



Redrow Homes

RUTHIN ROAD

Odour Risk Assessment





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WIND ROSES

1 INTRODUCTION

- 1.1.1 WSP has been commissioned by Redrow Homes to produce an odour risk assessment in relation to a proposed wastewater treatment works (WwTW) to be included within a proposed residential development on land immediately south of Ruthin Road, Wrexham. Hereafter referred to as the 'Application Site' or 'Proposed Development'.
- 1.1.2 The Application Site lies within the administrative boundary of Wrexham County Borough Council (WCBC) and is located immediately to the south of Ruthin Road, adjacent to the east of the A483, to the west of Wrexham and north of Rhostyllen and the River Clywedog. Locally, the Application Site is bordered to the east by residential properties along Homestead Lane and The Homestead, in addition to residential properties to the north on the opposite side of Ruthin Road, and Bryn Tyron Hall School adjacent to the southwest site boundary.
- 1.1.3 The Proposed Development comprises up to 1520 dwellings, plus associated roads, open space, community facilities, a site for a primary school and a wastewater treatment plant (if necessary). The Proposed Masterplan can be found in **Appendix A**.

1.2 DETAILS OF PROPOSED WWTW PLANT

- 1.2.1 A system called NUTREM has been proposed for the WwTW developed by Plantworks. Currently it is proposed that this system would be managed and operated by Severn Trent Connect – see supporting letter in **Appendix B**. NUTREM is a Biological Nutrient Removal (BNR) system, which facilitates phosphorus and nitrogen removal from wastewater. This system works by initially processing sewage through the inlet flows where screening and removal of wipes, grit and other unsuitable matter takes place before being passed to a Balance Tank/Fermenter (BMF) which balances the incoming flows prior to processing and produces Volatile Fatty Acids (VFA) to enable Phosphorus Accumulating Organisms (PAOs) to carry out effective phosphorus removal.
- 1.2.2 Following these phases, the wastewater is then transported to the reactors using a simultaneous fill and discharge technique. The influent is introduced at the bottom of the tank where it is mixed with settled biomass, leaving the sludge undisturbed. During this stage the anaerobic treatment takes place involving the storage of VFAs by PAOs and the release of phosphorus. Following this, the aerobic phase where PAO's uptake an increased amount of phosphorus and anoxic phase, involving the de-nitrification of the effluent, are carried out. The remaining sludge is removed from the fermenter and stored in the sludge storage tank until removed by tanker to a treatment centre. Treated effluent is stored in the attenuation tank before being released into the River Clywedog.
- 1.2.3 NUTREM is considered by the manufacturer to be odourless, even in hot temperatures and with high loads¹. An Odour Impact Assessment was undertaken by ACCON UK Limited, presented in **Appendix B**, on a NUTREM demonstrator plant in Petersfield that concluded that the WwTW would not cause any loss of amenity, annoyance, nuisance or complaint beyond 10-15m from the plant boundary. The ACCON assessment recommended that a buffer of 30-50m should be included between the plant and any receptors to reduce odour impact.

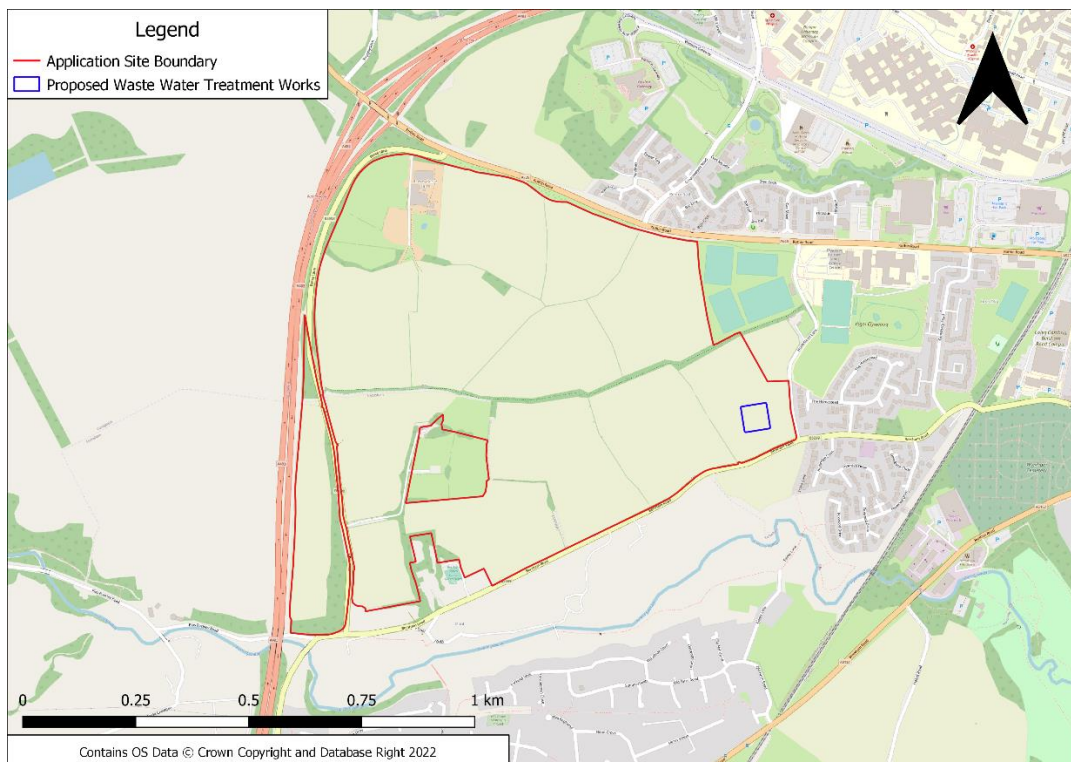
¹ Plantwork Systems (2023) NUTREM [online]. Available at: <https://www.plantworksystems.com/nutrem/>. Accessed August 2023.

- 1.2.4 The WwTW is proposed to be located within the east of the Application Site and a relatively conservative 40-50m buffer has been recommended by the WwTW suppliers, within which any existing or proposed sensitive receptors should not be located. Whilst this buffer has not been recommended specifically for odour risk, it does align with the findings of the ACCON report. The Proposed Development Masterplan does allow for a 50m buffer for the WwTW, within which no sensitive receptors will be located, which aligns with the recommendations provided by Plantworks, the WwTW plant supplier.
- 1.2.5 Given the presence of nearby existing sensitive residential receptors adjacent to the east of the Application Site boundary (Homestead Lane and The Homestead), as well as proposed sensitive receptors being introduced as part of the Proposed Development, an odour risk assessment is required to assess the potential for odour impacts and to confirm the suitability of the proposed WwTW placement.

