

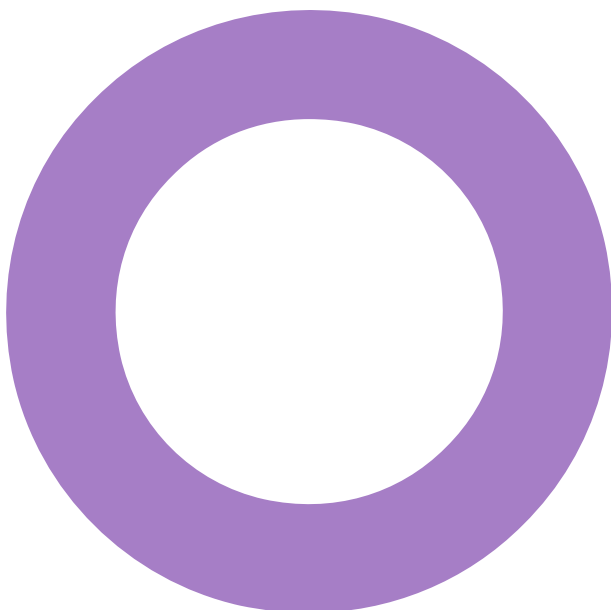
APPENDIX 11.1

ODOUR ASSESSMENT TECHNICAL REPORT

Land at Ford Airfield. Ford, West Sussex. Redrow Homes Southern and Wates Developments.

AIR QUALITY
QUANTITATIVE ODOUR ASSESSMENT

REVISION 05 – 18 FEBRUARY 2020



Audit sheet.

Rev.	Date	Description of change / purpose of issue	Prepared	Reviewed	Authorised
01	14/11/2018	First draft	MS/AD	CH	CR
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Executive summary

Barton Wilmore has appointed Hoare Lea to undertake a detailed odour impact assessment of the Ford Wastewater Treatment Works (WwTW) with the aim of predicting the potential odour impact at a proposed development on land at Ford Airfield. The site lies within the administrative authority of Arun District Council and West Sussex County Council. The WwTW is operated by Southern Water.

Dr Claire Holman of Hoare Lea contacted Arun District Council in May 2018 to agree the assessment approach. The details of the WwTW were confirmed through discussions with Southern Water at a site visit. Emissions data for sources agreed with Southern Water has been used as input to an atmospheric dispersion model. For this assessment the AERMOD model has been used with due consideration to the relevant guidance. Odour emission rates derived from H₂S monitoring data and 'worst case' published emission rates for emissions from the aeration lanes and final tanks have been used.

The odour impact isopleths (contours) for the WwTW are presented in drawings AQ1 and AQ2:

- Drawing AQ1 shows the odour impact isopleths 1.5ouE/m³, 3.0ouE/m³ and 5ouE/m³ based on the average 98th percentile values for 5 years of meteorological data;
- Drawing AQ2 shows the odour impact isopleths 1.5ouE/m³, 3.0ouE/m³ and 5ouE/m³ based on the maximum 98th percentile value for each grid point from 5 years of meteorological data.

Drawing AQ1 also shows a 100m standoff for 'calm conditions' which would not be accounted for in the dispersion model due to the wind having no direction.

The results of the assessment provide a buffer region where the odour impact associated with the WwTW is greater than the limit of C_{98,1-hour} 3 ouE/m³ at the Proposed Development under 'typical' operation. Receptors closest to this isopleth (contour) would be likely to experience odours from the works on occasion (i.e. they would not be 'odour free' however this would be below the C_{98,1-hour} 3 ouE/m³ limit based on the modelling inputs applied in this study.

1. Introduction

Barton Wilmore has appointed Hoare Lea to undertake a detailed odour impact assessment of the Ford Wastewater Treatment Works (WwTW) with the aim of predicting the potential odour impact at a Proposed Development on land at Ford Airfield. The Site lies within the administrative authority of Arun District Council and West Sussex County Council. The WwTW is operated by Southern Water.

1.1 Development Description

The village of Ford is located to the north east of the site, with the villages of Climping and Yapton located to the immediate south east and west of the site. The town of Littlehampton is located approximately 1.5km to the east of the site while Bognor Regis is located approximately 2km to the south west of the site.

The Site extends to approximately 86.63 hectares (ha) and predominantly comprises an area of land formerly used as an airfield. Large areas of the Site now comprise agricultural fields, separated by hedgerows and trees.

The proposals comprise the development of up to 1,500 dwellings (Use Class C3), 60-bed care home (Use Class C2), up to 9,000 sqm of employment floorspace (Use Classes B1), local centre of up to 2,350 sqm including up to 900 sqm retail / commercial (Use Classes A1-A5) and 1,450 sqm community / leisure floorspace (Use Classes D1-D2), land for a two-form entry primary school (Use Class D1), public open space, allotments, new sports pitches and associated facilities, drainage, parking and associated access, infrastructure, landscape, ancillary and site preparation works, including demolition of existing buildings and part removal of existing runway hardstanding.

1.2 Scope

This detailed assessment report only relates to odour from the WwTW and does not include assessment of the air quality impacts associated with construction or the traffic during operation of the Proposed Development. Similarly, this assessment does not assess the potential for odour impact from other sources adjacent to the Ford Airfield quantitatively, but a qualitative assessment of the odour impact of Grundon Waste Transfer Station, located to the east of the northern part of the site has been undertaken.

