REC
Resource & Environmental Consultants Ltd

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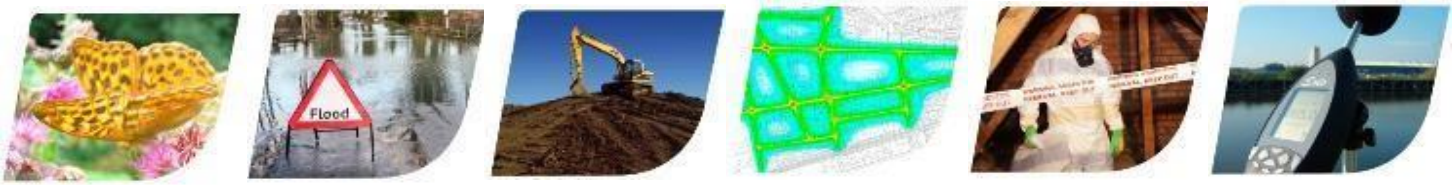
ODOUR ASSESSMENT

GILLOW HEATH, BIDDULPH

REC REFERENCE: AQ100222R3

REPORT PREPARED FOR: SEABRIDGE DEVELOPMENTS LTD

TH
DATE: 16 NOVEMBER 2015



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EXECUTIVE SUMMARY

Resource and Environmental Consultants Ltd was commissioned by Seabridge Developments Ltd to undertake an Odour Assessment in support of the potential development of land at Gillow Heath, Biddulph.

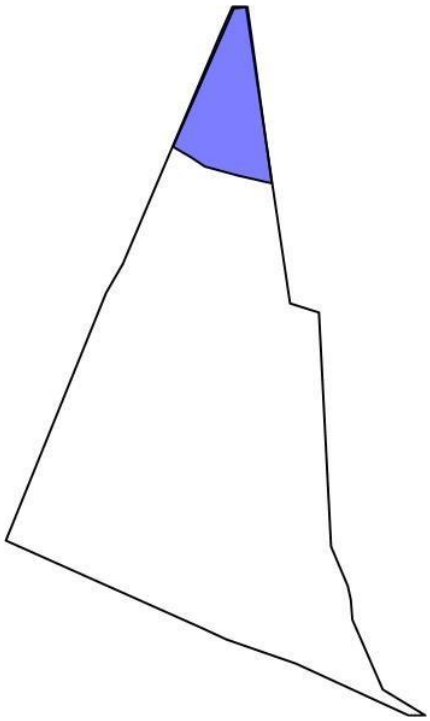
The proposed site is located in close proximity to the Biddulph Wastewater Treatment Works. As such, there are concerns that odour emissions from the facility may act as a constraint to development. An Odour Assessment has therefore been undertaken to quantify odour concentrations across the site and consider location suitability for residential use.

Potential odour emissions were determined utilising industry guidance. Impacts across the development site were quantified using dispersion modelling and the results compared with the relevant odour guidance criteria.

Predicted odour concentrations were below the relevant benchmark level across the majority of the site for all modelling years with approximately the top 5-10% of land potentially being constrained by odour. As such, it is considered that between 90-95% of the site is suitable for development with dwellings.

Based on the results of this assessment, it is considered that the vast majority of the site is suitable for residential use and odour issues should not be viewed as a constraint to planning consent.

Plan 1 produced hereunder shaded blue shows the extent of the site on which it is proposed to exclude the construction of houses.



Plan 1 Extent of area excluded from housing

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1.0 INTRODUCTION

1.1 Background

Resource and Environmental Consultants (REC) Ltd was commissioned by Seabridge Developments Ltd to undertake an Odour Assessment in support of the proposal for residential development of land at Gillow Heath, Biddulph.

The proposed site is located in close proximity to the Biddulph Wastewater Treatment Works (WwTWs). As such, there are concerns that odour emissions from the WwTWs may act as a constraint to development. An Odour Assessment has therefore been undertaken to quantify odour concentrations across the site and provide consideration of location suitability for residential use.

1.2 Site Location and Context

The proposed development is located in Gillow Heath, to the south of the Biddulph WwTWs, at National Grid Reference (NGR): 388550, 358830. Reference should be made to Figure 1 for a map of the site and surrounding area.

The site is located in close proximity to the Biddulph WwTWs. Reference should be made to Figure 1 for a map of the WwTWs in the context of the proposed development.

The site and surroundings are situated on a relatively flat gradient. There are areas of vegetation on all boundaries of the WwTWs, which provides a visual screen between the facility and the proposed development.

The operation of WwTWs can result in odour emissions as an effect of the biological processes that occur on site. These have the potential to cause nuisance or loss of amenity, particularly when new exposure is introduced into an area. In order to consider the extent of any impacts associated with the Biddulph WwTWs, and how these may affect development of the site, an Odour Assessment has been undertaken. The results are detailed in the following report.

1.3 Limitations

This report has been produced in accordance with REC's standard terms of engagement. REC has prepared this report solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from REC; a charge may be levied against such approval.

2.0 LEGISLATION AND POLICY

2.1 Odour Legislation and Guidance

The following legislation and guidance was used in this assessment:

- H4: Odour Management, Environment Agency (EA), 2011;
- Odour Guidance for Local Authorities, Department for the Environment, Food and Rural Affairs (DEFRA), 2010; and,
- Guidance on the Assessment of Odour for Planning, Institute of Air Quality Management (IAQM), 2014.

2.2 Odour Definition

DEFRA guidance[1] defines odour as:

> "An odour is the organoleptic attribute perceptible by the olfactory organ on sniffing certain volatile substances. It is a property of odorous substances that make them perceptible to our sense of smell. The term odour refers to the stimuli from a chemical compound that is volatilised in air. Odour is our perception of that sensation and we interpret what the odour means. Odours may be perceived as pleasant or unpleasant. The main concern with odour is its ability to cause a response in individuals that is considered to be objectionable or offensive.
>
> Odours have the potential to trigger strong reactions for good reason. Pleasant odours can provide enjoyment and prompt responses such as those associated with appetite. Equally, unpleasant odours can be useful indicators to protect us from harm such as the ingestion of rotten food. These protective mechanisms are learnt throughout our lives. Whilst there is often agreement about what constitutes pleasant and unpleasant odours, there is a wide variation between individuals as to what is deemed unacceptable and what affects our quality of life."

