the suggested benchmarks outlined in the IAQM guidance on the assessment of odours for planning (IAQM, 2018).

3.14 The IAQM guidance states that *"odours from sewage treatment works plant operating normally, i.e. non-septic conditions, would not be expected to be at the 'most offensive' end of the spectrum...and can be considered on par with 'moderately offensive' odours such as intensive livestock rearing"*. Therefore, the odours from the STW have been assumed to be "*moderately offensive*" when assessing the significance of the impacts. This offensiveness criterion is also used in the modelling report (Olfasense UK Ltd, 2022) and thus is in agreement with Thames Water's own assessment.

3.15 The IAQM guidance provides descriptors for odour effects for "*moderately offensive*" odours for medium (i.e., commercial) and low (i.e., industrial use, farms, footpaths and roads) sensitivity land use. These have been set out in Table 4 below and have been used to determine the overall significance of the odour effects at the proposed development.

3.16 The IAQM guidance states that *"where the overall effect is greater than "slight adverse", the effect is likely to be considered significant"*; thus, where an effect is negligible or slight adverse, the overall effect will be 'not significant' and thus there should be no constraint to development.

Table 4: Odour Effect Descriptors for Impacts Predicted by Modelling – "Moderately Offensive" Odours

Risk of Odour Impact	Odour Effect	
	Low Sensitivity Receptor (e.g., industrial use, farms, footpaths and roads)	Medium Sensitivity Receptor (e.g., commercial property/office)
≥10	Moderate	Substantial
5-<10	Slight	Moderate
3-<5	Negligible	Slight
1.5-<3	Negligible	Negligible
0.5-<1.5	Negligible	Negligible
<0.5	Negligible	Negligible

4 Odour Impact Assessment

Sniff Testing

4.1 Four non-consecutive site visits were completed, on the 20th July 2021, 3rd August 2021, 8th September 2021 and 28th July 2022. The site visits were all undertaken during warm, dry weather when the development site was directly downwind of the STW; these conditions are conducive to a worst-case assessment in terms of odours across the site. During the first and final visits, one full odour survey per day was completed, and two full surveys were completed each day on the other two visits; thus, a total of six odour surveys were completed.

4.2 Figure 2, Figure 3, Figure 4 and Figure 5 show the worst-case odour effects at each test location from either of the two surveys on each day (not including the first and final visit when only one survey was competed). The results of the individual surveys from the visits undertaken on the 3rd August and 8th September 2021 are shown in Appendix A2. The odour effect at each location has been determined using the data collected during the survey and the matrices set out in Table 2 and Table 3 assuming all locations are of medium sensitivity (e.g., commercial properties).