The sources of odour generation at the WwTW have been identified and the resultant release and impact on the surrounding locality estimated, using site monitoring data and dispersion modelling techniques to determine exposure in terms of European Odour Units (ouE/m³).

1.3 Objectives

The objectives of this assessment are as follows:

- To predict odour impacts from the Ford WwTW on future receptors sited within the Ford Airfield development; and
- To assess the significance of these impacts to inform the site masterplan.

2. Regulatory Standards and Guidance

In the UK there are no statutory numerical standards for assessing the acceptability of predicted odour impacts. Odour impact criteria are typically based upon guideline documents (predominately based on research from outside of the UK), case law and research which differ depending on the regime i.e. planning (to avoid significant detriment to amenity) or permitting (to avoid unacceptable pollution).

The numerical guidelines have largely been derived from the findings of a limited number of research studies where modelled odour impacts have been compared to the findings of quality of life surveys to provide a dose-effect relationship. These dose-effect studies have only been undertaken for a limited number of odour sources; however, they have been used as the foundation for the setting of acceptable odour standards in many countries.

In reality, the acceptable level of impact will be dependent on the nature (offensiveness) of the odour and the broad sensitivity of the population. To account for this, differing numerical guidelines are often set not only depending on the offensiveness of the odour but also the broad sensitivity of the environment.

2.1 The National Planning Policy Framework (NPPF)

The National Planning Policy Framework (NPPF)¹ sets out the Government's planning policies for England and how these are expected to be applied.

At the heart of the NPPF is a presumption in favour of sustainable development. It is described as providing a framework within which locally-prepared plans for housing and other development can be produced. It requires Local Plans to be consistent with the principles and policies set out in the Framework with the objective of contributing to the achievement of sustainable development.

Under paragraph 170(e), it 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 and water quality, taking into account relevant information such as river basin management plans."

2.2 IAQM Odour Guidance

In October 2018 the Institute of Air Quality Management (IAQM) released the latest version of its guidance on the assessment of odour for planning². The guidance is for assessing odour impacts for planning purposes. It provides background information relating to requirements for odour impact assessments and suitable impact criteria and draws from other sources of information such as that described in Environmental Permitting Regulations H4 horizontal odour guidance³.

The IAQM guidance identifies a range of odour impact criteria depending primarily on the nature of the odour (i.e. its pleasantness/unpleasantness) and the likelihood of causing unacceptable impacts based on the 98th percentile of predicted hourly average concentrations over a year. It is therefore evident that such criteria apply only to locations where an individual's exposure is likely to occur for prolonged periods of time i.e. residential properties. Where exposure is more transient (i.e. roads, footpaths etc.) the direct application of such criteria should be treated with caution and further consideration should be given to how the duration and frequency of exposure of the individual will influence the acceptability of the predicted impact.

¹ National Planning Policy Framework, Department for Communities and Local Governments, February 2019

² Bull et al (2018). IAQM Guidance on the assessment of odour for planning – version 1.1, Institute of Air Quality Management, London.
www.iaqm.co.uk/text/guidance/odour-guidance-2018

³ Environment Agency (March 2011) Additional guidance for H4 Odour Management. How to comply with your environmental permit.
GEHO0411BTQM-E-E

The IAQM Guidance describes the concept of the FIDOL factors, which affect public sensitivity to odours:

- Frequency;
- Intensity;
- Duration;
- Offensiveness; and
- Location.

The probability of disamenity occurring will be dependent upon the inter-relationship between each of these factors. For example, a less frequent but more offensive odour may (or may not) be more problematic than a more frequent but less offensive odour dependent upon the duration of exposure.

The IAQM Guidance suggest that, where possible, ‘multi-tool odour assessment’ of site suitability should be applied:

- Monitoring (e.g. sniff tests) can give a measure of odour at specific locations under the conditions prevailing at the times and days of the sampling, but cannot cover all receptor locations under every meteorological condition over a typical year;
- Complementing monitoring with dispersion modelling provides greater spatial and temporal coverage and the reasonableness of the estimates from the model can be compared with the observed (i.e. monitored) levels; and
- Modelling (and probably monitoring) is only likely to characterise normal operations of the odour source, whereas it is known that unexpected events (e.g. breakdowns) and abnormal operations at some facilities can account for a significant proportion of high odour episodes. If there are already receptors in the locality, analysis of historical complaints data can provide an alternative perspective on the impact that is inclusive of such unexpected events and abnormal operations.

The IAQM guidance provides odour effect descriptors for impacts predicted by modelling for the “most offensive” odours, as likely to be emitted by a WwTW, as shown below.

Odour Exposure Level $C_{95}, \text{ou}_E/\text{m}^3$	Receptor Sensitivity		
	Low	Medium	High
≥ 10	Moderate	Substantial	Substantial
5–10	Moderate	Moderate	Substantial
3–5	Slight	Moderate	Moderate
1.5–3	Negligible	Slight	Moderate
0.5–1.5	Negligible	Negligible	Slight
<0.5	Negligible	Negligible	Negligible

It should be noted that the Table applies equally to cases where there are increases and decreases in odour exposure as a result of this development, in which case the appropriate terms “adverse” or “beneficial” should be added to the descriptors.

- IAQM 2018

It can be seen that, for a high sensitivity receptor, such as a new residence, exposed to the most offensive odours in the range 1.5 to 5.0 ou_E/m^3 would be a ‘moderate’ odour effect. Moderate and substantial odour effects are generally considered to be a ‘significant’ adverse odour impact.