2.3 Odour Impacts

The magnitude of odour impact depends on a number of factors and the potential for complaints varies due to the subjective nature of odour perception. The **FIDOR** acronym is a useful reminder of the factors that will determine the degree of odour pollution:

- Frequency of detection - frequent odour incidents are more likely to result in complaints;
- Intensity as perceived - intense odour incidents are more likely to result in complaints;
- Duration of exposure - prolonged exposure is more likely to result in complaints;
- Offensiveness - more offensive odours have a higher risk of resulting in complaints; and,
- Receptor sensitivity - sensitive areas are more likely to have a lower odour tolerance.

It is important to note that even infrequent emissions may cause loss of amenity if odours are perceived to be particularly intense or offensive.

The **FIDOR** factors can be further considered in conjunction with the following in regards to the potential for an odour emission to cause a nuisance:

- The rate of emission of the compound(s);

[1] Odour Guidance for Local Authorities, DEFRA, 2010.

- The duration and frequency of emissions;
- The time of the day that this emission occurs;
- The prevailing meteorology;
- The sensitivity of receptors to the emission i.e. whether the odorous compound is more likely to cause nuisance, such as the sick or elderly, who may be more sensitive;
- The odour detection capacity of individuals to the various compound(s); and,
- The individual perception of the odour (i.e. whether the odour is regarded as unpleasant). This is greatly subjective, and may vary significantly from individual to individual. For example, some individuals may consider some odours as pleasant, such as petrol, paint and creosote.

2.4 Odour Measurement

The concentration at which an odour is just detectable to a "typical" human nose is referred to as the "threshold" concentration. This concept of a threshold concentration is the basis of olfactometry in which a quantitative sensory measurement is used to define the concentration of an odour. Standardised methods for measuring and reporting the detectability or concentration of an odour sample have been defined by European standard BS:EN 13725:2003. The concentration at which an odour is just detectable by a panel of selected human "sniffers" is defined as the detection threshold and has an odour concentration of 1 European odour unit per cubic metre ($1ou_E/m^3$).

At the detectability threshold, the concentration of an odour is so low that it is not recognisable as any specific odour at all, but the presence of some, very faint, odour can be sensed when the "sample" odour is compared to a clean, odour-free sample of air.

For a simple, single odorous compound (e.g. hydrogen sulphide (H_2S)), the concentration of odour present in a sample of air can be expressed in terms of ppm, ppb or mg/m^3. More usually, odours are complex mixtures of compounds and the concentration of the mixture can be expressed in ou_E/m^3.

The concept of odour concentrations, as ou_E/m^3, is based on a correlation between a physiological response when odour is detected by the nose and exposure to a particular sample at a specific concentration. The results of this assessment are expressed in terms of a single number. The odour sample assessed can be one of many individual odorous substances or a complex mixture of many substances, and so the odour unit or concentration will vary between test samples. A defined measurement standard for the odour unit is prescribed in the BS:EN standard on olfactometry using n-butanol. This gas is used to select and calibrate odour panel members.

An odour at a strength of $1ou_E/m^3$ is in reality so weak that it would not normally be detected outside the controlled environment of an odour laboratory by the majority of people (that is individuals with odour sensitivity in the "normal" range - approximately 96% of the population[2]). As an odour becomes more concentrated, then it gradually becomes more apparent. Some guidance as to concentrations when this occurs can be derived from laboratory measurements of intensity. The following guideline values have been stated by DEFRA[3] to provide some context for discussion about exposure to odours:

[2] Code of Practice on Odour Nuisance from Sewage Treatment Works, DEFRA, 2006.

[3] Odour Guidance for Local Authorities, DEFRA, 2010.

- $1ou_E/m^3$ is the point of detection; $5ou_E/m^3$ is a faint odour; and, $10ou_E/m^3$ is a distinct odour.

It is important to note that these values are based on laboratory measurements and in the general environment other factors affect our sense of odour perception, such as:

- The population is continuously exposed to a wide range of background odours at a range of different concentrations, and usually people are unaware of there being any background odours at all due to normal habituation. Individuals can also develop a tolerance to background and other specific odours. In an odour laboratory the determination of detection threshold is undertaken by comparison with non-odorous air, and in carefully controlled, odour-free, conditions. Normal background odours such as those from traffic, vegetation, grass mowings etc, can provide background odour concentrations from 5 to $60ou_E/m^3$ or more;
- The recognition threshold may be about $3ou_E/m^3$, although it might be less for offensive substances or higher if the receptor is less familiar with the odour or distracted by other stimuli; and,
- An odour which fluctuates rapidly in concentration is often more noticeable than a steady odour at a low concentration.

2.5 Odour Benchmark Levels

2.5.1 Environment Agency: H4

There is no statutory limit in the UK for ambient odour concentrations, whether set for individual chemical species or for mixtures. However, the EA has issued guidance on odour[4] which contains indicative benchmark levels for use in the assessment of potential impacts from facilities regulated under the Environmental Permitting (England and Wales) Regulations (2010) and subsequent amendments.

Benchmark levels are stated as the 98th percentile (%ile) of hourly mean concentrations in ou_E over a year for odours of different offensiveness. In practice this is the 175th highest hourly average recorded in the year. This parameter reflects the previously described **FIDOR** factors, where an odour is likely to be noted on several occasions above a particular threshold concentration before an annoyance occurs. EA odour benchmark levels are summarised in Table 1.

Table 1 Odour Benchmark Levels

Relative Offensiveness of Odour	Benchmark Level as 98th %ile of 1-hour Means (ou_E/m^3)

[4] Odour Guidance for Local Authorities, DEFRA, 2010.