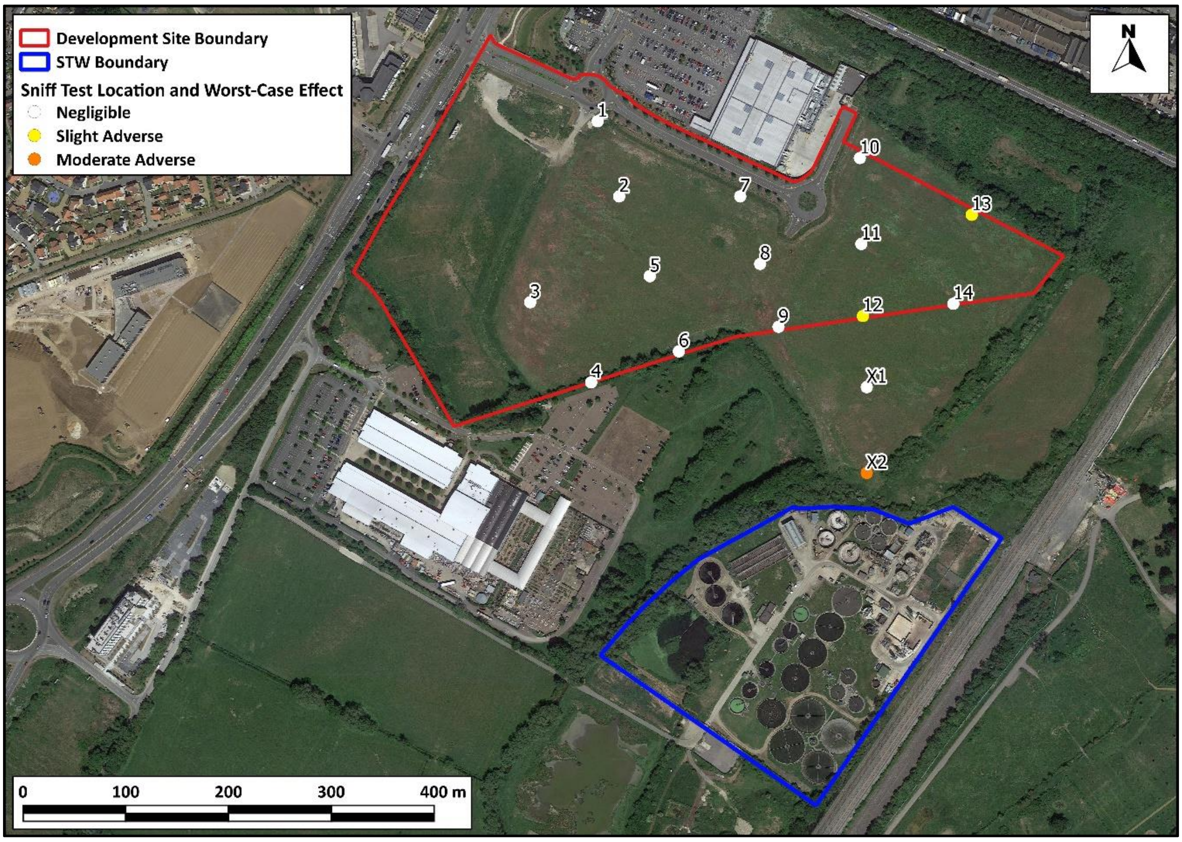

Figure 2: Sniff Test Results – 20th July 2021

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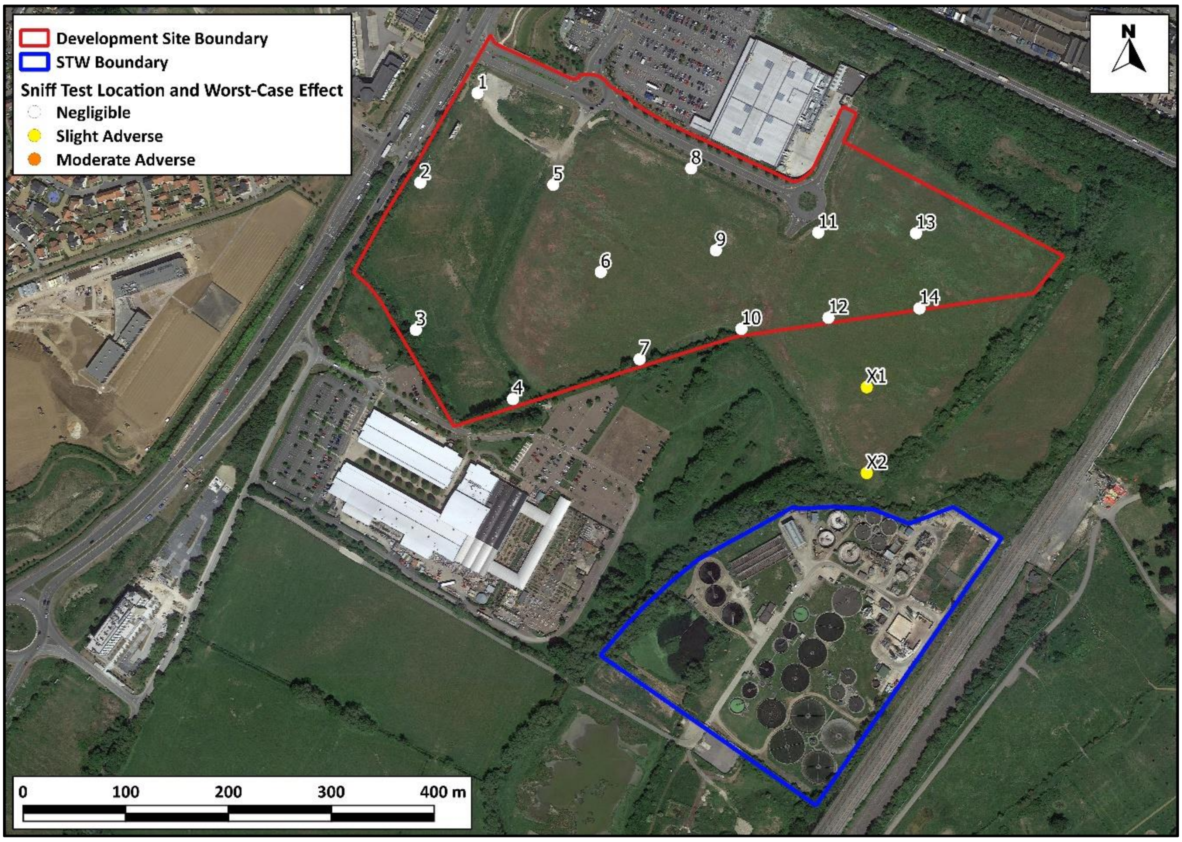

Figure 3: Sniff Test Results – 3rd August 2021

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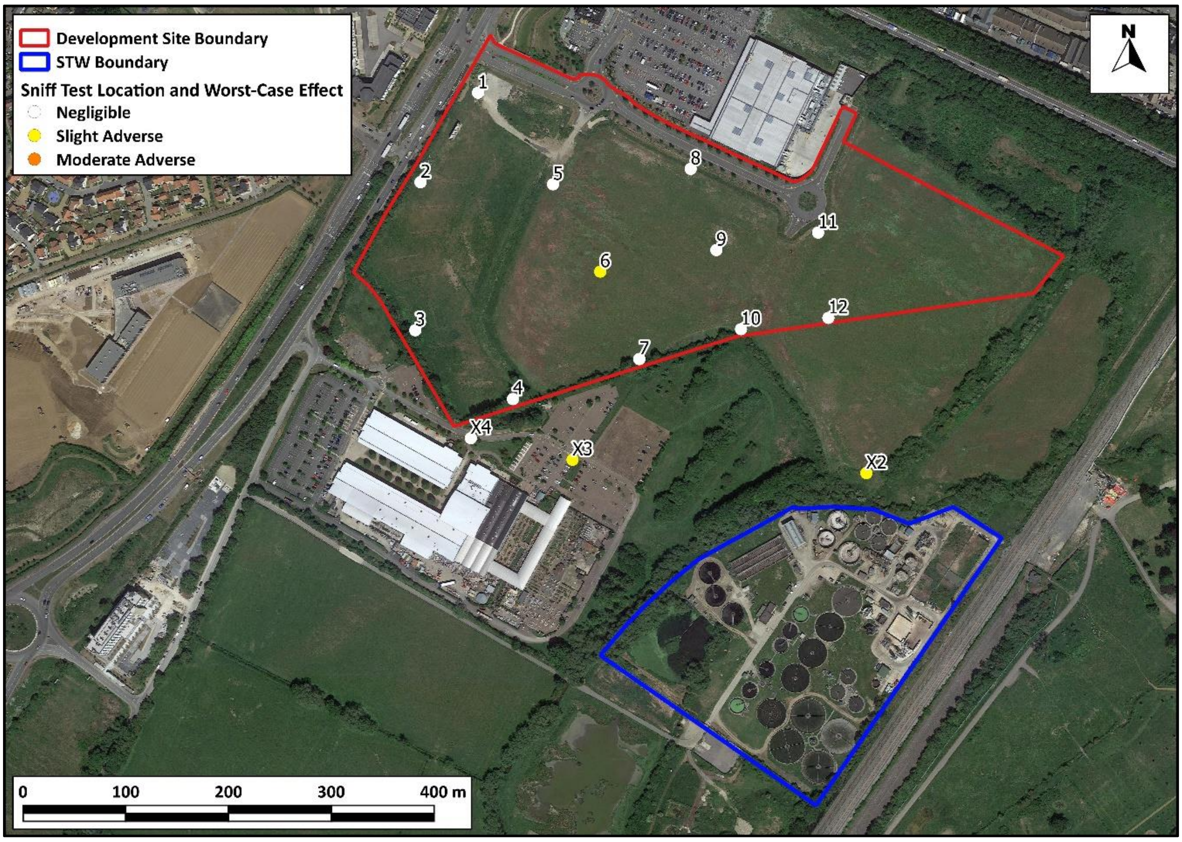