The IAQM guidance also provides odour effect descriptors for impacts predicted by modelling – “moderately offensive” odours, as shown below.

Odour Exposure Level C_{98} , ouE/m ³	Receptor Sensitivity		
	Low	Medium	High
≥10	Moderate	Substantial	Substantial
5-10	Slight	Moderate	Moderate
3-5	Negligible	Slight	Moderate
1.5-3	Negligible	Negligible	Slight
0.5-1.5	Negligible	Negligible	Negligible
<0.5	Negligible	Negligible	Negligible

It should be noted that the Table applies equally to cases where there are increases and decreases in odour exposure as a result of this development, in which case the appropriate terms "adverse" or "beneficial" should be added to the descriptors.

- IAQM 2018

It can be seen that, for a high sensitivity receptor odour in the range 3.0 to 10 ouE/m³ would constitute a 'moderate' odour effect and therefore a 'significant' adverse odour impact when odours of moderate offensiveness are experienced.

2.3 UK Planning Appeals

There have been a number of planning judgments specifically in relation to the acceptability of odour from WwTW on residential development; both in terms of encroachment of new housing in proximity to an existing WwTW and for new WwTW in proximity to existing housing.

Decisions in a number of planning appeals have accepted the use of an assessment criterion of the 98th percentile of 1-hour average ($C_{98, 1\text{-hour}}$) of 3 ouE/m³ and a $C_{98, 1\text{-hour}}$ 5 ouE/m³ as being sufficient to safeguard residential amenity near WwTW.

Odour concentrations within the $C_{98, 1\text{-hour}}$ 5 ouE/m³ contour and above has been found to be of perceived odour nuisance in the following planning appeal:

- Land at Stoke Road, Leighton Linsdale (APP/P0240/A/09/2110667) where the planning inspector suggested that a $C_{98, 1\text{-hour}}$ 5 ouE/m³ "could be a risk of regular and unacceptable odour annoyance to such an extent that it would detract from the future resident's living conditions."

Where odour concentrations are between $C_{98, 1\text{-hour}}$ 3 ouE/m³ and $C_{98, 1\text{-hour}}$ 5 ouE/m³, two planning appeals have considered these contour lines as having the potential to cause annoyance as follows:

- Land between Uphorpe Road and Hepworth Road, Stanton (APP/E3525/A/11/2162837) where the planning inspector stated that "annoyance levels producing complaints are subjective and can arise both at levels below 1.5 ouE/m³ and from events in the 2% frequency" and that "the appropriate threshold for this type of small [sewage treatment works] STW is more than the 1.5 ouE/m³ now promoted by [Anglian Water] and the Council." He considered "a more appropriate threshold in this case is 3-5 ouE/m³, the level of DEFRA guidance's "faint odour"."; and
- The Fitz, Cockermouth (APP/G0908/A/11/2151737) where the planning inspector concluded that "should odours fall within medium offensiveness, rather than low, the $C_{98, 1\text{-hour}}$ 3 ouE/m³ level modelled by the appellant indicated it would not impinge on the appeal dwellings."

In addition to consideration of disamenity, a number of planning appeals have also considered the proximity of the proposed development to existing sewage treatment works.

On the 1st March 2016 the decision on the appeal relating to 'Land South of Le Neubourg Way, Gillingham, Dorset' (Appeal Ref: APP/N1215/W/15/3005513) was released. This is the most recent appeal regarding odour and centred on a development north of Southern Water's Gillingham WwTW and included a significant and detailed discussion between two odour expert witnesses. The issues are described in some detail in the Inspector's report. In relation to odour criteria, the Inspector concluded the following:

"19. Taking all the above into account, I conclude that the appropriate parameter to apply in this case is the 3 ouE/m³ contour line; a more restrictive approach would preclude from development areas which are comparable in odour terms with extensive areas of existing housing in Gillingham. A less restrictive approach would permit development of areas which, in odour terms, clearly ought not to be developed."

Furthermore, the appeal decision notice for Haverhill Snooker Club, Chalkstone Way, Haverhill (APP/E3525/A/11/2145235) was released in 2011. The appeal site is located 40m within an existing sewage treatment works and *"lies within a predicted 1.5-3.0 ouE/m³ contour range"*. In this case, the planning inspector concluded that *"the existing sewage treatment works would not be likely to cause significant harm by reason of odour on future residential occupiers."*

The criteria used in this assessment is discussed further in Section 3.1 of this report.

2.4 Southern Water Guidance

Southern Water does not have any published guidelines relating to development near WwTW.

Southern Water has previously applied an impact criterion of between C_{98, 1-hour} 1.5 ouE/m³ and C_{98, 1-hour} 3 ouE/m³ as being sufficient enough to safeguard residential amenity. However, their current position, is that C_{98, 1-hour} 1.5 ouE/m³ is appropriate. This is lower than that adopted by other water companies and also that suggested as appropriate by the IAQM.

3. Assessment Methodology

3.1 General Approach

This odour assessment has been undertaken using the concept of the European Odour Unit (ou_E), as defined in BS EN 13725. This approach allows impact assessment of any odorous gas as it is independent of chemical constituents and centres instead on multiples of the detection threshold (i.e. the physiological response of a human) of the gas in question. This approach is consistent with the requirements of Southern Water.