1.3 PURPOSE OF THIS REPORT

- 1.3.1 This report presents the findings of a qualitative assessment of the potential odour risks at existing and proposed sensitive receptors located within the vicinity of the WwTW. The report also considers baseline air quality conditions at the Application Site, which will inform the suitability of the site for the proposed land uses.
- 1.3.2 **Figure 1-1** shows the location of the Application Site and the Proposed WwTW.

Figure 1-1 - Application Site Boundary and location of Proposed WwTW



2 LEGISLATION, GUIDANCE & POLICY

2.1 ODOUR GUIDANCE FOR LOCAL AUTHORITIES

ODOUR PERCEPTION

2.1.1 Odour consists of a mixture of chemicals, compounds or aerosols detectable in the air by humans as a smell. Individual response to detection such as whether an odour might be considered to be acceptable, objectionable or offensive is entirely subjective. Human response to perception can depend upon a person's previous exposure to odour, life experience, age, health and even activities undertaken on any given particular day.

2.1.2 The Department for Environment Food and Rural Affairs (Defra) guidance² 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."

ODOUR EXPOSURE

2.1.3 The detection of an odour nuisance requires that there is an emission source, a pathway for transport of the emissions and a receptor to detect the emissions.

2.1.4 The scale of exposure, or impact for odour can be determined by parameters collectively known as the FIDOR factors i.e. Frequency of Exposure, Intensity of Exposure, Duration of exposure, Odour unpleasantness, and the Receptor sensitivity. The term FIDOL is also used for this determination where the L stands for Location characteristics of receptors.

2.2 APPLICABLE ODOUR LEGISLATION AND GUIDANCE

ENVIRONMENT PROTECTION ACT 1990³

2.2.1 Statutory nuisance is defined by section 79 of the Environmental Protection Act 1990, which can be constituted as:

- Fumes or gases emitted from premises so as to be prejudicial to health or a nuisance; or

² The Department for Environment, Food and Rural Affairs (Defra) (2010) Odour Guidance for Local Authorities [online]. Available at: <https://www.gov.uk/government/publications/odour-guidance-for-local-authorities>. Accessed August 2023.

³ Environmental Protection Act 1990 [online]. Available at: <https://www.legislation.gov.uk/ukpga/1990/43/resources>. Accessed August 2023.

- Any dust, steam, smell or other effluvia arising on industrial, trade or business premises and being prejudicial to health or a nuisance.

2.2.2 The relevant local authority has a duty under the act to take reasonably practicable steps in order to investigate any complaints received from persons living within its area.

ENVIRONMENT AGENCY(EA) – H4 ODOUR MANAGEMENT⁴

2.2.3 The EA issued guidance on odour management for compliance with an environmental permit. The guidance sets out the conditions related to odour that will typically be applied to a permit application and the requirement for the production of an Odour Management Plan (OMP) for those activities where odour emission is expected to occur.

2.2.4 Control measures to reduce the emission of odorous compounds are suggested, along with dispute resolution procedures when a complaint occurs resulting from odorous emissions.

INSTITUTE OF AIR QUALITY MANAGEMENT

2.2.5 The Institute of Air Quality Management (IAQM) issued updated guidance on the assessment of odour for planning in 2018⁵ (“IAQM guidance”), which provides details on the suggested approaches to odour assessment. The guidance provides a best practice approach to odour assessment which includes recommendations for the techniques and tools available to assess and/or monitor odour.

ODOUR UNITS

2.2.6 The concentration at which an odour is just detectable to a “typical” human nose is referred to as the “threshold” concentration. As odours are often very complex mixtures of compounds the concentration of the mixture is expressed as an odour unit, which is a sensory measurement of the concentration of a mixture of odorous compounds in a sample of odour.

2.2.7 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 (1 OUE /m³).

2.2.8 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.

2.2.9 An odour at a strength of 1 OUE /m³ is in reality so weak that it would not normally be detected outside the controlled environment of an odour laboratory by the majority of the population (that is individuals with odour sensitivity in the “normal” range). As an odour becomes more concentrated, then it gradually becomes more apparent.

2.2.10 The following guideline values provide a context for discussion about exposure to odours:

- 1 OUE /m³ is the point of low detection;
- 5 OUE /m³ is a faint odour; and
- 10 OUE /m³ is a distinct odour.

⁴ Environment Agency (2011) H4 Odour Management – How to comply with your environmental permit [online]. Available at: <https://www.gov.uk/government/publications/environmental-permitting-h4-odour-management>. Accessed August 2023.

⁵ Institute of Air Quality Management (IAQM) (2018) Guidance on the assessment of odour for planning [online]. Available at: <https://iaqm.co.uk/guidance/>. Accessed August 2023.

2.3 APPLICABLE AIR QUALITY LEGISLATION

UK AIR QUALITY STRATEGY

- 2.3.1 The Government's policy on air quality within the UK is set out in the Air Quality Strategy for England, Scotland, Wales and Northern Ireland (AQS)⁶. The AQS provides a framework for reducing air pollution in the UK with the aim of meeting the requirements of European Union legislation⁷ which were transposed into UK law by the Air Quality Standards Regulations¹⁰.
- 2.3.2 The AQS also sets standards and objectives for nine key air pollutants to protect health, vegetation and ecosystems. These are benzene (C₆H₆), 1,3 butadiene (C₄H₆), carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO₂), particulate matter (PM₁₀ and PM_{2.5}), sulphur dioxide (SO₂), ozone (O₃), and polycyclic aromatic hydrocarbons (PAHs).
- 2.3.3 The air quality objectives are policy based targets set by the Government, which take into account economic efficiency, practicability, technical feasibility and timescale.
- 2.3.4 For the pollutants considered in this assessment (nitrogen dioxide (NO₂) and particulate matter (PM₁₀ and PM_{2.5})), specifically with respect to analysing baseline air quality conditions at the Application Site, there are both long-term (annual mean) and short-term standards. In the case of NO₂, the short-term standard is for a 1-hour averaging period, whereas for PM₁₀ it is for a 24-hour averaging period. These periods reflect the varying impacts on health of differing exposures to pollutants, for example temporary exposure on the pavement adjacent to a busy road (i.e. 1-hour exposure), compared with the length of exposure of residential properties adjacent to a road (24-hour and annual).
- 2.3.5 The AQS contains a framework for considering the effects of a finer group of particles known as 'PM_{2.5}' as there is increasing evidence that this size of particles can be more closely associated with observed adverse health effects than PM₁₀. However, there is no statutory objective given in the AQS for PM_{2.5}.
- 2.3.6 The air quality objectives for NO₂, PM₁₀ and PM_{2.5} are displayed in **Table 1**.