Most offensive odours: • Processes involving decaying animal or fish • Processes involving septic effluent or sludge • Biological landfill odours	1.5
Moderately offensive odours: • Intensive livestock rearing • Fat frying (food processing) • Sugar beet processing • Well aerated green waste composting	3.0
Less offensive odours: • Brewery • Confectionery • Coffee roasting • Bakery	6.0

2.5.2 Wastewater Industry Research

In addition to the levels shown in Table 1, the wastewater industry has published an in-depth study through United Kingdom Waste Industry Research (UKWIR) into the correlation between modelled odour impacts and human response (dose-effect) in 2001. This was based on a review of the correlation between reported odour complaints and modelled odour impacts in relation to nine Wastewater Treatment Works (WwTWs) in the UK with ongoing odour complaints. The findings of this research (and subsequent UKWIR research) indicated the following:

- At modelled exposures of below $5ou_E/m^3$ as a 98%ile of 1-hour means, complaints are relatively rare, at only 3% of the total registered;
- At modelled exposures between $5ou_E/m^3$ and $10ou_E/m^3$ as a 98%ile of 1-hour means, a significant proportion of total registered complaints occur; 38% of the total; and,
- The majority of complaints occur in areas of modelled exposure greater than $10ou_E/m^3$ as a 98%ile of 1-hour means, 59% of the total.

2.5.3 Chartered Institute of Water and Environmental Management

The Chartered Institute of Water and Environmental Management (CIWEM) has released a Position Statement on the Control of Odour which provides the guidance on likely response to odour concentrations. These are summarised in Table 2.

Table 2 CIWEM Odour Guidance

Odour Concentration as 98th Percentile of 1-hour Means (ou_E/m^3)	Response
Less than 3	Complaints are unlikely to occur and exposure below this level are unlikely to constitute significant pollution or significant detriment to amenity unless the locality is highly sensitive or the odour highly unpleasant in nature
5 - 10	Complaints may occur and depending on the sensitivity of the locality and nature of the odour this level may constitute a nuisance
Greater than 10	Complaints are highly likely and odour exposure at these levels represents an actionable nuisance

2.5.4 Planning Case Law

A $5ou_E/m^3$ impact criterion has been accepted as being appropriate in a number of WWTWs planning applications for avoidance of significant risk of annoyance and a low risk of nuisance (e.g. Newbiggin, JS Bloor Ltd, Leighton Linslade, etc).

2.5.5 Institute of Air Quality Management Guidance

The IAQM published the 'Guidance on the Assessment of Odour for Planning'[5] document on 20th May 2014. This guidance specifically deals with assessing odour impacts for planning purposes, namely potential effects on amenity. The assessment methodology outlined in the guidance has been utilised in throughout this report where relevant.

2.6 National Planning Policy

The National Planning Policy Framework[6] (NPPF) was published on 27th March 2012 and sets out the Government's core policies and principles with respect to land use planning, including odour. The document includes the following considerations which are relevant to this assessment:

> "The planning system should contribute to and enhance the natural and local environment by:
> […]
>
> Preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability."

The implications of the NPPF have been considered during the production of this report.

[5] Guidance on the Assessment of Odour for Planning, IAQM, 2014.

[6] National Planning Policy Framework, Department for Communities and Local Government, 2012.

3.0 METHODOLOGY

The Biddulph WwTWs may cause odour impacts at the site during normal operation. These were assessed in accordance with the following stages:

- Identification of odour sources;
- Quantification of odour emission rates;
- Dispersion modelling of odour emissions; and,
- Comparison of modelling results with relevant criteria.

The following Sections outline the methodology and inputs used for the assessment.

3.1 Dispersion Modelling

Dispersion modelling was undertaken using the United States Environmental Protection Agency (US EPA) dispersion model, AERMOD. AERMOD is a development from the ISC3 dispersion model and incorporates improved dispersion algorithms and pre-processors to integrate the impact of meteorology and topography within the modelling output. AERMOD is routinely used throughout the world for the prediction of pollutant dispersion and results are accepted within the UK by the EA and DEFRA.

The model utilises hourly meteorological data to define conditions for plume rise, transport and diffusion. It estimates the concentration for each source and receptor combination for each hour of input meteorology, and calculates user-selected long-term and short-term averages.

3.2 Modelling Scenarios

The scenarios considered in the modelling assessment are summarised in Table 3.

Table 3 Dispersion Modelling Scenarios

Parameter	Modelled As	
	Short Term	Long Term
Odour	98%ile 1-hour mean	-

3.3 Odour Sources

Potential odour sources were identified through desk top mapping. These are summarised in Table 4.

Table 4 Sources

Source	Shape	Exposed Area Per Unit (m^2)	Elevation (m)
Inlet Channel	Polygon	123.3	0
Storm Tanks 1	Rectangular	176.6	0
Source	**Shape**	**Exposed Area Per Unit (m^2)**	**Elevation (m)**
Storm Tanks 2	Rectangular	520.3	0
Aeration Lanes	Rectangular	554.8	0
Primary Tank 1	Circular	243.3	0
Primary Tank 2	Circular	243.3	0
Final Settlement Tank 1	Circular	307.9	0
Final Settlement Tank 2	Circular	191.1	0
Final Settlement Tank 3	Circular	191.1	0

Reference should be made to Figure 2 for a schematic of the Biddulph WwTWs.

3.4 Emissions

Consultation with Staffordshire Moorlands District Council (SMDC) indicated that the authority has no record of odour complaints from the Biddulph WwTWs, although the facility is located close to existing properties. Due to the lack of complaints, it is considered likely that minimal odour is being produced from the facility. As such, low emission rates were utilised from the UKWIR in accordance with best practice. These are summarised in Table 5.

Table 5 Odour Emission Rates

Source	Odour Emission Rate ($ou_E/m^2/s$)
Inlet Channel	20
Storm Tanks	2
Aeration Lanes	2
Primary Tanks	0.8
Final Settlement Tanks	0.3

3.5 Assessment Extents

Ambient concentrations were predicted over the area NGR: 388375, 358700 to 388755, 359080. One Cartesian grid with a resolution of 20m was used within the model to provide data suitable for plotting within the Surfer software package.