The odour unit is a Standard Unit in the same way as gram or milligram, and the notation used in odour assessment follows the conventions of any pollutant:

- concentration: ou_E/m^3
- emission: ou_E/s
- specific emission (emission per unit area): $\text{ou}_E/\text{m}^2/\text{s}$

Like air quality standards for individual pollutants, exposure to odour is given in terms of a percentile of averages over the course of a year. The exposure criteria most accepted in the UK is given in terms of European Odour Units as a 98th percentile of hourly averages ($C_{98, 1\text{-hour}}$). This allows 2% of the year when the impact may be above the criterion (175 hours). The notation for impact is therefore: $C_{98, 1\text{-hour}} \times \text{ou}_E/\text{m}^3$.

3.2 Impact Screening

Using the IAQM Guidance document, it is possible to assess the significance the potential odour impact in qualitative terms using the source-pathway-receptor approach. The 'risk factors' for the Ford WwTW are as follows:

- Medium source odour potential as this is a medium sized WwTW;
- Highly effective pathway for odour flux to receptor as a result of the near ground level odour releases and receptors within 200m;
- High receptor sensitivity (residences) as well as medium sensitivity locations (amenity locations).

The risk of odour exposure at a specific receptor location will be 'medium risk' and the likely magnitude of the odour effect at the specific receptor location will be 'moderate' using this method. As described above, where the overall effect is 'moderate', the effect is likely to be considered 'significant'.

For this reason, the impact may not be screened out and a detailed odour dispersion modelling approach is required for the quantitative prediction of impact. Detailed odour modelling is also consistent with the requirements of Southern Water in this case and for the previous planning applications at this site.

3.3 Site Visit

Mr Matthew Stoeing of Isopleth Ltd visited the Ford WwTW on behalf of Hoare Lea, on the 14th June 2018. The weather on the day was warm ($>20^\circ\text{C}$) with a south westerly breeze of approximately 5-10 m/s. The site visit was conducted by Mr Craig Radoki-Smith Field Performance Manager (Site Manager) East Worthing and Ford WR&EP (Central). Mr Radoki-Smith explained the operation of the site and subsequently provided additional information relating to the hydrogen sulphide (H_2S) monitoring undertaken at the odour control stacks.

The IAQM suggests the use of a 'multi-tool' approach, where possible. At the time of assessment, the Ford WwTW was the subject of refurbishment works. For this reason, it was not appropriate to undertake formal 'sniff testing' in the area surrounding the WwTW during these works as this would not represent the odour for any future resident. Monitoring data from the odour control plant treating air extracted from the most offensive sources of odour on the site has been provided by Southern Water and used in this odour assessment. No further monitoring of the aeration lanes / final tanks has been undertaken as these are not expected to represent a significant odour constraint at this (or any) site.

3.4 Arun District Council Consultation

Dr Claire Holman of Hoare Lea contacted Arun District Council in May 2018 to agree the assessment approach. Mr Colin Giddings, Senior Environmental Health Officer at Arun District Council was in agreement that the assessment methodology be based on the IAQM odour guidance and agreed with Southern Water. Mr Giddings also agreed with the use of meteorological data from Shoreham Airport for use in the odour assessment.

3.5 Southern Water Consultation

The dispersion modelling inputs were discussed during the site visit on 14th June 2018 and subsequently sent for agreement with Mr Craig Radoki-Smith and Mr Gong Yang Lead Technical Expert, Odour Control Engineering Solutions at Southern Water.

Southern Water has confirmed that:

- The WwTW is largely covered, with odorous air extracted to odour control;
- The site undertakes continuous H₂S monitoring at the odour control stacks; and
- That detailed dispersion modelling is a suitable assessment method.

3.6 Quantification of Odour Impact

Emissions data for sources agreed with Southern Water has been used as input to an atmospheric dispersion model. For this assessment the AERMOD model has been used with due consideration to relevant guidance. This model is widely used and accepted by the EA and UK planning authorities for undertaking such assessments and its predictions have been validated against real-time monitoring data by the United States Environmental Protection Agency. Southern Water consider AERMOD to be a suitable model for this assessment.

Dispersion modelling guidance indicates that at least 3 (ideally 5) years of meteorological data should be applied to ensure that infrequent weather conditions do not unduly bias the results. This results in a range of predicted impacts for different years of meteorological data and the average value is used to assess compliance, with the range of impacts used to assess likely variation between years and the risk of shorter-term impacts. This is particularly important in relation to odour, where acceptability of impacts is assessed by receptor over long time periods rather than as a result of infrequent or unusual meteorological conditions.

The results of the dispersion modelling have been presented in the form of:

- Illustrations of the odour footprint as isopleths (contours of equal concentration) for the criteria selected enabling determination of impact at any locations within the study area; and
- Tabulated odour concentrations ($C_{98, 1\text{-hour}}$ X ouE/m³) at discrete receptor locations to facilitate the discussion of results.

3.7 Additional Odour Sources

Part of the eastern boundary, in the northern extent of the Application Site is located adjacent to the Grundon Waste Management Waste Transfer Station (WTS). This facility has an environmental permit (permit number: EPR/DB3304HB) and operations should ensure any odour released beyond the site boundary is at levels below those that would be considered likely to cause pollution. The relevant extracts from their environmental permit is provided below:

“3.2.1 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 Environment Agency, unless the operator has used appropriate measures, including, but not limited to, those specified in any approved odour management plan, to prevent or where that is not practicable, to minimise, the odour.