2.4 AIR QUALITY REGULATIONS

- 2.4.1 Many of the objectives in the AQS have been made statutory in Wales with the Air Quality (Wales) Regulations 2000⁸ and the Air Quality (Wales) (Amendment) Regulations 2002⁹ for the purpose of Local Air Quality Management (LAQM).

⁶ Department for Environment, Food and Rural Affairs (2007) The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Volume 1) [online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69336/pb12_654-air-quality-strategy-vol1-070712.pdf. Accessed August 2023.

⁷ The UK formally left the EU on 31st January 2020 and new air quality legislation for the UK will be brought forward in due course. The Air Quality (Miscellaneous Amendment and Revocation of Retained Direct EU Legislation) (EU Exit) Regulations 2018 (SI 2018/1407) (see Regulation 5) makes changes to retained direct EU legislation relating to air quality, to ensure that it continues to operate effectively.

⁸ Welsh Statutory Instruments (2000) The Air Quality Standards (Wales) Regulations 2000 (2000 No.1940 (W.138) [online]. Available at: <https://www.legislation.gov.uk/wsi/2000/1940/made>. Accessed August 2023.

⁹ Welsh Statutory Instruments (2002) The Air Quality (Amendment) (Wales) Regulations 2002 (2010 No.3182 (W.298) [online]. Available at: <https://www.legislation.gov.uk/wsi/2002/3182/made>. Accessed August 2023.

- 2.4.2 These Regulations require that likely exceedances of the AQS objectives are assessed in relation to the quality of air at locations situated outside of buildings or other structures, above or below ground, and where members of the public are regularly present.
- 2.4.3 The Air Quality Standards Regulations 2010¹⁰ transpose the European Union Ambient Air Quality Directive (2008/50/EC) into law in Wales. This Directive sets legally binding limit values for concentrations in outdoor air of major air pollutants that impact public health such as PM₁₀, PM_{2.5} and NO₂.

ENVIRONMENT ACT 1995

- 2.4.4 Under Part IV of the Environment Act 1995¹¹, local authorities must review and document local air quality within their area by way of staged appraisals and respond accordingly, with the aim of meeting the air quality objectives defined in the Regulations, shown in **Table 1** below. Where the objectives are not likely to be achieved, an authority is required to designate an Air Quality Management Area (AQMA). For each AQMA the local authority is required to draw up an Air Quality Action Plan (AQAP) to secure improvements in air quality and show how it intends to work towards achieving air quality objectives in the future.

ENVIRONMENT ACT 2021

- 2.4.5 The Environment Act 2021¹², published in November 2021, provides a new framework for environmental protection within the UK. It aims to ensure that environmental standards are maintained and that improvements are achieved (specifically in relation to air quality, water, waste and resources, nature and biodiversity) and bridges the gaps in legislation resulting from the UK's departure from the EU. The Environment Act 2021 does not replace the Environment Act 1995, but it does make amendments in order to strengthen environmental protections. In relation to air quality, the Environment Act 2021 includes a legally binding duty on Government to bring forward at least two new air quality targets for PM_{2.5} into secondary legislation by 31 October 2022, which would only apply within England at the time of writing. This deadline has been delayed due to the time taken to process the large quantity of responses received from the public regarding the proposed targets.

Table 1 - Relevant Air Quality Objectives for the Protection of Human Health

Pollutant	Applies to	Objective / Limit Value	Measured as
Nitrogen dioxide (NO ₂)	UK	40µg/m ³	Annual Mean
		200µg/m ³ not to be exceeded more than 18 times a year	1-hour Mean
	UK	40µg/m ³	Annual Mean

¹⁰ Welsh Statutory Instruments (2010) The Air Quality Standards (Wales) Regulations 2010 (2002 No.1433 (W.126) [online]. Available at: <https://www.legislation.gov.uk/wsi/2010/1433/contents/made>. Accessed August 2023.

¹¹ Environment Act 1995 [online]. Available at: <https://www.legislation.gov.uk/ukpga/1995/25/contents>. Accessed August 2023.

¹² Environment Act 2021 [online]. Available at: <https://www.legislation.gov.uk/ukpga/2021/30/schedule/11/enacted>. Accessed August 2023.

Particulate Matter (PM ₁₀)	(except Scotland)	50µg/m ³ not to be exceeded more than 35 times a year	24-hour Mean
Particulate Matter (PM _{2.5})	UK (except Scotland)	20µg/m ³	Annual Mean

2.5 LOCAL POLICY

2.5.1 The Wrexham Unitary Development Plan¹³ Policy GDP1 indicates that:

“All new development should:- ...

(f) Ensure the safety and amenity of the public and safeguard the environment from the adverse effects of pollution of water, land or air, hazards from industry and quarrying, and associated noise, odour or vibration arising from development.”

2.5.2 The Wrexham Local Plan¹⁴ is currently being developed to replace the former Unitary Development Plan. The Local Plan sets out policies for development within the district from 2013 – 2028. Policies relevant to the Proposed Development include

“Policy MW6 Waste Management Facilities

Proposals for waste management will be supported provided

- i. The proposal would move the management of waste up the waste hierarchy; or*
- ii. There is an identified need for the facility type at the regional level, in accordance with Technical Advice Note 21, and*
- iii. There would be no adverse impact on residential amenity by virtue of noise, dust or odour; and*
- iv. There would be no adverse impact on air quality;”*

¹³ Wrexham County Borough Council (2005) Wrexham Unitary Development Plan (1996 – 2011), adopted February 2005 [online]. Available at: <https://www.wrexham.gov.uk/service/development-plans-and-other-planning-policy/wrexham-unitary-development-plan>. Accessed August 2023.

¹⁴ Wrexham County Borough Council (2019) Wrexham Local Development Plan 2 (LDP2) 2013 to 2028 [online]. Available at: <https://www.wrexham.gov.uk/service/development-plans-and-other-planning-policy/wrexham-local-development-plan-2-ldp2-2013-2028>. Accessed 2023.

3 ASSESSMENT METHODOLOGY

3.1 CONSULTATION

- 3.1.1 A consultation email was sent to the environmental protection department at WCBC on the 28th October 2022, outlining the proposed methodology for the odour assessment. The response from the council was received on the 8th November 2022 confirming agreement with the scope and methodology of the assessment.
- 3.1.2 Given that this report is a qualitative assessment, it was not deemed necessary to include any detailed odour modelling at this stage.

3.2 BASELINE AIR QUALITY CONDITIONS

- 3.2.1 To inform the assessment, a baseline desk-study on air quality conditions at the Site and surrounding area was undertaken. This included the following tasks:
- Review of WCBC's latest review and assessment report¹⁵ and air quality data for the area surrounding the Site, including data from Defra¹⁷;
 - Review of information on any nearby industrial pollutant sources available from WCBC and the public register published by Natural Resources Wales¹⁶.
 - Desk study to confirm the locations of nearby existing receptors that may be sensitive to changes in local air quality.