3.6 Site Sensitivity

The IAQM document 'Guidance on the Assessment of Odour for Planning'[7] provides guidance on the sensitivity of different land uses to odour impacts. The IAQM recommend that the assessor uses professional judgement to identify where on the spectrum between high and low sensitivity a receptor lies, taking into account the principles summarised in Table 6.

Table 6 Odour Receptor Sensitivity

Sensitivity	Description
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 would not reasonably expect to enjoy the same level of amenity as in their home; or, • People would not 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 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

The site is for residential development and in accordance with the IAQM guidance, the proposals are therefore considered to be of **high** sensitivity. This is because enjoyment of amenity would be expected and people would be present here regularly.

3.7 Terrain Data

[7] Guidance on the Assessment of Odour for Planning, IAQM, 2014.

Ordnance Survey Landform Panorama terrain data was included for the site and surrounding area in order to take account of the specific flow field produced by variations in ground height throughout the assessment extents. This was pre-processed using the dedicated function within AERMOD.

3.8 Meteorological Data

Meteorological data used in this assessment was taken from Manchester Airport meteorological station over the period 1st January 2012 to 31st December 2014 (inclusive). Manchester Airport meteorological station is located at NGR: 381744, 383958, which is approximately 26km north of

the proposed development. DEFRA guidance LAQM.TG(09)[8] recommends meteorological stations within 30km of an assessment area as being suitable for detailed modelling.

All meteorological data used in the assessment was provided in a pre-processed format by Atmospheric Dispersion Modelling (ADM) Ltd.

Reference should be made to Figure 3 for wind roses of the utilised meteorological data.

3.9 Significance of Odour Impacts

The significance of impacts was assessed through the interaction of the predicted 98th %ile of 1-hour mean odour concentrations and receptor sensitivity, as outlined in the IAQM guidance[9]. It should be noted that this document has been compiled on the assumption that the odour in question is at the offensive end of the spectrum. As shown in Table 1, odours from the WwTWs would fall into the 'moderately offensive' category as they are unlikely to be septic in nature. As such, the significance criteria has been adapted from the IAQM guidance[10] to reflect this odour type. The relevant adjusted assessment matrix is summarised in Table 7.

Table 7 Odour Impact

Odour Exposure Level as 98th %ile of 1-hour Means (ou_E/m^3)	Receptor Sensitivity		
	Low	**Medium**	**High**
Greater than 10	Moderate	Moderate	Substantial
5 - 10	Slight	Moderate	Moderate
3 - 5	Negligible	Slight	Moderate
1.5 - 3	Negligible	Negligible	Slight
0.5 - 1.5	Negligible	Negligible	Negligible
Less than 0.5	Negligible	Negligible	Negligible

The IAQM guidance[10] states that an assessment must reach a conclusion on the likely significance of the predicted impact. Where the overall effect is **moderate** or **substantial**, the effect is likely to be considered **significant**, whilst if the impact is **slight** or **negligible**, the impact is likely to be considered **not significant**. It should be noted that this is a binary judgement of either it is **significant** or it is **not significant**. This has been considered to determine the overall significance of potential odour impacts associated with the facility.

[8] Local Air Quality Management Technical Guidance LAQM.TG(09), DEFRA, 2009.

[9] Guidance on the Assessment of Odour for Planning, IAQM, 2014. [10]

Guidance on the Assessment of Odour for Planning, IAQM, 2014.

[10] Guidance on the Assessment of Odour for Planning, IAQM, 2014.

3.10 Modelling Uncertainty

Uncertainty in dispersion modelling predictions can be associated with a variety of factors, including:

- Model uncertainty - due to model limitations;
- Data uncertainty - due to errors in input data, including emission estimates, land use characteristics and meteorology; and,
- Variability - randomness of measurements used.

Potential uncertainties in model results have been minimised as far as practicable and worst-case inputs used in order to provide a robust assessment. This included the following:

- Choice of model - AERMOD is a commonly used atmospheric dispersion model and results have been verified through a number of studies to ensure predictions are as accurate as possible;
- Meteorological data - Modelling was undertaken using five annual meteorological data sets from the closest observation site to the facility to take account of worst-case conditions;
- Emission rates - Emission rates were utilised from UKWIR;
- Receptor locations - A Cartesian grid was included in the model to predict odour concentrations across the development site. Odour levels at any point within the assessment extents may be derived from the relevant Figure; and,
- Variability - All model inputs are as accurate as possible in order to ensure a robust assessment of odour concentrations.

Results were considered in the context of the relevant odour benchmark level. It is considered that the use of the stated measures to reduce uncertainty when necessary has resulted in acceptable model accuracy.

3.11 Consultation

Consultation was undertaken with Denis Colgan, a Pollution Control Officer at SMDC, to determine the number of complaints received by the Local Authority regarding the Biddulph WwTWs. On 19th October 2015, it was confirmed that SMDC have no records of any odour complaints against any water/waste water treatment facilities in Biddulph despite the nearest existing residential properties are only some 40m from the WwTWs and lie within the 3-10 ou_E/m^3 odour concentration prediction.

4.0 ASSESSMENT

Dispersion modelling of potential odour emissions was undertaken using the input data specified previously. Reference should be made to Figure 4 to Figure 6 for graphical representations of predicted odour concentrations for each modelled year. All concentrations referenced in the following paragraphs are presented as the 98%ile of 1-hour means.

The predicted odour concentrations using all three meteorological data sets are very similar and show comparable contour plots. The following analysis is therefore relevant to all results.

The proposed development is residential and is therefore considered to be a high sensitivity receptor in accordance with the IAQM guidance, as discussed in Section 3.6. The results indicate that the contour for the commonly accepted criteria of $3.0ou_E/m^3$ intrudes up to a maximum of approximately 50m over the north of the proposed development site, extending furthest during the 2013 scenario. As such, development within this small area may be constrained on the grounds of odour.