Figure 4: Sniff Test Results – 8th September 2021

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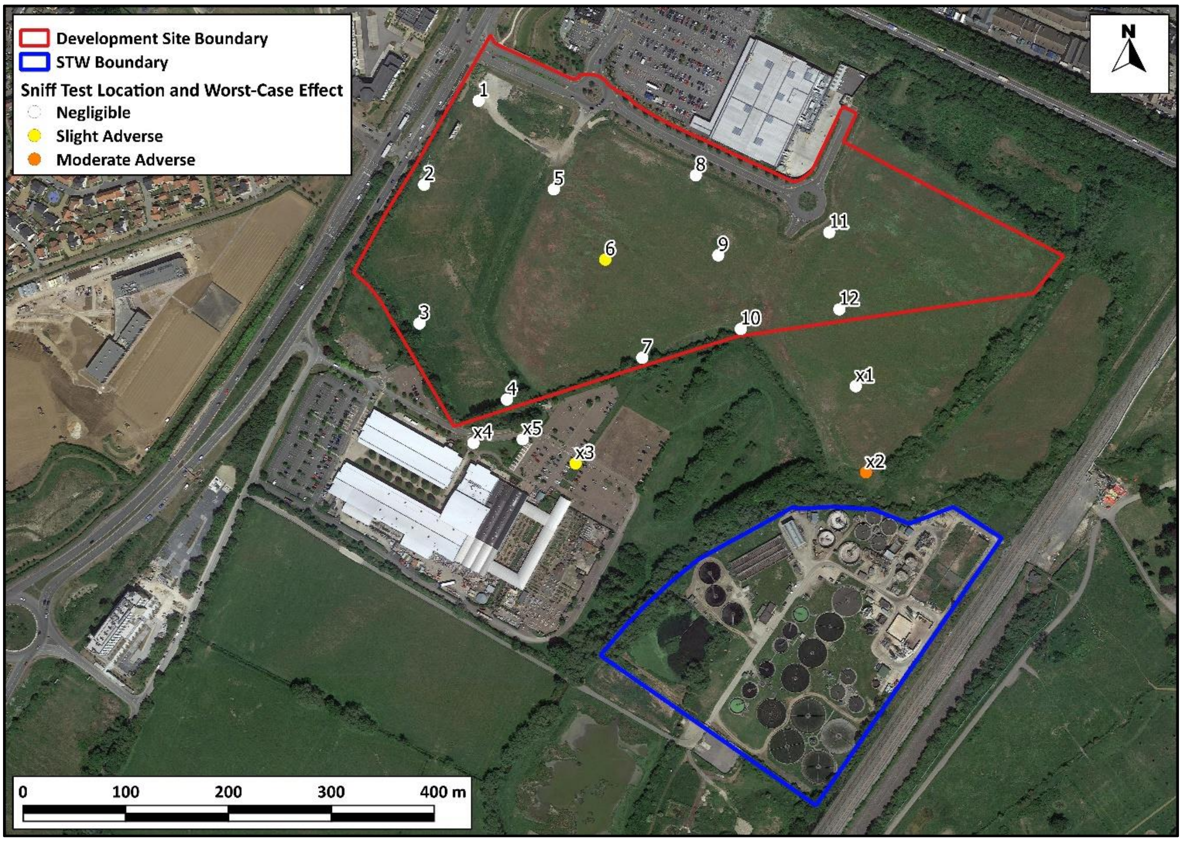

Figure 5: Sniff Test Results – 28th July 2022

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4.3 As summary of the sniff tests is set out below.

Sniff Test Results – 20 July 2021

4.4 The first visit was undertaken during southerly and south-south-westerly winds with very warm temperatures reaching a high of 28ºC; these conditions are conducive to worst-case odour conditions from the STW. The winds were light throughout the tests, varying from still to 2.5 m/s. The weather conditions also demonstrate that the STW was likely to be receiving influent wastewater at or below Dry Weather Flow (DWF); DWF is the typical influent rate when the wastewater is much less diluted, and thus more odorous, than during conditions with elevated rainfall.

4.5 At the majority of test locations, the assessor did not detect any odours. At locations 12 and 13, however, the assessor noted "*easily identifiable sewage odours*" which were described as being "*unpleasant*". These odours, however, were very intermittent resulting in slight adverse effects at these locations. At location X2, which is located adjacent to the STW and outside of the site boundary, and was assessed at the end of the surveys, the assessor recorded "*very strong sewage odours*" with a maximum intensity of '5'; the frequency of these odours resulted in a moderate adverse effect.

Sniff Test Results – 3 August 2021

4.6 Conditions during the second visit were again conducive to worst-case odour conditions; temperatures were warm (reaching 19ºC), and winds were southerly and south-south-easterly and light.

4.7 Odours relating to the STW were not detected by the assessor at the majority of locations during both surveys. Sewage odours were detected at locations 1 and 10-14; however, the frequency, duration and intensity of these odours was low enough to result in negligible effects at all locations. At locations X1 and X2, which are located offsite and close to the STW, the assessor recorded "*very strong sewage odours*" with a maximum intensity of '5'; however, the frequency of these odours was low, and thus the effects at these locations was slight adverse.

Sniff Test Results – 8 September 2021

4.8 During the third site visit, temperatures were warm (reaching 19ºC), and winds were south-easterly to east-south-easterly and gusty, reaching speeds of up to 5.2 m/s.

4.9 Odours described by the assessor as being "*sewage*" in character with a maximum intensity of '4' were detected during gusts of winds at two locations within the proposed development, resulting in a slight adverse effect at location 6. The odour effects at all other locations was negligible. Closer to the STW at locations offsite, sewage odours were detected resulting in slight adverse effects.

Sniff Test Results – 28 July 2022

4.10 During the third site visit, temperatures were warm (reaching 23ºC), and winds were south-easterly to east-south-easterly, reaching speeds of up to 2.5 m/s.