3.3 ODOUR RISK ASSESSMENT

The approach to the odour risk assessment was undertaken following IAQM guidance on the assessment of odour for planning⁵. With reference to this guidance, an assessment of odour risk on relevant receptors requires the following;

- A description of baseline odour conditions;
- A description of the location of the receptors and their relative sensitivities to odour effects;
- Details of potential odour sources, including the activities and materials involved and the resulting potential for odour generation;
- Description of mitigation and control measures incorporated into the development
- A prediction, using appropriate assessment tools, of the likely odour impact and resulting effects at sensitive receptors, taking into account;
 - The likely magnitude of odour emissions.
 - The likely meteorological conditions at the Site.
 - The dispersion and dilution afforded by the pathways to the receptors and the resulting likely magnitude of odour.
 - The sensitivity of receptors.

¹⁵ North Wales Authorities Collaborative Project (2021) Air Quality Progress Report [online]. Available: <https://www.conwy.gov.uk/en/Resident/Environmental-problems/assets-Air-Quality/documents/North-Wales-Authorities-Collaborative-Project-2022-Air-Quality-Progress-Report-v2-Final-Issue00001-C02.pdf>. Accessed 2023.

- Where odour effects are assessed as significant, details of appropriate further mitigation and control measures that could allow the proposal to proceed without causing significant loss of amenity.
- The residual odour impacts and their effects on local receptors.
- A conclusion on the significance of the residual effect, i.e. whether “significant” or “not significant”.

3.3.1 The Proposed Development includes a WwTW using a BNR system called NUTREM to process wastewater. Although the process is considered to be virtually odourless, the processing elements of the system carry a risk of odour. These elements include the inlet screening where the rag and grit parts of the waste are extracted and the balance tank, where the fermentation of incoming sewage occurs prior to biological nutrient removal.

3.3.2 It is recommended by the IAQM guidance⁵ that at least one odour assessment tool is used that takes the frequency, intensity, duration, unpleasantness and location of the odour into account. As the Proposed Development is a potential future source of odour with closely located receptors, a qualitative approach has been selected to carry out the odour risk assessment. This involves use the Source-Pathway-Receptor concept to assess the risk to sensitive receptors from the placement of the Proposed WwTW.

3.3.3 SOURCE-PATHWAY-RECEPTOR APPROACH

3.3.4 The Source-Pathway-Receptor approach is a concept that presents the hypothetical relationship between the source of an odour, the pathway by which exposure might occur and the receptor that could be adversely affected.

3.3.5 From an odour exposure to occur all three links in the Source-Pathway-Receptor chain must be present:

- An emissions source – a means for the odour to enter the atmosphere (i.e. the proposed WwTW in this case).
- A pathway – for the odour to travel through the air to locations off site noting that:
 - Anything that increases dilution and dispersion of an odorous pollutant plume as it travels from source to receptor will reduce the concentration at the receptor, and hence reduce exposure.
 - Increasing the length of the pathway will – all other things being equal – increase the dilution and dispersion.
- The presence of receptors (people) that could experience an adverse effect, noting that people vary in their sensitivities to odour. Suggested definitions for the sensitivity of receptors to odour from the IAQM odour guidance are given in **Table 2**.

Table 2 - IAQM Odour Guidance - Receptor Sensitivity to Odours

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 wouldn't reasonably expect to enjoy the same level of amenity as in their home; or - People wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land. Examples may include places of work, commercial/retail premises and playing/recreation fields.
Low	Surrounding land where: - The enjoyment of amenity would not reasonably be expected; or - There is transient exposure, where the people would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land. Examples may include industrial use, farms, footpaths and roads.

- 3.3.6 The Proposed Development will allow for new residential properties and a school, all of which will be classified as high sensitivity receptors as per the IAQM guidance. The Proposed Development also includes a local community centre, which will be classified as a medium sensitive receptor as per the IAQM guidance. There are also existing off-site residential receptors located to the southwest of the Application Site boundary, specifically on The Homestead and High Ridge Drive, 15m and 40m from the Application Site boundary respectively. There are also residential receptors to the north of the Application Site on Pentre Bach, approximately 40m to the north of the Site boundary and a local primary school, Ysgol Clywedog, 100m to the northeast. These off-site receptors are all considered to be high sensitivity with respect to potential odour emissions.
- 3.3.7 The qualitative odour risk assessment has been undertaken to identify the potential for odour impacts at both the existing and proposed receptors and, where necessary, propose any mitigation measures that can reduce any potential adverse effects.
- 3.3.8 The location of the proposed and existing receptors are depicted in **Figure 3-1**. The full proposed masterplan can be seen in **Appendix A**.
- 3.3.9 The magnitude of the potential odour impact can be determined by the parameters collectively known as FIDOL:
- Frequency: How often an individual is exposed to odour.
 - Intensity: The individual's perception of the strength of the odour.
 - Duration: The overall duration that individuals are exposed to odour over time.

- **Odour Unpleasantness:** The character of an odour as it relates to the ‘hedonic tone’ at any given odour intensity or concentration.
- **Location:** The land use and nature of human activities in the vicinity of the odour source.

3.3.10 In addition to FIDOL, **Table 3** and **Table 4** below from the IAQM guidance⁵ have been utilised to help define the overall risk of odour effects at the identified existing and proposed receptors.

3.3.11 The first stage, as shown in **Table 3**, is to estimate the odour generating potential of the site activities, also called the ‘Source Odour Potential’. The Source Odour Potential is based on three factors which involve consideration of:

- The scale (magnitude) of the release of the odour source;
- How odorous the emissions from the source are likely to be; and,
- The unpleasantness of the odour emitted.

3.3.12 The ‘Pathway Effectiveness’ is also considered at this stage. The pathway refers to the transport mechanism through the air, from source to receptor and any factors that may increase or decrease dilution and dispersion of the odour. The pathway from source to receptor may be categorised as highly effective, moderately effective or ineffective based on the following factors;

- The distance of sensitive receptors from the odour source;
- The location of the receptors in relation to source. Odour episodes often tend to occur during stable atmospheric conditions with low wind speed, which gives poor dispersion and dilution. During these conditions receptors close to the source in all directions around it can be affected. When conditions are not calm, it will be the downwind receptors that are affected. Overall therefore, receptors that are downwind with respect to the prevailing wind direction tend to be at higher risk of odour impact;
- The effectiveness of the point of release in promoting good dispersion; and,
- The topography and terrain between the source and the receptor.

3.3.13 Both the Source Odour Potential and Pathway Effectiveness are used to identify the risk of odour exposure at each relevant receptor, as per the matrix in **Table 3**.