It should be noted that there are a number of existing dwellings located within the $3.0ou_E/m^3$ contour. Due to the lack of complaints received by the Local Authority it is likely that the model may be over estimating concentrations and actual odours from the site will be less.

5.0 CONCLUSION

REC Ltd was commissioned by Seabridge Developments Ltd to undertake an Odour Assessment in support of a proposed residential development at Gillow Heath, Biddulph.

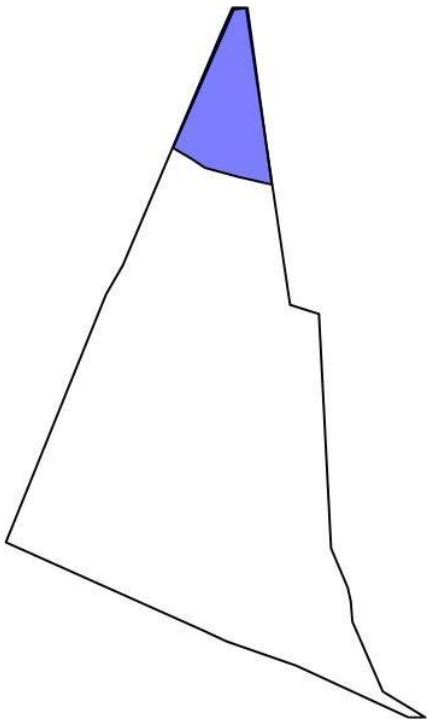
The proposed site is located in close proximity to the Biddulph WwTWs. As such, there are concerns that odour emissions from the WwTWs may cause loss of amenity for future users of the development and act as a constraint to development at this location. An Odour Assessment was therefore required to quantify odour concentrations across the development and provide consideration of the site suitability for residential use.

Emissions from the WwTWs were defined based on the UKWIR emissions. These were represented within a dispersion model produced using AERMOD. Impacts across the development site were quantified using three years of meteorological data for comparison with the relevant criteria.

Predicted odour concentrations were below the relevant EA odour benchmark level across the majority of the site for all modelling years. Approximately 90-95% of land is predicted to be outside of the $3.0ou_E/m^3$ contour and as such development of this area should not be constrained by odour issues.

Based on the results of this assessment, it is considered that the vast majority of the site is suitable for residential use and odour issues should not be viewed as a constraint to planning consent.

Plan 1 below shows coloured blue the extent of the site it is proposed to exclude the construction of houses.



Plan 1 Extent of area excluded from housing

6.0 ABBREVIATIONS

%ile	Percentile
ADM	Atmospheric Dispersion Modelling
CIWEM	Chartered Institute of Water and Environmental Management
DEFRA	Department for Environment, Food and Rural Affairs
EA	Environment Agency
H_2S	Hydrogen sulphide
IAQM	Institute of Air Quality Management
NGR	National Grid Reference
NPPF	National Planning Policy Framework
REC	Resource and Environmental Consultants
SMDC	Staffordshire Moorlands District Council
UKWIR	United Kingdom Waste Water Industry Research
US EPA	United States Environmental Protection Agency
WwTWs	Wastewater Treatment Works

APPENDIX I FIGURES

Legend

Site Boundary

Biddulph WwTWs

Title

Figure 1

Site Location

Project

Air Quality Assessment
Gillow Heath, Biddulph

Project Number

AQ100222

Client

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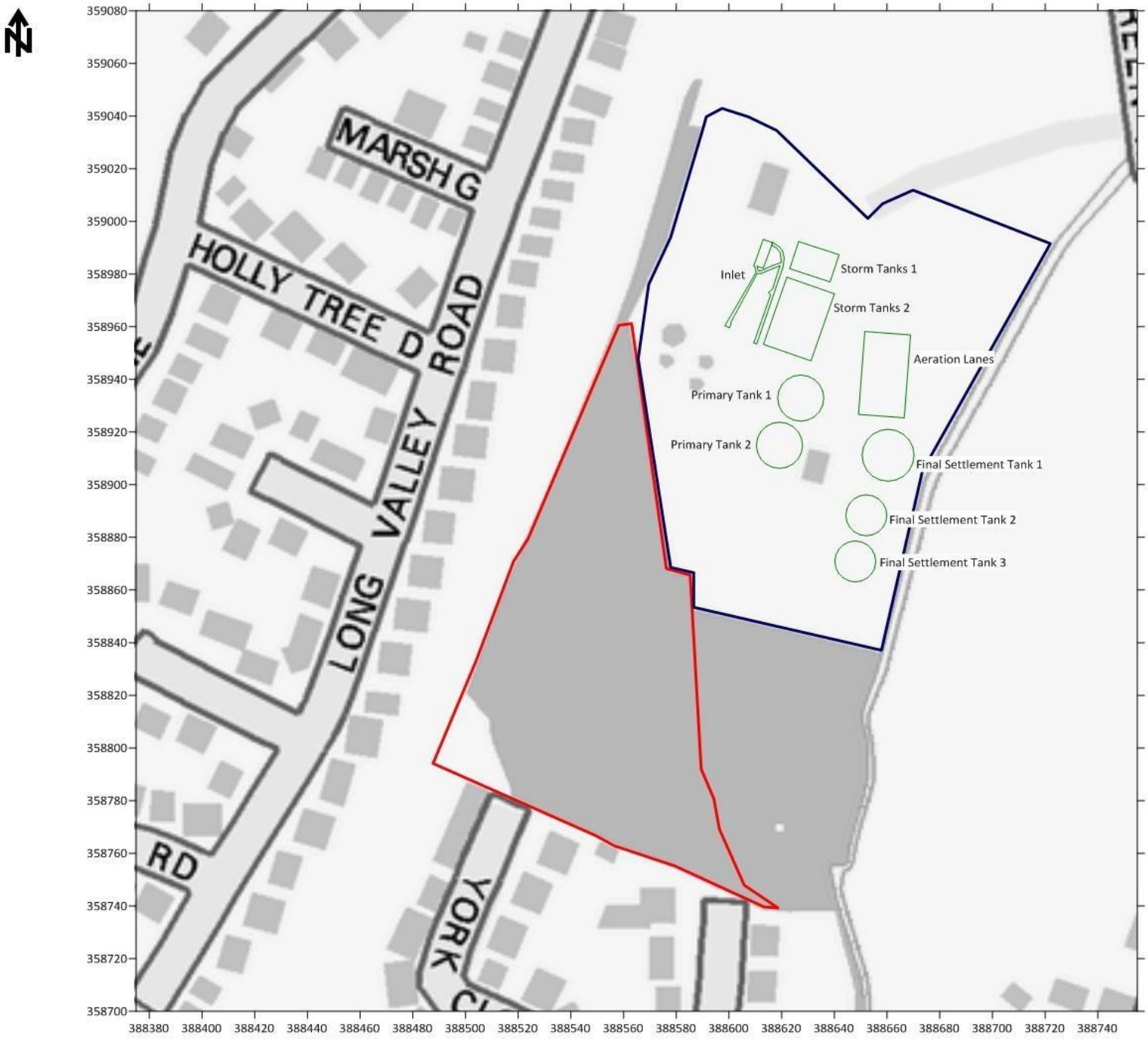