3.2.2 The operator shall:

(a) if notified by the Environment Agency that the activities are giving rise to pollution outside the site due to odour, submit to the Environment Agency for approval within the period specified, an odour management plan;

(b) implement the approved odour management plan, from the date of approval, unless otherwise agreed in writing by the Environment Agency."

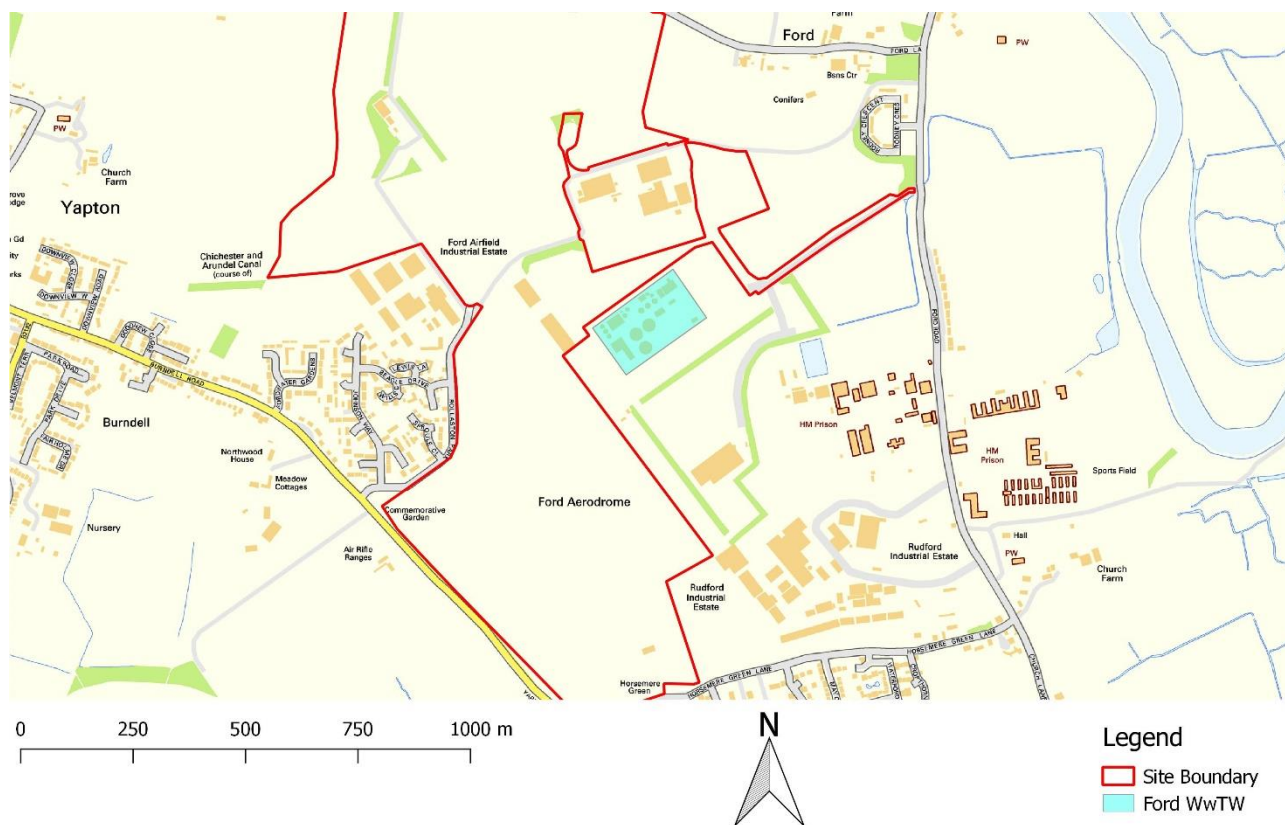
It has been assumed that the Grundon Waste Management WTS is operating in line with its environmental permit and that odour from the site is controlled. Furthermore, the Application Site is located downwind of the WTS and therefore, for the majority of the year, any odour arising from the WTS would be blown away from the Application Site. Odour impacts from the Grundon Waste Management WTS have therefore not been considered further within this assessment.

4. Site Setting and Source Description

4.1 Development Area and Complaint History

The location of the WwTW in proximity to the Ford Airfield is shown in Figure 4-1, below.

Figure 4-1 -WwTW Location



Although there are existing residences in the settlements of Yapton, Ford and Climping, none are as close to the works as those associated with the proposed development. Dr Holman of Hoare Lea contacted Arun District Council in May 2018 to obtain complaint data however Arun District Council were not able to provide this at that time. However, the Council did subsequently provide complaint data (October 2018) as follows:

- 2018: 2 (both notifications from southern water, not complaints);
- 2017: 1 (received March);
- 2016: 2 (received August and October);
- 2015: 5 (all during a period 23rd June until 7th July);
- 2014: 0;
- 2013: 1; and
- 2012: 0.

Limited complaints have been received from Ford and Yapton residents and therefore are likely to have occurred during abnormal operations at the WwTW. It is not known what there were.

4.2 Topography

The presence of elevated terrain can significantly affect the dispersion of pollutants and the resulting ground level concentration in a number of ways. Elevated terrain reduces the distance between the plume centre line and the ground level, thereby increasing ground level concentrations. Elevated terrain can also increase

turbulence and hence, plume mixing with the effect of increasing concentrations near to a source and reducing concentrations further away. The WwTW facility lies on a flat plain, with a basal elevation of around 4-5m AoD.