3.3.14 The risk of odour exposure is then combined with the sensitivity of the receptor to predict the likely magnitude of effect that the receptor is likely to experience, as per the matrix presented in **Table 4**.

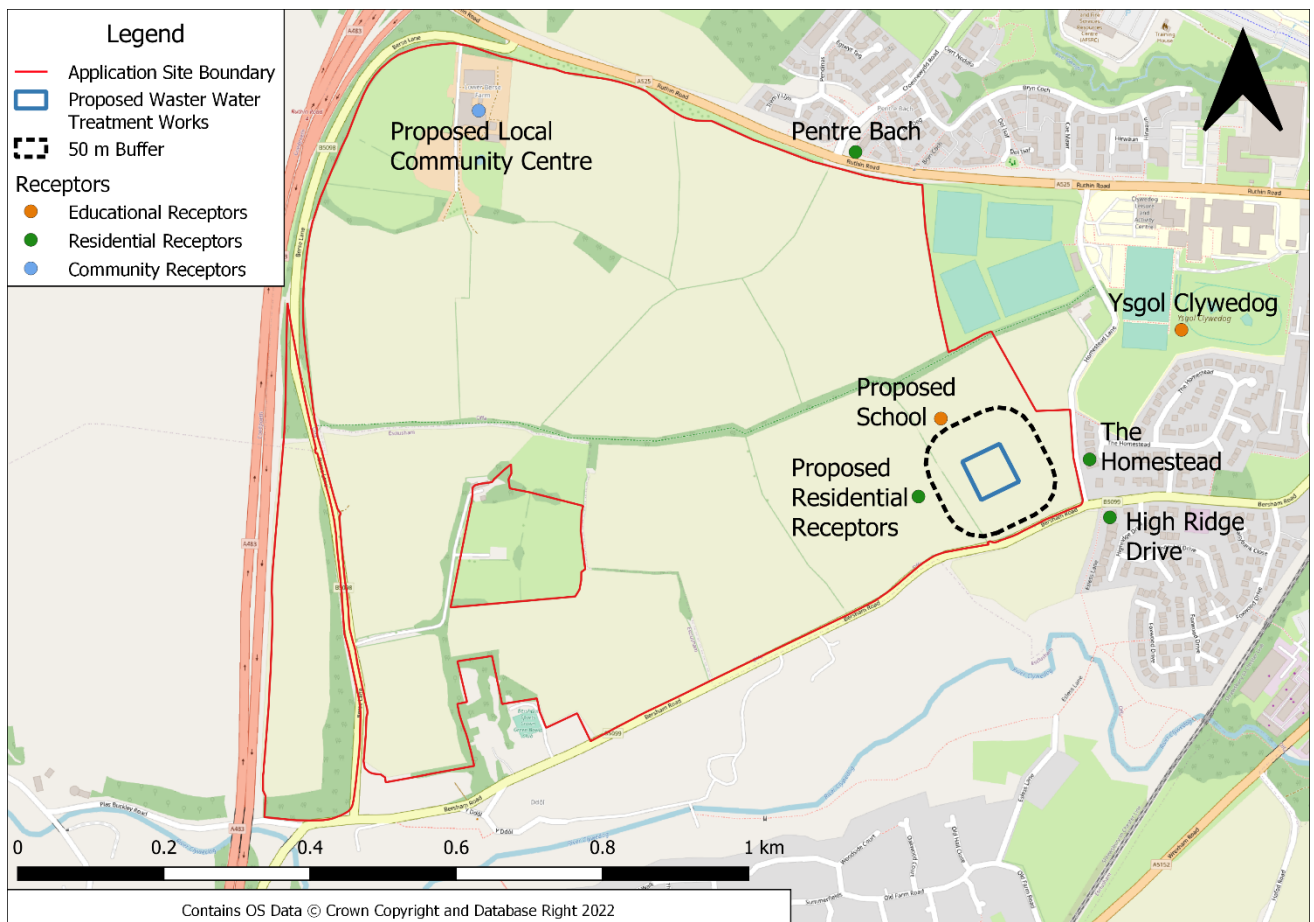
Table 3 – Risk of odour exposure at specific receptor location

Pathway Effectiveness	Source Odour Potential		
	Small	Medium	Large
Highly Effective Pathway	Low Risk	Medium Risk	High Risk
Moderately Effective Pathway	Negligible Risk	Low Risk	Medium Risk
Ineffective Effective Pathway	Negligible Risk	Negligible Risk	Low Risk

Table 4- Likely magnitude of odour effect at the specific receptor location

Risk of Odour Exposure	Receptor Sensitivity		
	Low	Medium	High
High Risk of Odour Exposure	Slight Adverse Effect	Moderate Adverse Effect	Substantial Adverse Effect
Medium Risk of Odour Exposure	Negligible Effect	Slight Adverse Effect	Moderate Adverse Effect
Low Risk of Odour Exposure	Negligible Effect	Negligible Effect	Slight Adverse Effect
Negligible Risk of Odour Exposure	Negligible Effect	Negligible Effect	Negligible Effect

Figure 3-1 - Location of Existing and Proposed Sensitive Receptors included in Odour Risk Assessment



4 BASELINE AIR QUALITY CONDITIONS

- 4.1.1 A baseline air quality review has been carried out in order to understand the air quality conditions at and near to the Application Site. This will enable the suitability of the site for the proposed land uses, specifically the addition of high sensitive receptors (residential properties, primary school) and medium sensitive receptors (local community centre), to be assessed.

4.2 REVIEW AND ASSESSMENT OF AIR QUALITY

- 4.2.1 WCBC has not designated any Air Quality Management Areas (AQMAs) within the district.

4.3 LOCAL EMISSION SOURCES

- 4.3.1 The Proposed Development is located in an area where air quality is mainly influenced by emissions from road traffic operating on the local road network. The major roads nearby which would have a significant influence on pollutant concentrations within the Site are Ruthin Road (A525) to the north of the Application Site boundary, the A483 to the west and Bersham Road (B5099) to the south.
- 4.3.2 A review of the Public Register provided by Natural Resources Wales¹⁶ showed that there are no industrial pollution sources in the immediate vicinity of the site that will influence the local air quality.

4.4 BACKGROUND AIR QUALITY DATA

- 4.4.1 **Table 5** summarises the background pollutant concentrations of NO₂, PM₁₀ and PM_{2.5} taken from Defra's Background mapping¹⁷ for the current year (2022), an interim year of 2025 and a future year of 2030.