Legend

Site Boundary

Biddulph WwTWs

Odour Source

Title

Figure 2

Biddulph WwTWs Site Layout

Project

Air Quality Assessment
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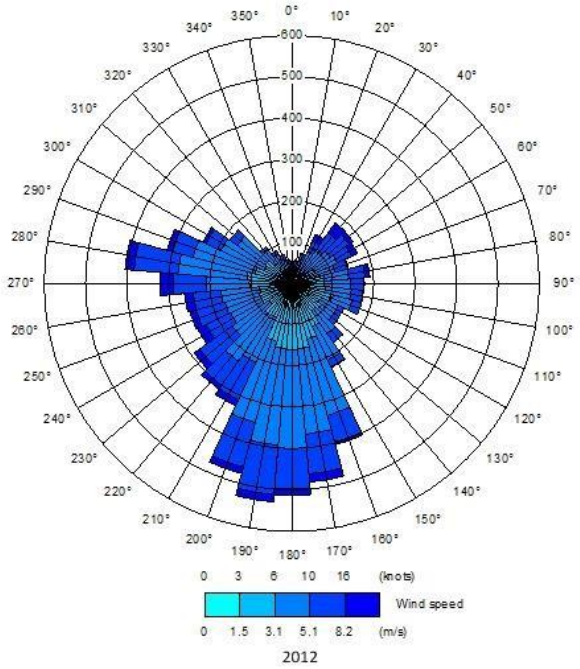
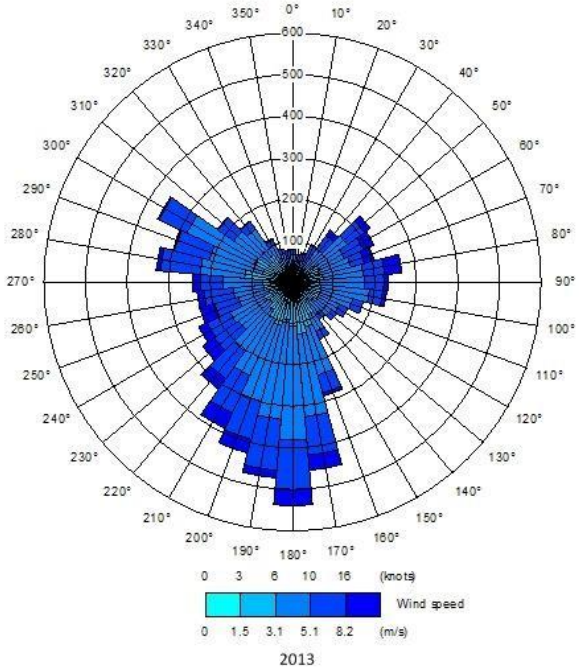
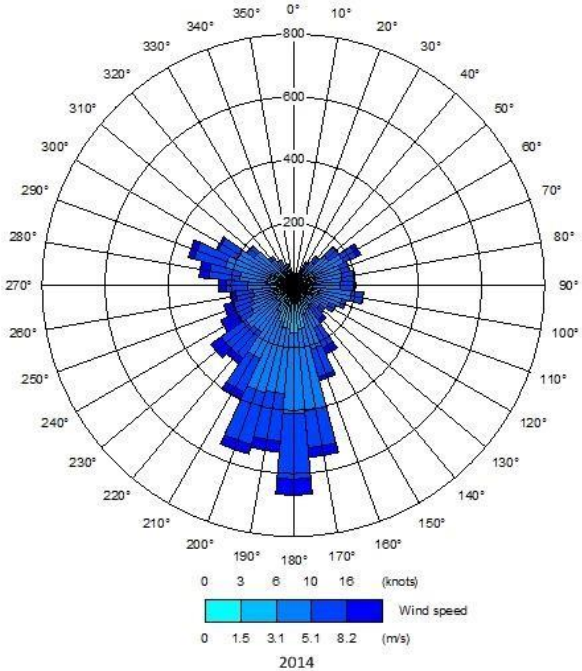