4.3 Site Surroundings and Potentially Sensitive Receptors

The results of the odour modelling have been used for the development of the masterplan for the site. There are no existing residential receptors on the Ford Airfield site and impacts have been assessed by use of a receptor grid.

4.4 Odour Baseline Conditions

Ambient odour is not a pollutant that is measured in the UK as it is not possible to accurately obtain a background concentration using standard monitoring techniques. As noted above, the IAQM Guidance (2018) recommends that odour 'sniff' tests are undertaken. However due to refurbishment works at the time of assessment, such walkover testing was not possible.

4.5 Description of WwTW

The Ford WwTW is part of Southern Water's Bognor Regis and Littlehampton wastewater scheme and opened in 1999. The inlet flows are pumped to screens, primary tanks, activated sludge (aeration lanes) and then final settlement tanks. The sludge is digested on site before being centrifuged and removed from site via HGV. There are no storm tanks, the flows instead being balanced at the source works in each case.

The full flow to treatment (FFT) for the site is 715 l/s coming from 2 large mains (Bognor and Littlehampton) and 4 smaller mains from local sites. The influent is dosed with ferric for odour control/influent quality. The population equivalent (p.e.) currently served by the works is 136,344. Southern Water does not monitor the variation in the impact associated with tourism, however it is estimated by them to be equivalent to approximately 1,780 p.e. The plant treats a maximum 37,764 cubic meters of waste water per day.

The site also receives sludges imported by tanker from other WwTW in the area and these are also digested with biogas fed to a Combined Heat and Power Plant (CHP).

In summary:

- Liquid sludge imports for the calendar year 2017 were 69,400 cubic metres;
- Cake imports for the calendar year 2017 were 5,985 cubic metres;
- Cess imports for the calendar year 2017 were 20,022 cubic metres; and
- Based on current Dry Weather Flow (DWF) there is capacity for around 15,000 additional properties within the current permit value.

Southern Water and Arun District Council is aware of a large number of historic odour complaints due to emission from the WwTW and as a result the majority of the works has been covered with the air extracted to two odour control units (OCU):

- Main OCU: flow 4.272m³/s; and
- Imported sludge OCU: 1.667m³/s.

The two OC units can be seen in the image below.

Figure 4-2 Ford WwTW Odour Control.



The only remaining process units not covered are the aeration lanes and final tanks.

5. Dispersion Modelling

5.1 Model Scenarios

A single model scenario has been assessed. In this scenario, odour emission rates converted from H₂S monitoring data and 'worst case' published emission rates for emissions from the aeration lanes and final tanks have been used.

5.2 Quantification of Odour Emissions

The WwTW includes the following potentially odorous sources, as agreed with Southern Water:

- Main odour control;
- Sludge reception odour control;
- Aeration lanes; and
- final settlement tanks.

No seasonal variability has been applied to the specific emission rates, although in reality emissions are likely to be lower during the winter months and higher in the summer when volatilisation will be higher and the development of septicity more rapid. All storm water provision is offsite (i.e. pumping of storm water to the Ford WwTW will only occur to the maximum levels (i.e. FFT) and anything above that will not reach the works until the flows return to normal. Southern Water monitors levels of hydrogen sulphide (H₂S) in the stacks of the OCUs in order to demonstrate (in line with their obligations under the planning permission for the works) that they are operating optimally. A summary of the H₂S results for the period 2017 – 2018 has been supplied by Southern Water and is shown in Table 5.1 for the sludge receptor carbon filter.

Table 5.1 H₂S concentration – Sludge Reception Odour Control

	H ₂ S (ppb)	Calculated Odour Concentration (ouE/m ³)	Calculated Odour Emission (ouE/s)
average	3.0	6.4	10.7
maximum	90.0*	191.5	319.1
95th %ile	13.1	27.8	46.3

[*upper range of instrument]

Table 5.2 shows the same data for the main OCU.

Table 5.2 H₂S concentration – Main Odour Control

	H ₂ S (ppb)	Calculated Odour Concentration (ouE/m ³)	Calculated Odour Emission (ouE/s)
average	0.3	0.7	3.0
maximum	178.6	380.1	1623.5
95th %ile	0.4	0.8	3.5

[*upper range of instrument is 180ppb]

H₂S is odorous, with a detection threshold (1ouE/m³) equivalent to 0.47 parts per billion (ppb) H₂S. It is recognised that the WwTW can also produce odours when H₂S is absent, however, for a sewage works inlet odour there is likely to be a strong relationship between H₂S concentration and total odour concentration and this is why Southern Water has a continuous H₂S monitoring system on their odour control units.

For purposes of the dispersion modelling, the calculated odour emission rates for the two OCUs has been increased to allow for this potential H₂S to odour calculation deficit. This is shown in Table 5.3.

Table 5.3 Modelled Odour Emission Rates

	Calculated Odour Emission (ouE/s)	Modelled Odour Emission (ouE/s)
Sludge Reception OC	319.1	640.0
Main OC	1623.5	3250.0

It is clear therefore that the modelled odour emission rate is significantly higher than the odour emission value calculated from the maximum H₂S monitored throughout 2017 and this is considered to represent a cautious approach for purposes of odour constraints identification.

The modelled odour emission rates for the aeration lanes and final settlement tanks are as detailed in Table 5.4 below.