Table 5 - Background Concentrations (µg/m³)

Grid Square (centre on O.S. Grid Reference)	NO ₂ (µg/m ³)			PM ₁₀ (µg/m ³)			PM _{2.5} (µg/m ³)		
	2022	2025	2030	2022	2025	2030	2022	2025	2030
331500,350500	9.5	8.1	6.8	11.4	11.1	11.0	7.0	6.8	6.7
331500,349500	6.6	5.9	5.3	11.0	10.6	10.5	6.8	6.5	6.4
332500,349500	7.7	6.9	6.2	11.0	10.6	10.5	7.1	6.9	6.8
330500,349500	7.5	6.5	5.6	10.5	10.2	10.1	6.6	6.3	6.3
Annual Mean Objectives	40			40			20		

- 4.4.2 The reported background concentrations are observed to be well below the respective annual mean air quality objectives for all identified pollutants in the current year (2022) and future years (2025 and

¹⁶ Natural Resources Wales (2022) Public Register [online]. Available at: <https://publicregister.naturalresources.wales/>. Accessed August 2023.

¹⁷ Department For Environment, Food and Rural Affairs (Defra) (2022) Background Mapping Data For Local Authorities [online]. Available at: <https://uk-air.defra.gov.uk/data/lqgm-background-home>. Accessed August 2023.

2030). The estimated concentration of all pollutants is predicted to decrease between 2022 and 2030 with the steepest rate of decline predicted to be for NO₂.

- 4.4.3 A new PM_{2.5} target of 10ug/m³ by 2040 has been proposed under the Environment Act 2021¹². If the Welsh Government adopts this target, PM_{2.5} concentrations at the Application Site are likely to fall below this given that the concentrations between 2022 and 2030 remain below this value.

4.5 LOCAL AUTHORITY AIR QUALITY MONITORING DATA

AUTOMATIC MONITORING

- 4.5.1 WCBC carries out automatic monitoring of NO₂, PM₁₀ and PM_{2.5} alongside passive diffusion tube monitoring of NO₂ within the district. There is one automatic monitor located approximately 800m to the east of the Application Site on Victoria Road. The nearest diffusion tube is located on Ruthin Road, approximately 47m to the north of the Site boundary.
- 4.5.2 Concentrations of NO₂, PM₁₀ and PM_{2.5} measured at Victoria Road by WCBC's automatic monitor are provided in **Table 6**. Concentrations of NO₂ measured using diffusion tubes in the vicinity of the Application Site by WCBC are shown in **Table 7**.

Table 6 - WCBC Automatic Air Quality Monitoring Data

Site Name	Site Type	Distance to Site (km)	Pollutant	Annual Mean NO ₂ Concentration (µg/m ³)*				
				2016	2017	2018	2019	2020
Victoria Road AURN (Wrexham AURN)	Roadside	0.8	NO ₂	18.8	16.5	18.2	16.0	13.0
			PM ₁₀	-	-	-	12.0	11.0
			PM _{2.5}	-	-	-	8.0	7.0

* North Wales Authorities Collaborative project (2021) Air Quality Progress Report

Table 7 - Local Authority Air Quality Monitoring Data

Site Name	Site Type	Distance to Site (km)	Annual Mean NO ₂ Concentration (µg/m ³)*				
			2016	2017	2018	2019	2020
30 (Rhostyllen Roundabout)	Roadside	1.1	35.8	33.1	34.9	31.7	26.3
38 (Pentre Bach)	Roadside	0.05	-	-	-	16.5	12.5
50 (Llys Y Groes)	Roadside	0.5	-	-	-	19.6	14.7

* North Wales Authorities Collaborative project (2021) Air Quality Progress Report

- 4.5.3 Concentrations at the AURN monitor and all reported diffusion tubes show concentrations below the relevant air quality objectives. After an initial rise in NO₂ concentrations between 2017 and 2018, concentrations for the Victoria Road AURN and DT30 showed a reduction between 2018 and 2020. It should be noted however, that 2020 concentrations will have been impacted by the travel restrictions brought in during the Covid-19 pandemic and therefore may not be representative of normal conditions.
- 4.5.4 The monitoring location likely to be most representative of air quality conditions at the Site is diffusion tube 38, as this is under 50m from the Site boundary alongside Ruthin Road. Concentrations of NO₂ measured at this location were 16.6 µg/m³ in 2019 and 12.5 µg/m³ in 2020, with the notable decrease in 2020 being likely associated with the travel restrictions in force during the pandemic. Nevertheless, the concentrations measured at diffusion tube 38 indicate that air pollutant levels within the Application Site will be well within the air quality objectives.
- 4.5.5 Given the above analysis of baseline conditions, which indicated that existing air quality is good, the Application Site is considered to be suitable for the proposed land uses.

5 ASSESSMENT OF POTENTIAL ODOUR EFFECTS

5.1 SOURCE-PATHWAY-RECEPTOR ASSESSMENT

SOURCE

- 5.1.1 The primary source which has potential to give rise to odour nuisance for existing and proposed local sensitive receptors is the proposed WwTW located 50m within the south and east boundaries of the Proposed Development. The primary sources of odour within the WwTW are the inlet screening, where rag and grit are removed from incoming sewage, and the balance tank, where incoming sewage is fermented to produce conditions for biological nutrient removal. At the time of the assessment, the WwTW was not completed or operational and as such, the assessment of odour potential from the proposed WwTW has been made using information provided from the project team and using professional judgement.
- 5.1.2 With reference to the FIDOL method and the IAQM odour guidance⁵, WwTWs are considered to have a large source odour potential. However, with reference to the Odour Impact Assessment of a similar NUTREM plant in **Appendix B** and the conclusion that this type of WwTW would not cause any loss of amenity, annoyance, nuisance or complaint beyond 10-15m from the plant boundary, the proposed WwTW has been classified as having an, at worst, medium odour potential.
- 5.1.3 There are no other significant odour sources in proximity to the Application Site that have potential to cause an odour nuisance.

PATHWAY

- 5.1.4 The proposed WwTW is located within the Application Site towards the southeast boundary. The nearest existing residential receptors are located 66m to the east of the proposed WwTW plant boundary on Homestead Lane and The Homestead. Future residential and educational receptors are proposed at 50m from the WwTW.
- 5.1.5 The effectiveness of the pathway between the WwTW and the identified receptors has been assessed based on hourly meteorological data from Hawarden Airport, which is located approximately 12km to the west of the Proposed Development and is considered to be representative of conditions at the Application Site. Five wind roses have been generated, each representing annual data from 2016 to 2020 inclusive, and are shown in **Appendix C**. The wind roses indicate that the predominant wind direction is from the southeast, with a secondary wind component from the northwest.

Table 8 shows data taken from this station between 2016 and 2020, specifically the wind direction and the percentage of time annually that winds blow from each direction.