2012



2013



2014

Legend

Title

Figure 3

Wind Roses of 2012 - 2014
Manchester Airport Meterological Data

Project

Air Quality Assessment
Gillow Heath, Biddulph

Project Number

AQ100222

Client

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Resource and Environmental Consultants Ltd
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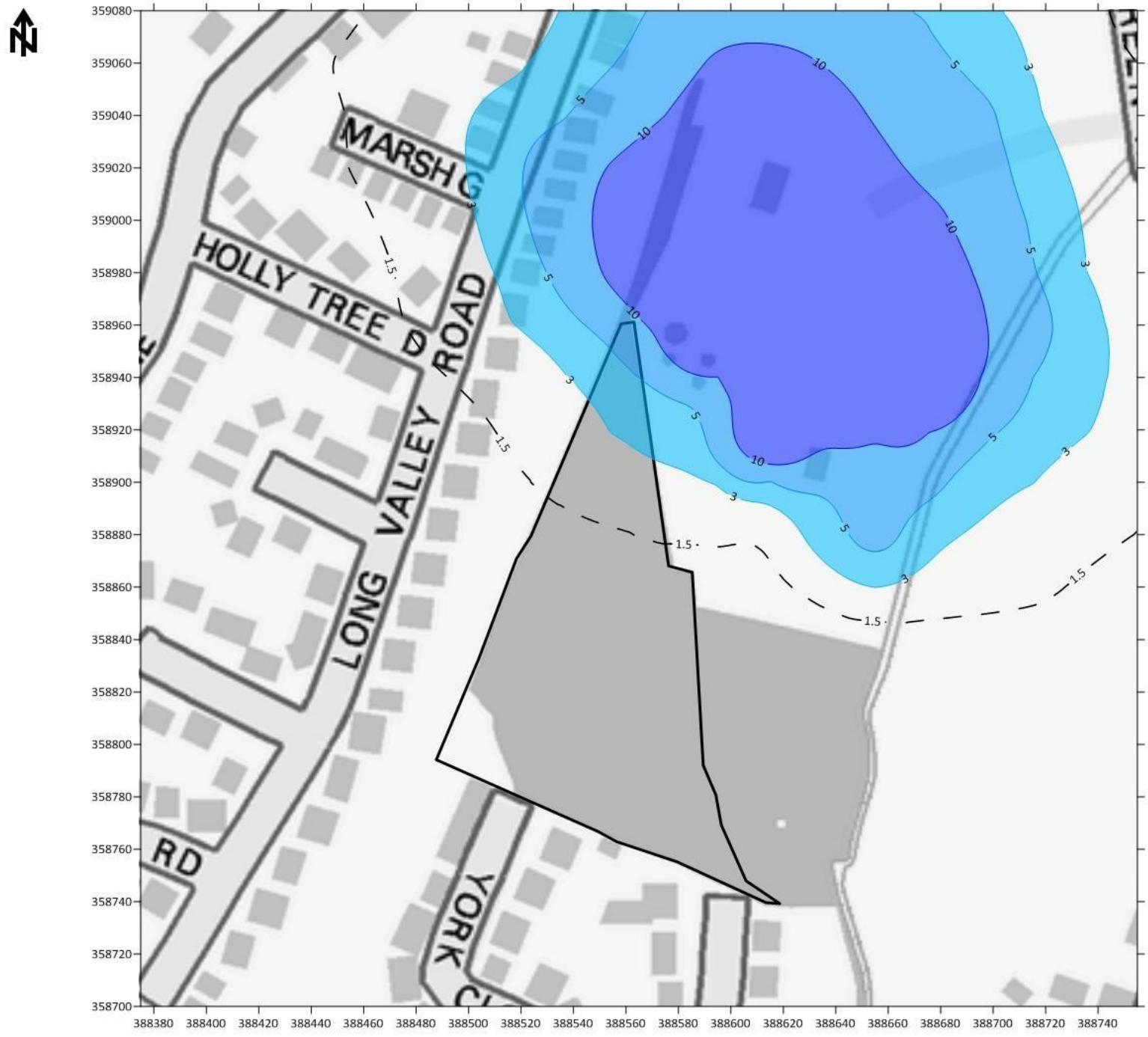

Legend

Site Location

10
5
3
1.5

Predicted 98%ile 1-hour Mean Odour Concentration (ou_E/m^3)

Title

Figure 4
Predicted 98%ile 1-hour Mean Odour Concentration (ou_E/m^3)
2012 Meteorological Data

Project

Air Quality Assessment
Gillow Heath, Biddulph

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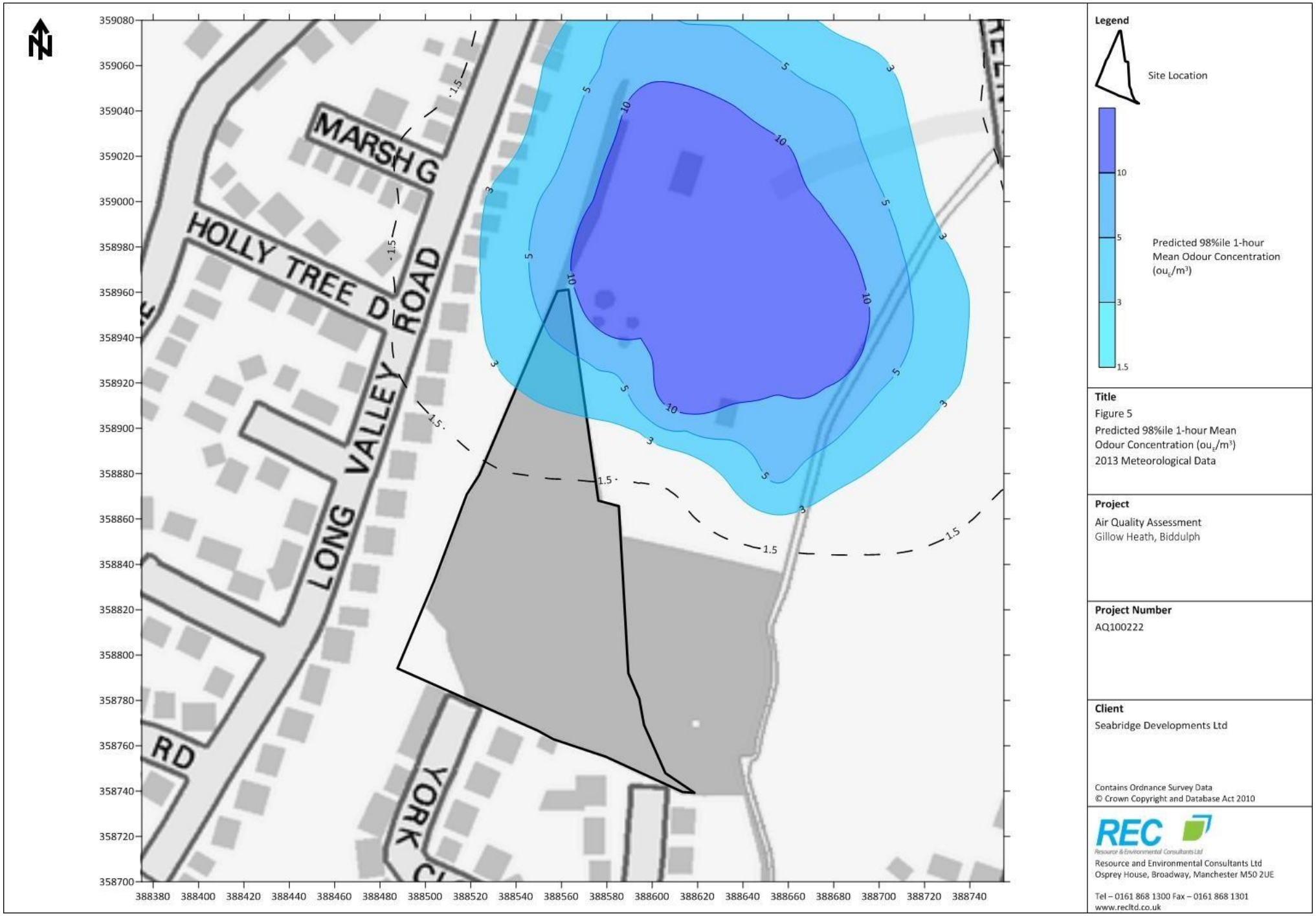