Table 5.4 Odour Emission Rates – Tanks

ID	Source	Surface Area (m ²)	Emission Rate (ouE/m ² /s)
AL1	Aeration Lane	2877.0	2
AL2	Aeration Lane	2877.0	2
AL3	Aeration Lane	2398.0	2
AL4	Aeration Lane	2398.0	2
FST1	Final Settlement Tank	615.8	1
FST2	Final Settlement Tank	615.8	1
FST3	Final Settlement Tank	615.8	1
FST4	Final Settlement Tank	615.8	1

The overall site odour emissions and the relative contribution of each source group based on the calculations described above, is presented in Table 5.5 below.

Table 5.5 Relative Source Contribution

Source	Emission (ouE/s)	% of Total
Sludge Import OC	640.0	6%
Main Works OC	3250.0	31%
Aeration Lanes	3650.0	35%
Final Settlement tanks	3034.8	29%
Total	10574.8	100%

5.3 Building Downwash

Building downwash occurs when turbulence, induced by nearby structures, causes pollutants emitted from an elevated point source to be displaced and dispersed rapidly towards the ground, resulting in higher ground level concentrations. Building downwash should always be considered for buildings that have a maximum height equivalent to at least 40% of the emission height and which are within a distance defined as five times the lesser of the height or maximum projected width of the building. Building heights have been included in the model.

5.4 Potentially Sensitive Receptors

This odour assessment has been used for purposes of Masterplanning and constraints review, and the approach has therefore been iterative. There are no existing residential receptors on the Ford Airfield site. Impacts have been assessed over a 1.125km x 1.125km grid at 25m resolution. These results have been presented as odour impact isopleths.

5.5 Topography

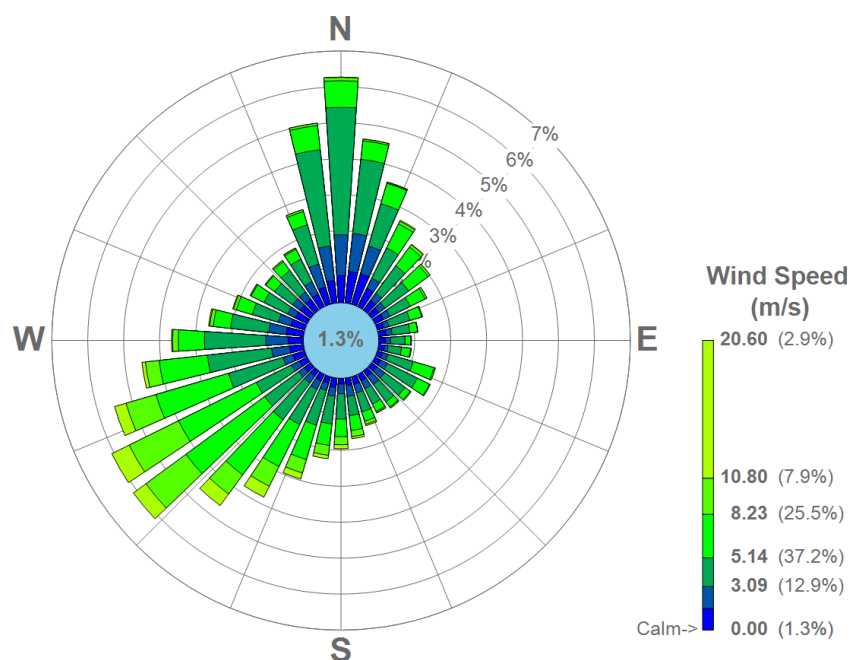
The WwTW facility lies on a flat plain, with a basal elevation of around 4-5m AoD. Topography is therefore unlikely to have a significant influence on dispersion, it has, however, been incorporated within the dispersion model.

5.6 Meteorological Conditions

For meteorological data to be suitable for dispersion modelling purposes a number of meteorological parameters need to be measured on a continuous basis. There are only a limited number of sites where the required meteorological measurements are made. In the UK, all of these sites are quality controlled by the Met Office.

The closest Met Office site to Ford is located at Shoreham. ADC was consulted regarding the suitability of using the Shoreham data set and has confirmed that this is their preferred meteorological data set due to proximity and height of ground level (mAoD).

Figure 5-1 Shoreham Data: Windrose 2013-2017



It is apparent from this data that the predominant wind direction is from the south west with a strong northerly component attributable to coastal effects. This is as would be expected given the lack of topographical influence in this area.

The AERMOD dispersion model requires the selection of a suitable data set (in this case Shoreham) and then 'preparation' of this data set using the AERMET software to account for site characteristics such as surface roughness, and albedo. The WwTW is currently surrounded by open fields (i.e. grassland), however these would be developed should the proposed development proceed. By selecting a surface roughness equivalent to grassland the area of odour impact will represent a worst case (i.e. the extent of the isopleth will be largest).

The surface roughness and albedo / bowen preparation is based on 40% grassland, 40% cultivated land and 20% urban.

5.7 Low Wind Speeds (Calm Conditions)

Detailed dispersion models are limited by the meteorological data used, in particular the lower wind speed limit of the anemometer and the direction of wind in calm conditions (when it will essentially have none). Dispersion models are therefore unable to represent the impact under these calm conditions despite the fact that, for some sites, these may be the occasions where the risk of odour impact is highest. For this reason, an additional development buffer has been incorporated into the masterplan for the site.