Table 8 – Wind Direction Percentage

Origination of wind direction (°)	Percentage of days per year (%)				
	2016	2017	2018	2019	2020
N-NE (0°-90°)	9.2	5.1	9.2	9.2	7.9
S-SE (90°-180°)	33.3	32.1	35.3	35.3	33.6

Origination of wind direction (°)	Percentage of days per year (%)				
	2016	2017	2018	2019	2020
S-SW (180°-270°)	27.1	30.5	25.4	25.4	29.7
N-NW (270°-360°)	30.0	29.8	27.7	27.7	27.5
No data	0.3	2.5	2.4	2.4	1.3

- 5.1.6 In all years the prevailing winds were blowing from a south-easterly direction (90°-180°) for over 32.1% of the year. A secondary wind component from the northwest (270°-360°) occurred for over 27.5% of each year analysed. South-westerly winds (180°-270°) occurred for over 25.4% of the year and winds from the north-east (0°-90°) were present for under 10% of the time.
- 5.1.7 An analysis of these data over a five-year period shows that the majority of the south-easterly winds in each year (>79.1%) are of low speed (0.1 to 5.4m/s). A further 12.7% - 16.7% are moderate winds equal to 5.5 to 7.9m/s, with 4.2% or less being high speed winds of 8m/s or above.
- 5.1.8 The majority of the hours when the wind originates from a north-westerly direction (>80.1%) are of low speed (0.1 to 5.4m/s). A further 13.7% - 16.6% of hours show moderate winds equal to 5.5 to 7.9m/s, with 3.3% or less being high speed winds of 8m/s or above.
- 5.1.9 The majority of existing receptors in proximity to the Application Site are located to the east and southeast of the Site. Receptors to the east and southeast are at the most risk of experiencing odour, particularly during periods when north-westerly winds are present, which make up approximately 28% of hours throughout the year. These off-site receptors would be considered to be at higher risk of odour impact during periods of low speeds due to the reduced likelihood of odour being dispersed. Based on the above analysis, 80.1% of all hours of windspeed from the northwest are low speed winds that may increase the risk of odour at nearby receptors to the southeast.
- 5.1.10 On the occasions that the south-easterly wind is blowing, odours emanating from the WwTW would be blown towards the proposed residential and school receptors, which will be located at a minimum distance of 50m from the proposed WwTW.
- 5.1.11 With reference to the IAQM guidance⁵, the pathway from the odour source (WwTW) to the existing off-site receptors located to the east on Homestead Lane, The Homestead and surrounding residential roads, is considered to be *moderately effective* based on the prevalence of north-westerly winds and the frequency of low speed winds that may reduce dispersion of odour. However, the distance between these receptors and the source is beyond the recommended buffer distance.
- 5.1.12 The pathway from the WwTW to the proposed residential units and school will also be *moderately effective*, based on the high percentage of winds from the southeast, in addition to the high frequency of calm wind conditions limiting dilution and dispersion. However, as both residential and school properties will be located at a minimum distance of 50m from the WwTW boundary, this will limit pathway effectiveness. The pathway from the WwTW to the proposed local community centre will be ineffective, primarily due to the distance between the source and receptor (770m).

RECEPTORS

- 5.1.13 The relevant odour sensitive receptors, as referenced above and shown in **Figure 3-1**, include:

- Residential receptors on Homestead Lane and The Homestead, located approximately 66m to the east of the WwTW plant boundary.
- Residential receptors on High Ridge Drive, located approximately 95m to the southeast of the WwTW.
- Residential receptors on Pentre Bach, located approximately 471m to the north of the WwTW.
- Ysgol Clywedog, a local primary school, located approximately 189m to the northeast of the WwTW.
- Proposed residential receptors within the Proposed Development, the nearest of which will be 50m to the west of the WwTW. A school is also proposed at a minimum distance of 50m to the north-northwest of the WwTW. A local community centre is proposed at a minimum distance of 770m to the northwest of the WwTW.

5.1.14 Given the type and proximity of both existing and proposed sensitive receptors, the sensitivity of these receptors to odours is classified as *high*, with reference to **Table 2**.

LIKELY MAGNITUDE OF ODOUR EFFECT

5.1.15 Based on the above analyses, the likely magnitude of odour effect at the identified sensitive receptors is summarised in **Table 9**, using the matrices presented in **Table 3** and **Table 4**, with reference to the IAQM guidance.

Table 9 – Likely odour effects at existing and proposed sensitive receptors

Receptor Details and distance from WwTW	Source Odour Potential	Pathway Effectiveness	Risk of Odour Exposure	Receptor Sensitivity	Likely Magnitude of Odour Effect
The Homestead (Residential 66m, downwind)	Medium	Moderately effective, based on the prevalence of north-westerly winds and potential for calm conditions to influence dispersion, but also the distance from source to receptor being beyond the recommended buffer distance.	Low	High	Slight Adverse
High Ridge Drive (Residential, 95m, downwind)	Medium	Moderately effective, based on the prevalence of north-westerly winds and potential for calm conditions to influence dispersion, but also the distance from source to receptor being beyond the recommended buffer distance.	Low	High	Slight Adverse

Receptor Details and distance from WwTW	Source Odour Potential	Pathway Effectiveness	Risk of Odour Exposure	Receptor Sensitivity	Likely Magnitude of Odour Effect
Pentre Bach (471m, downwind)	Medium	Ineffective due to distance from WwTW.	Negligible	High	Negligible
Ysgol Clywedog (educational, 189m, downwind)	Medium	Ineffective due to distance and direction from WwTW, within context of recommended buffer distance.	Negligible	High	Negligible
Proposed School development (50m, downwind)	Medium	Moderately effective, based on the prevalence of south-easterly winds and potential for calm conditions to influence dispersion, but also the distance from source to receptor being at the maximum recommended buffer distance.	Low	High	Slight Adverse
Proposed Local Community Centre	Medium	Ineffective due to distance from WwTW	Negligible	Medium	Negligible
Proposed Residential Receptors (50m, potentially downwind)	Medium	Moderately effective, based on potential for calm conditions to influence dispersion. Low number of winds from east-northeast and also the distance from source to receptor being at the maximum recommended buffer distance will limit effectiveness.	Low	High	Slight Adverse

5.1.16 The source odour potential from the WwTW, before mitigation, is considered to be *medium* and the pathway effectiveness for proposed residential and school properties is considered to be *moderately effective*, with all identified existing and proposed sensitive receptors located at or beyond 50m from the WwTW, which is equal to the buffer distance for the plant as per the Proposed Development Masterplan. With reference to **Table 3**, this indicates a *low risk* of odour exposure and, given the high sensitivity of these proposed receptors, the likely magnitude of odour effect will be *slight adverse* in the absence of any further mitigation.