Legend

Site Location

10
5
3
1.5

Predicted 98%ile 1-hour Mean Odour Concentration (ou_E/m^3)

Title

Figure 5
Predicted 98%ile 1-hour Mean Odour Concentration (ou_E/m^3)
2013 Meteorological Data

Project

Air Quality Assessment
Gillow Heath, Biddulph

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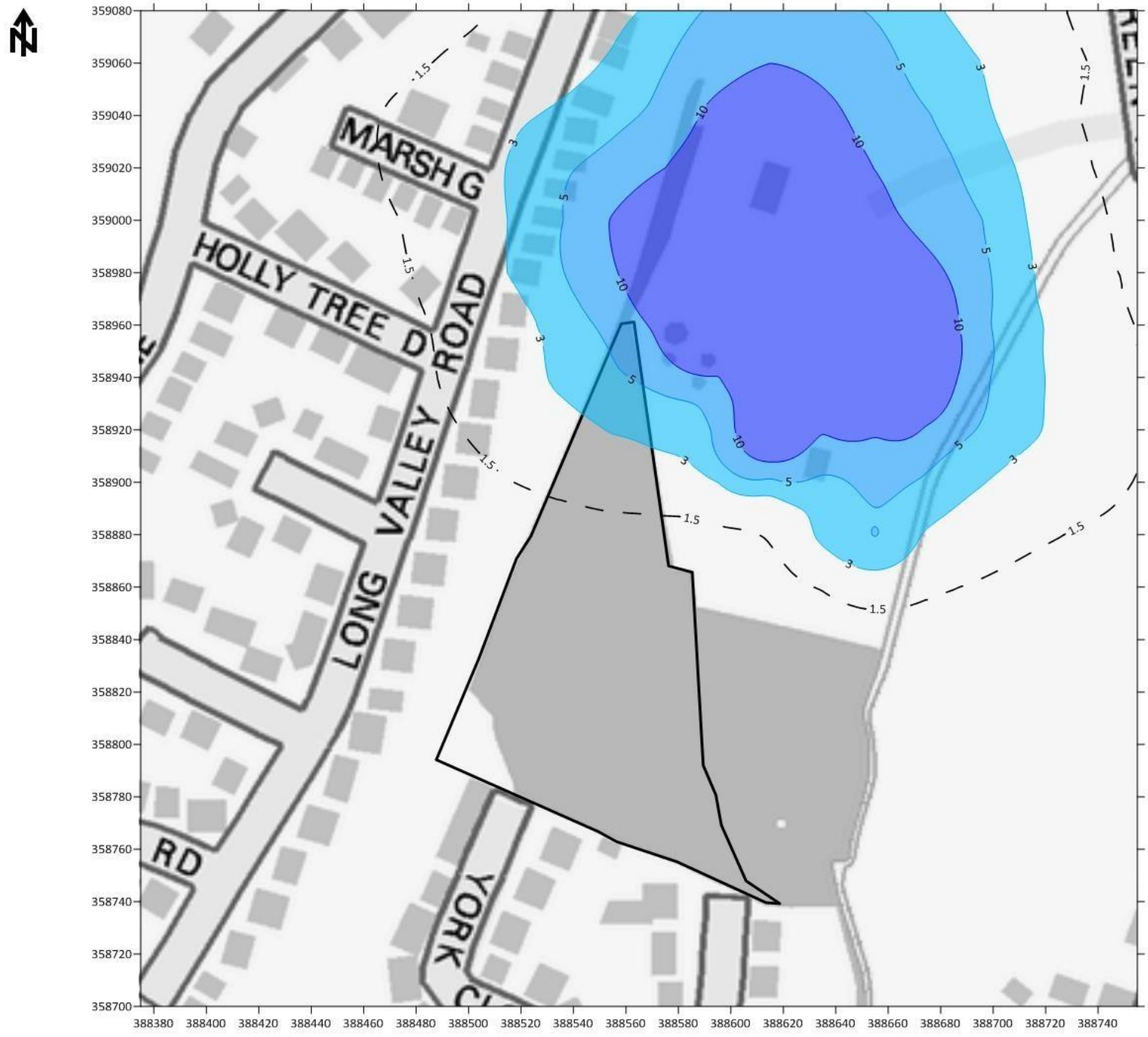

Legend

Site Location

Predicted 98%ile 1-hour Mean Odour Concentration (ou_E/m^3)

10
5
3
1.5

Title

Figure 6
Predicted 98%ile 1-hour Mean Odour Concentration (ou_E/m^3)
2014 Meteorological Data

Project

Air Quality Assessment
Gillow Heath, Biddulph

Project Number

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