5.8 Assessment Criteria

The objective of the assessment is to determine the potential extent to which unacceptable levels of odour impact could reasonably be expected to occur as a result of emissions from the WwTW.

An odour criterion of $C_{98,1\text{-hour}} 30\text{UE}/\text{m}^3$ is considered appropriate in this case. Although residential receptors are regarded as high sensitive receptors given that the most offensive odour sources are covered and abated. The remaining odours will either be residual emissions from the odour control units or secondary / final tank odours which are regarded as the least offensive sources on a WwTW.

For the reasons given above, the $C_{98, 1\text{-hour}} 30\text{UE}/\text{m}^3$ has been used as the odour criterion for new residential receptors for the purposes of this assessment. At these levels it is likely that odour will be detected occasionally, however the IAQM Guidance states that at this level it is unlikely that disamenity will be caused.

6. Predicted Impacts

The odour impact isopleths for the WwTW, based on the model inputs described above, are presented in drawings AQ1 and AQ2:

- Drawing AQ1 shows the odour impact isopleths $1.5\text{ou}_\text{E}/\text{m}^3$, $3.0\text{ou}_\text{E}/\text{m}^3$ and $5\text{ou}_\text{E}/\text{m}^3$ based on the average 98th percentile values for 5 years of meteorological data;
- Drawing AQ2 shows the odour impact isopleths $1.5\text{ou}_\text{E}/\text{m}^3$, $3.0\text{ou}_\text{E}/\text{m}^3$ and $5\text{ou}_\text{E}/\text{m}^3$ based on the maximum 98th percentile value for each grid point from 5 years of meteorological data.

Drawing AQ1 also shows a 100m buffer for 'calm conditions' which would not be accounted for in the dispersion model due to the wind having no direction.

The results of the assessment provide the area where the odour impact associated with the WwTW is greater than the $C_{98,1\text{-hour}} 3\text{ou}_\text{E}/\text{m}^3$ within the proposed development under 'typical' operation. Receptors closest to this isopleth would be likely to experience odours from the works on occasion (i.e. they would not be 'odour free' however this would be below the $C_{98,1\text{-hour}} 3\text{ou}_\text{E}/\text{m}^3$ limit based on the conservative modelling inputs applied in this study.

7. Model Sensitivity

It is standard practice to consider model sensitivity, with a view to determining the potential for any errors or assumptions which could lead to results significantly different from those experienced in reality.

7.1 Odour Sources

As described in Section 4.5 above, the odour sources were identified during a site visit and subsequently confirmed with Southern Water. No further sensitivity assessment is considered to be required for odour sources.

7.2 Emission Rates

Section 5.2 describes the odour emission rates used in the assessment and their derivation. These emission rates have been deliberately selected as conservative (i.e. higher). The final settlement tanks, for example, were observed to have no detectable odour and this is as would be expected for a well-managed works, which Ford WwTW was observed to be. The H₂S data was reviewed and the emission rate calculated from the highest value recorded (with additional factors added). Only through measurement at source (when the works improvements are complete) would it be possible to verify the assumptions made, however for the reasons described above, no further assessment is considered to be required for the odour emission rates.

7.3 Meteorological Data

Section 5.6 describes that Shoreham Airport meteorological data was used in this assessment. This is the closest Met Office site to Ford Airfield. ADC was consulted regarding the suitability of the Shoreham data set and has confirmed that this is their preferred meteorological data set for this site due to proximity and height of ground level (mAoD).

Shoreham is located approximately 20km to the east of Ford, approximately 1.6km from the coast. The Ford WwTW is located approximately 2.5km from the coast. The only other site of relevance to the Ford WwTW is Thorney Island, approximately 23km to the west near Hayling Island (near Portsmouth and Havant). In order to test model sensitivity, the dispersion model was run with 5 years of meteorological data from Thorney Island, prepared using the same AERMET input files as the Shoreham data.

The results of the sensitivity modelling using Thorney Island data was that the impact isopleth produced was no larger in any direction relevant to the proposed development site than for the Shoreham data set preferred by ADC. As such, the results produced for the Shoreham data set represent the 'worst case' in terms of potential impact.

7.4 Topography

As described in Section 5.5, the WwTW facility lies on a flat plain, with a basal elevation of around 4-5m AoD. Due to the absence of any terrain complexities, no further sensitivity is considered to be required for topography.

8. Conclusions

This report presents a detailed odour impact assessment of the Ford Wastewater Treatment Works (WwTW), in relation to the potential for impact at occupiers (and amenity users) of a proposed development on the adjacent Ford Airfield.

The assessment has been completed using information provided by Southern Water during and after a site odour visit in 2018 and library emission rates for similar sources. This includes:

- A list of odour sources on the site;
- Dimensions of all process units; and
- Emission rates for each of the sources.

The modelled odour impact isopleths show the extent of the odour constraints associated with the WwTW ('average' and 'maximum'). It is recommended that receptors should be sited outside the $C_{98,1\text{-hour}} 30 \mu\text{E}/\text{m}^3$ limit shown on the attached drawings. This is considered to be a reasonable criterion given the nature of the odour from the sources at the Ford WwTW which are not odour controlled (i.e. the aeration lanes and final tanks). This does not mean that residents would never experience odours from the works, rather that this criterion is being appropriate for a site such as the Ford WwTW. The odour modelling is based on the assumption that the odour control units at the Ford site will remain in good order and will prevent the most odorous emissions from being released untreated from the site.



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