4.11 Odours described by the assessor as being related to the STW with a maximum intensity of '4' were detected at two locations within the proposed development. However, the odours were intermittent and generally only detected on gusts of wind, resulting in negligible effects at all but one location where the effect was slight adverse. The assessor also noted that, at times, it was difficult to ascertain whether the stronger, unpleasant odours were being generated by the STW or from nearby agriculture. Nevertheless, any unpleasant odours that were detected have been attributed to the STW to provide a conservative assessment. In terms of the offsite locations closer to the STW - comparable to the previous surveys - strong sewage odours were detected with maximum intensities up to 5, resulting in a moderate adverse and slight adverse effect at locations X2 and X3, respectively.

Summary

4.12 Odours from the STW were not detected at significant levels across the development site; they were intermittent and low enough in intensity to result in negligible effects at most locations. Furthermore, it should also be noted that the sniff tests were all undertaken during meteorological conditions which were conducive to elevated odour generation from the STW and thus worst-case for the sniff tests; warm temperatures with light winds, and low rainfall in the days preceding the tests resulting in influent levels at the works being close to, or below, DWF.

4.13 Whilst some slight adverse effects are observed within the development site boundary, the IAQM guidance (IAQM, 2018) is clear that "*where the overall effect is greater than 'slight adverse', the effect is likely to be considered significant*". Thus, based upon the findings of the sniff tests, there are no significant adverse effects for medium sensitivity land use (i.e., commercial development) at any location at the development site. Based upon the results of the six field surveys, the odour effects at all locations within the development site are 'not significant'.

Odour Dispersion Modelling

Model Results

4.14 The results of the modelling undertaken by Thames Water's approved consultants are presented in Figure 6 below. The figure shows the modelled odour concentrations, with the 3 and 5 OU_E/m^3 concentration lines labelled. These can be used to determine the potential odour effects using the criteria in Table 4. It should be noted that the 1.5 OU_E/m^3 contour was not included in the model outputs in the report (Olfasense UK Ltd, 2022); Thames Water does not assess any land use against this criterion and uses the 5 OU_E/m^3 criteria for assessment against office use.

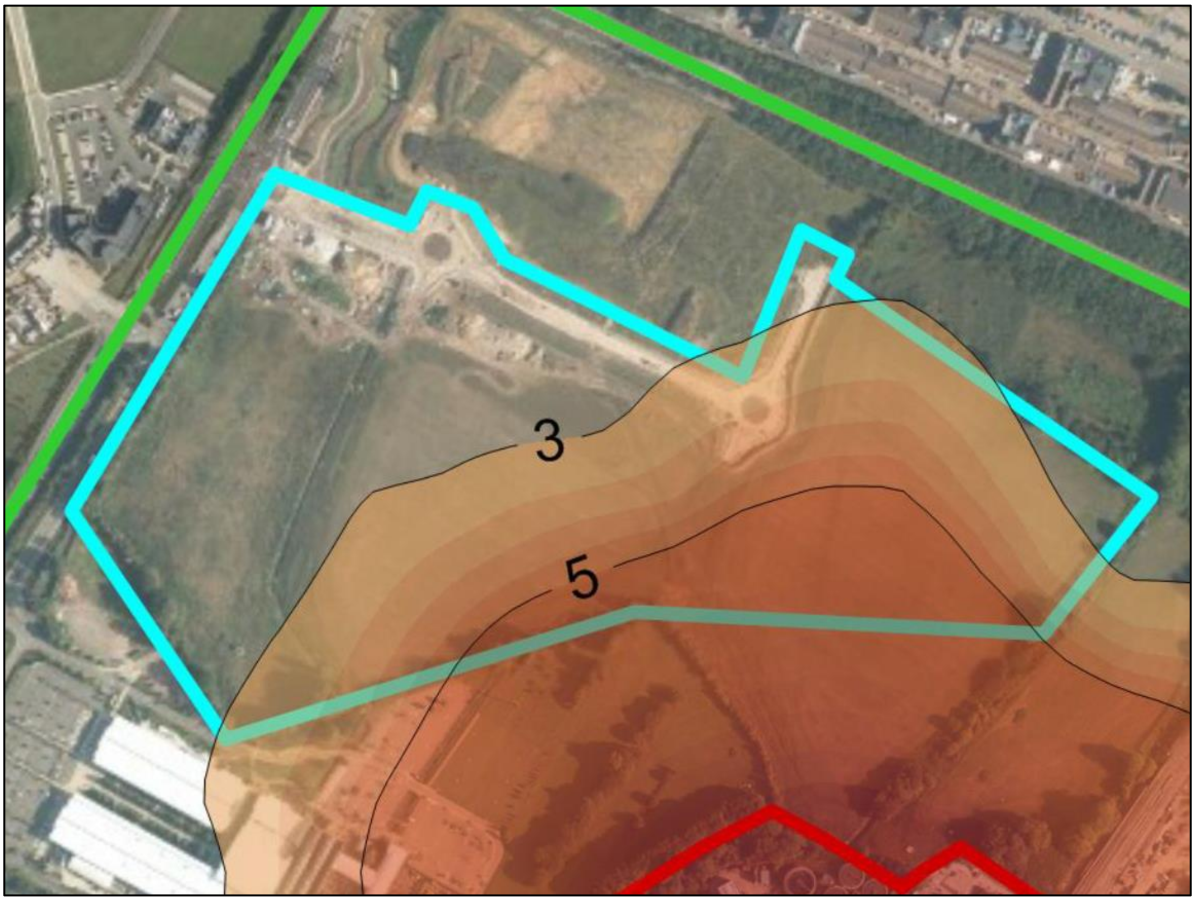

Figure 6: Contour plot of 98th Percentile of 1-hour Odour Concentrations (OU_E/m^3)

Image obtained from the odour report commissioned by Thames Water (Olfasense UK Ltd, 2022).

4.15 The odour contours have been reproduced and overlain onto a parameters plan of the proposed development, as shown in Figure 7.

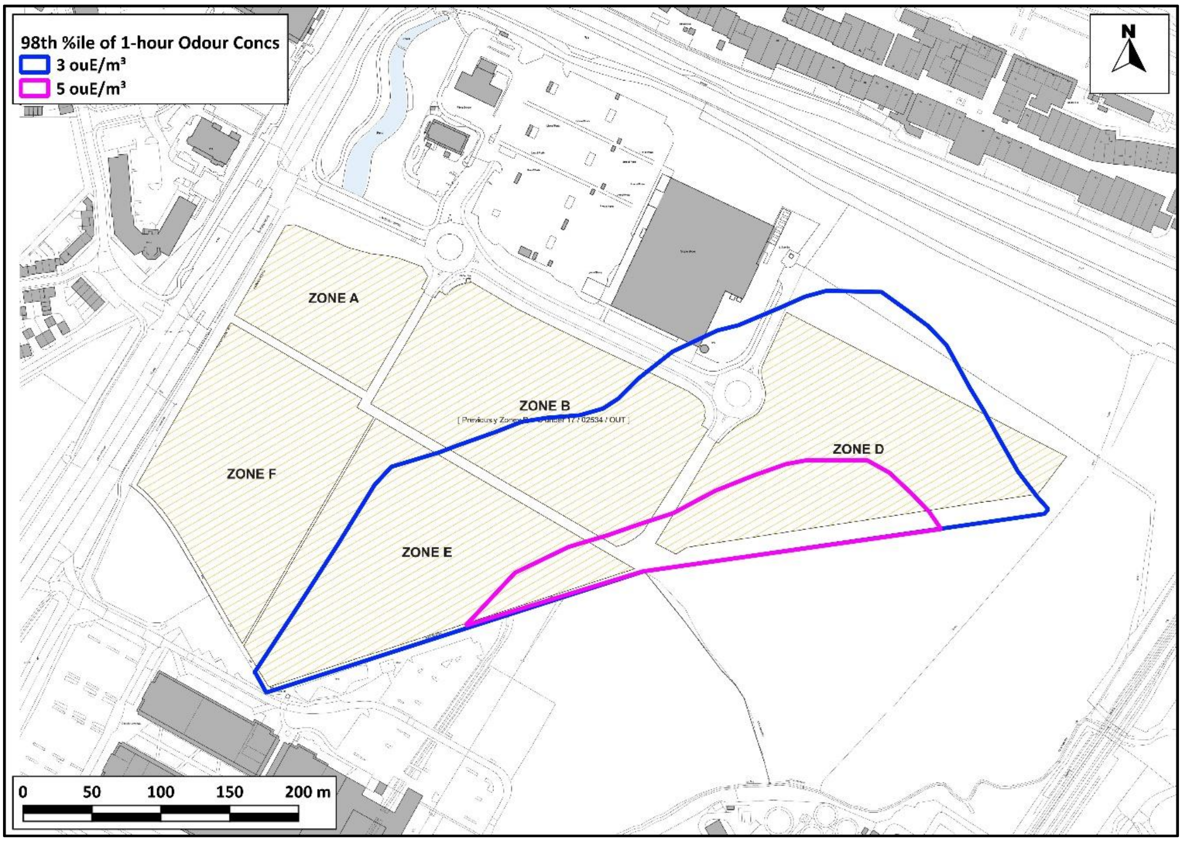

Figure 7: Contour plot of 98th Percentile of 1-hour Odour Concentrations Overlain on Development Parameters Plan

Contains section of 5plus Architect's drawing number 05935-5PA-MP-00-DR-A-9010.

Potential Odour Effects

4.16 As set out in Table 4, medium sensitivity development (e.g., commercial and office use) would be suitable within the 3 OU_E/m^3 contour (slight adverse and thus 'not significant'); however, odour effects within the 5 OU_E/m^3 contour would be moderate adverse and thus 'significant'. The report commissioned by Thames Water states the following:

"*Odour dispersion modelling of the current operations at the works indicates that odours from the STW pose a potential risk of odour impact across a proportion of the development land, with the C98, 1-hour = 5 OU_E/m^3 isopleth predicted to encompass approximately 12% of the land.*

Taking account of the proposed usage of the development land (commercial offices), any development in the area encompassed within the C98, 1-hour = 5 OU_E/m^3 isopleth is likely to be at risk of odour impact."

Overall Significance of Odour Effects

4.17 The results of the sniff tests undertaken by AQC demonstrate that there are no significant adverse effects for the office use at any location at the development site.

4.18 The results of the modelling study commissioned by Thames Water (Olfasense UK Ltd, 2022) demonstrate that approximately 88% of the development site is suitable for office development (i.e., commercial/office use); however, approximately 12% of the site lies within the 5 OU_E/m^3 and thus the odour effects at this location are moderate adverse and thus 'significant' if office buildings are located within this area. It should be noted that it would be acceptable to have car parking within the 5 OU_E/m^3 contour, as this represents a lower sensitivity and transient land use.

4.19 It is of AQC's professional judgement that the overall odour effects for the whole proposed development are 'not significant'. The overall judgement is made in accordance with IAQM guidance (IAQM, 2018), which states that the assessment of the significance of odour effects should be based on the drawing together of findings from multiple odour assessment tools, applying an appropriate amount of weight to each tool according to how well-suited it is to the study scenario in question. Whilst it is recognised that the modelling study predicts significant effects for a small area of the development site closest to the STW, the multiple sniff tests undertaken by AQC under worst-case meteorological conditions suggest that the model appears to be overpredicting and that odour effects are 'not significant' for commercial use at any location on the site. Nevertheless, it is recommended that the layout of the site be designed with consideration to odours, and that any commercial building located within the 5 OU_E/m^3 contour area be fitted with mechanical ventilation which draws air from roof level and/or the façades facing north or northwest, away from the STW, where odour concentrations will be lowest.

5 Summary

5.1 The odour effects of Bicester STW on the nearby proposed Bicester Arc development have been assessed using sniff testing (undertaken by AQC) and dispersion modelling (commissioned by Thames Water (Olfasense UK Ltd, 2022)).

5.2 The results of the sniff tests demonstrate that the site is suitable for commercial development, and that the odour effects will be 'not significant'. The dispersion modelling demonstrates that, whilst the vast majority of the site is suitable for the proposed land uses, a small area of land closest to the STW will experience 'significant' odour effects if developed for commercial use.

5.3 It is of AQC's professional judgement that the overall odour effects are 'not significant'. This overall judgement is made in accordance with IAQM guidance (IAQM, 2018), which states that the assessment of the significance of odour effects should be based on the drawing together of findings from multiple odour assessment tools, applying an appropriate amount of weight to each tool according to how well-suited it is to the study scenario in question. It is recommended, though, that the design of the proposed development is discussed with Thames Water during the planning application process.

6 References

Environment Agency (2011) *H4 Odour Management. How to comply with your environmental permit*.

HMSO (1990) *Environmental Protection Act 1990*.

IAQM (2018) *Guidance on the assessment of odours for planning v1.1*.

Ministry of Housing, Communities & Local Government (2021a) *National Planning Policy Framework*, Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/779764/NPPF_Feb_2019_web.pdf.

Ministry of Housing, Communities & Local Government (2021b) *Planning Practice Guidance*, Available: https://www.gov.uk/government/collections/planning-practice-guidance.

Olfasense UK Ltd (2022) *Odour impact assessment for land to the north west of Bicester sewage treatment works*.

7 Appendices

A1 Professional Experience

Laurence Caird, MEarthSci CSci MIEnvSc MIAQM

Mr Caird is a Technical Director with AQC, with over 17 years' experience in the field of air quality and odour management and assessment. He has carried out air quality and odour assessments for a wide range of residential and commercial developments, airports, industrial processes, road schemes and energy-from-waste installations throughout the UK and abroad. Mr Caird's experience in terms of odour assessment includes odours from poultry farms and other intensive livestock farming, wastewater treatment, brewing and distilling, meat processing, sugar refining, various processes using paints and solvents and a large number of commercial kitchens. He has acted as expert witness in relation to the assessment of air quality or odour impacts at a number of previous planning appeals, and is a contributory author to the IAQM's *Guidance on the assessment of odours for planning.*

Paul Outen, BSc (Hons) MIEnvSc MIAQM

Mr Outen is a Principal Consultant with AQC, with over 13 years' experience in the assessment of air quality and odours. He undertakes air quality and odour assessments covering residential and commercial developments, industrial installations, road schemes, energy centres and mineral and waste facilities. These involve qualitative assessments, and quantitative modelling assessments using the ADMS dispersion models, for both planning and permitting purposes. He has also acted as expert witness in relation to the assessment of odour impacts presented at public inquiries. Mr Outen has a particular interest in odour assessment, and has extensive experience in the assessment of odours across a wide range of industries throughout the UK, Europe and Asia. He also has experience in pollutant monitoring techniques. He regularly undertakes site audits for various installations to advise on pollution control and mitigation strategies. He is a Member of both the Institution of Environmental Sciences and Institute of Air Quality Management.

A2 Sniff Test Results

A2.1 The results of the individual field odour surveys from the site visits undertaken on the 3rd August 2021 and 8th September 2021 are shown in the figures below.

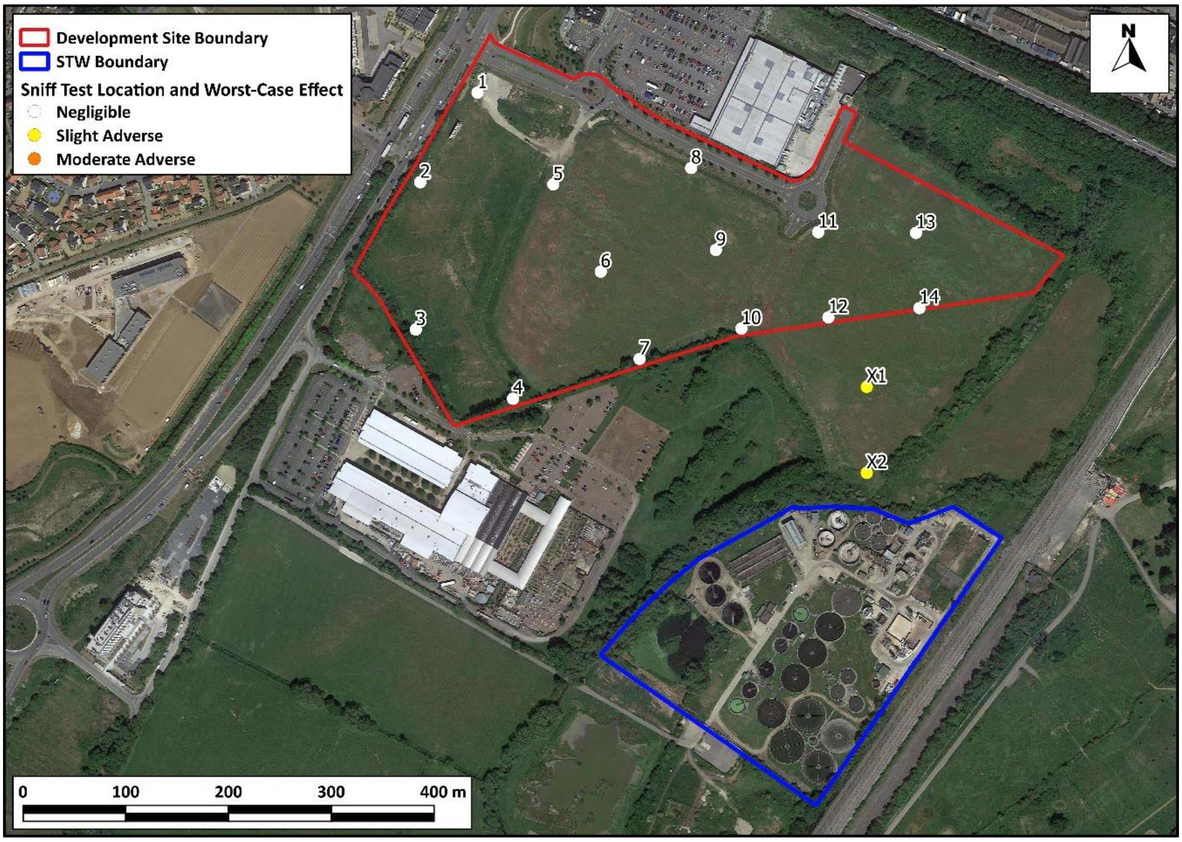

Figure A2.1: Sniff Test Results – 3rd August 2021 Survey 1

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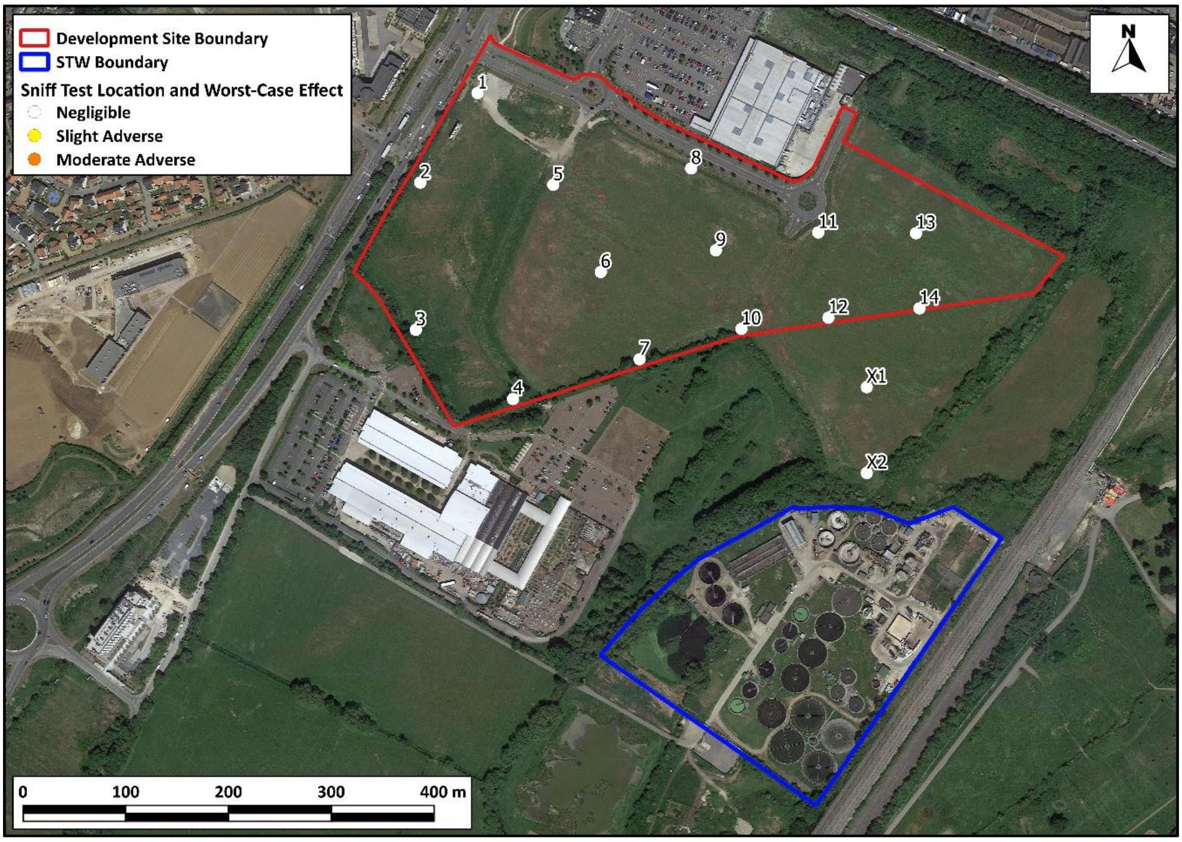

Figure A2.2: Sniff Test Results – 3rd August 2021 Survey 2

Imagery ©2023 Google.

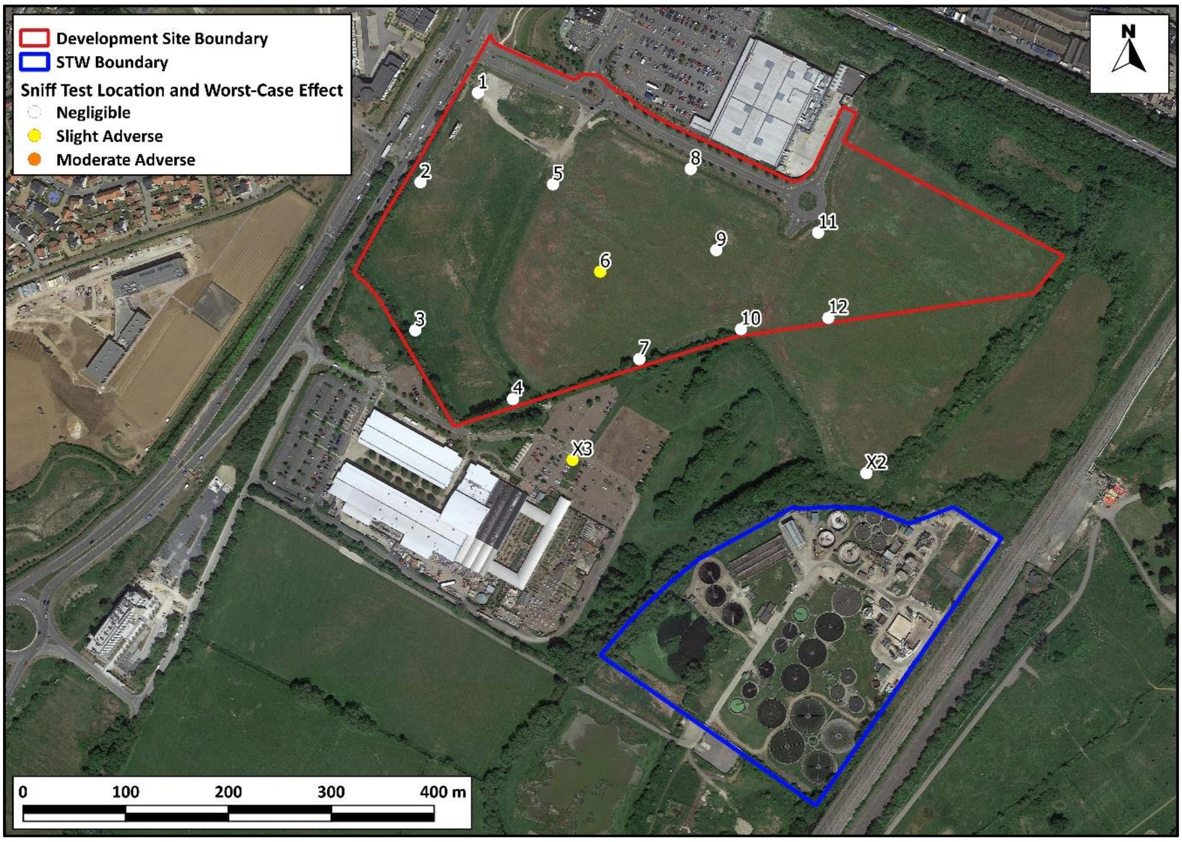

Figure A2.3: Sniff Test Results – 8th September 2021 Survey 1

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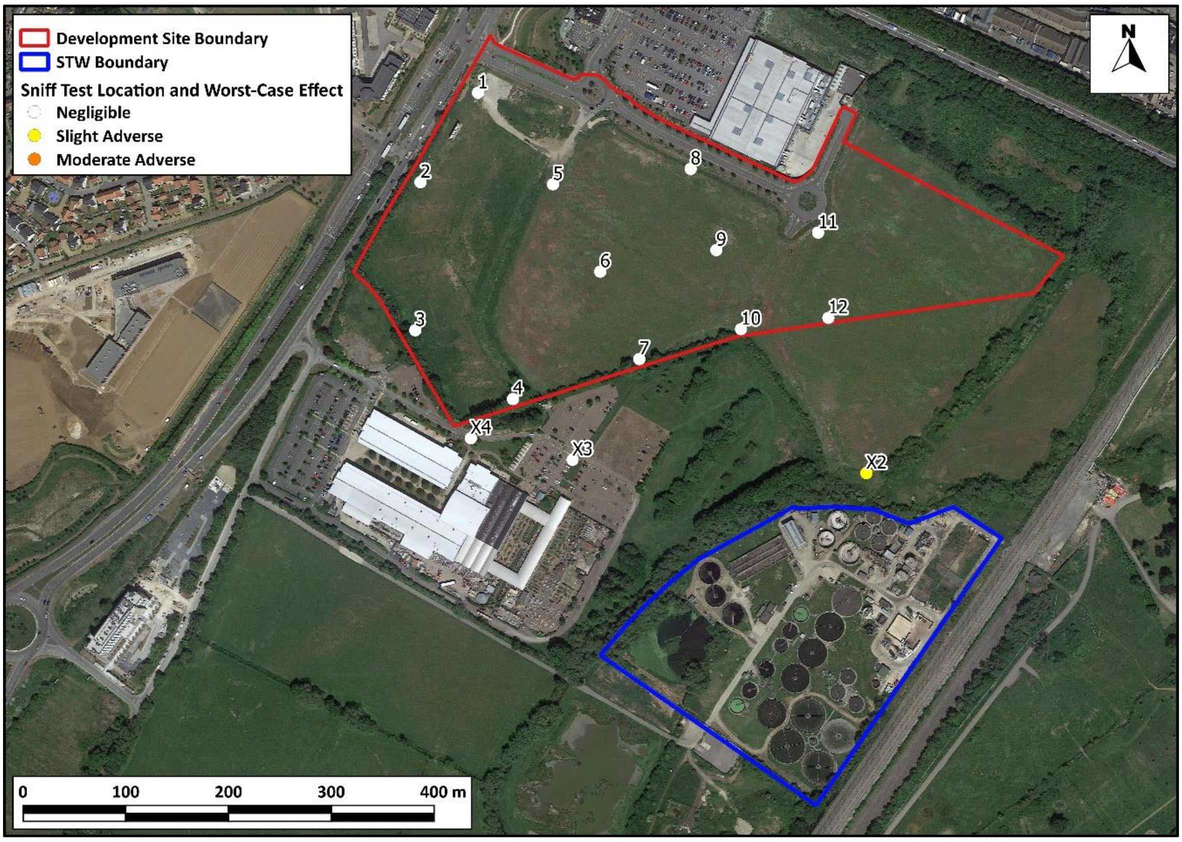

Figure A2.4: Sniff Test Results – 8th September 2021 Survey 2

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A3 Modelled Emission Rates (Olfasense UK Ltd, 2022)

A breakdown of the estimated odour emissions under summer conditions from each aspect of the sewage treatment process under current site operations is presented in the table below. The emission rates presented in the table have been adjusted to reflect the frequency of occurrence of each odour source and are hence 'time-weighted'.

Table 6: Contribution of emissions from each aspect of the treatment process

Stage of treatment	Source	Emission rate [ou_E/s]	Contribution to total site emissions
Preliminary Treatment	Pumping stations	754	1.5%
	Inlet channels	4533	8.8%
	Screens	546	1.1%
	Rag and grit skips	225	0.4%
Storm water	Pumping station and channels	1648	3.2%
	Screens and skip	113	0.2%
	Storm tanks (storm water)	2540	4.9%
	Storm tanks (retained sediment)	667	1.3%
Primary Treatment	Distribution channels	673	1.3%
	Primary settlement tanks	5859	11.3%
	Settled sewage	458	0.9%
Secondary Treatment	Activated sludge plant	1626	3.1%
	Primary filters (inc. distribution)	2730	5.3%
	Primary humus tanks	269	0.5%
	Secondary filters (inc. distribution)	1824	3.5%
	Secondary humus tanks	271	0.5%
Sludge storage and handling	PST desludge sumps	112	0.2%
	PFT feed PS	74	0.1%
	PFT	352	0.7%
	PFT supernatant chambers	306	0.6%
	PFT OCU	159	0.3%
	Blend tanks PS	86	0.2%
	Blend tanks	1484	2.9%
	Centrate sump	1046	2.0%
	Raw sludge hopper	230	0.4%
	Liming plant (conveyors and mixers)	3404	6.6%
	Limed sludge cake day pad	17183	33.2%
	Limed sludge cake daily export (Mon:Fri)	315	0.6%
	RAS/SAS handling	922	1.8%
	Humus sludge return PS	22	<0.1%
	Storm returns & sludge liquor PS	1328	2.6%
TOTAL		51759	100%