- 5.1.17 The existing sensitive receptors to the southwest on The Homestead and High Ridge Drive are considered to have a *moderately effective* pathway, predominantly due to the prevalence of north-westerly winds and the potential for calm conditions to influence dispersion odour emissions within 100m from the WwTW. However, all receptors are located beyond the recommended buffer distance for the WwTW, so this will limit the pathway effectiveness. This equates to a *negligible risk* of odour exposure for these existing receptors. Given the high sensitivity of these existing receptors, the likely magnitude of odour effect will be *slight adverse* in the absence of any further mitigation.
- 5.1.18 Existing residential receptors at Pentre Bach, the school receptor at Ysgol Clywedog and the proposed local community centre are beyond 450m, 150m and 770m, respectively, of the proposed WwTW. As such, the pathway for odour emissions will be *ineffective* within the context of the recommended buffer distance for the plant. The associated risk of odour exposure is *negligible* and, despite the high and medium sensitivity of these receptors, the likely magnitude of odour effect will also be *negligible*.

6 MITIGATION

6.1 ODOUR MITIGATION FOR WWTW

- 6.1.1 In the absence of any specific odour mitigation at the WwTW beyond those inherent to the design of the plant, the likely magnitude of odour effect at the identified existing and proposed sensitive receptors will be, at worst, *slight adverse*.
- 6.1.2 To ensure that there is no loss of amenity or nuisance to surrounding receptors due to odour, a 30-50m buffer is recommended for the NUTREM WwTW plant, within which no sensitive receptors should be located, based on the conclusions of an Odour Impact Assessment undertaken by ACCON, presented as **Appendix B**. Plantworks, the WwTW suppliers for the proposed WwTW, have recommended a minimum 40m buffer to reduce disturbance to nearby receptors during the construction and operational phases of the WwTW. Whilst this buffer has not been recommended specifically for odour risk, it does align with the findings of the ACCON report. The Proposed Development Masterplan allows for a 50m buffer for the WwTW, within which no sensitive receptors will be located, which aligns with the recommendations provided by Plantworks, the WwTW plant supplier.
- 6.1.3 Although the NUTREM system is unlikely to generate significant odour emissions based on the current design, the screening, grit removal and sludge handling processes can be enclosed to provide an additional barrier to odour emissions, thus mitigating odour risk further. The plant also has the option to utilise an odour scrubber to further mitigate odour risk.
- 6.1.4 Enclosing the aforementioned treatment processes is recommended to reduce the source odour potential further, which would effectively reduce the likely magnitude of odour effects from *slight adverse* to *negligible* at all identified receptors.

6.2 POTENTIAL ADDITIONAL ASSESSMENT

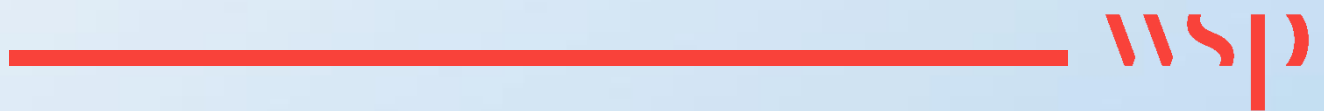
- 6.2.1 Given the likely negligible residual odour effect at all receptors, which are located at the maximum recommended buffer distance from the WwTW and beyond, the additional option of installing an odour scrubber is not considered necessary at this stage. However, further quantitative assessment of potential odour impacts (i.e. using atmospheric dispersion modelling) could be undertaken to confirm the assessment findings.

7 CONCLUSIONS

- 7.1.1 This report presents to outcomes of a qualitative risk assessment on the potential odour effects from a Proposed WwTW, located within a residential led development located on land south of Ruthin Road. An odour risk assessment is required due to the WwTW potential proximity to existing and proposed residential and educational receptors.
- 7.1.2 The proposed WwTW will utilise a Biological Nutrient Removal System (BNR) called NUTREM. This processes the wastewater using a system that is considered to be near odourless and further mitigation measures can be included within the NUTREM system to reduce odour risk further, if deemed necessary. These include covering of the primary treatment and sludge storage tanks and, if required, the use of an odour scrubber.
- 7.1.3 A separate Odour Impact Assessment completed for a similar WwTW plant at the Plantworks Petersfield Site, presented as **Appendix B** to this document, recommended the implementation of a 30-50m buffer to reduce odour nuisance and loss of amenity to sensitive receptors. The Proposed Development Masterplan allows for a 50m buffer for the WwTW, within which no sensitive receptors will be located, which aligns with the recommendations provided by Plantworks, the WwTW plant supplier.
- 7.1.4 In addition to an odour risk assessment, this report has also considered the baseline and future potential air quality conditions at the Application Site to assess the Sites suitability for the proposed land uses.
- 7.1.5 A review of baseline air quality information and monitoring data near to the Application Site concluded that existing levels of key air pollutants – NO₂, PM₁₀ and PM_{2.5} – are not likely to exceed the relevant air quality objectives now or in the future. The Proposed Development is not located within or near an AQMA and air quality at the Application Site is considered to be good.
- 7.1.6 A qualitative assessment of the potential odour effects of the WwTW on nearby receptors has been completed with reference to the IAQM methodology⁴. The assessment has been completed using the Source-Pathway-Receptor approach and has identified that the likely magnitude of odour effects at the identified existing and proposed sensitive receptors will be, at worst, slight adverse, in the absence of further mitigation.
- 7.1.7 However, through enclosing the aforementioned primary treatment and sludge handling processes at the WwTW, the source odour potential could be reduced further, which would effectively reduce the likely magnitude of odour effects to *negligible* at all identified receptors.
- 7.1.8 Given the likely negligible residual odour effect at all receptors, which are located at the maximum recommended buffer distance (50m) from the WwTW and beyond, the additional option of installing an odour scrubber is not considered necessary at this stage. However, further quantitative assessment of potential odour impacts (i.e. using atmospheric dispersion modelling) could be undertaken to confirm the assessment findings.

Appendix A

PROPOSED MASTERPLAN





Key

Existing

Application Boundary (72.85ha)

Trees/Woodland

Hedgerow

Watercourse

Public Right of Way (PRoW) Footpath

Public Right of Way (PRoW) Bridleway

Public Right of Way (PRoW) BOAT

Proposed

Residential Development up to 1430 dwellings (37.57ha)

Wastewater Treatment Plant (if necessary) with 50m Easement (2.55ha)

2FE Primary School Site (1.62ha)

Local Centre with possible nursery, shops, cafe, public house and community facilities subject to viability(1.46ha)

Telecom Mast Exclusion Zone

Spine Road with Tree Avenue, Landscape Verge and Swale

Secondary Road/Shared Drive

Emergency Access

Footpath

Footpath Cycleway

Footpath Cycleway Off Road

Public Open Space (15.98ha)

Strategic Open Space (7.89ha)

Drainage Attenuation (1.96ha)

Tree Planting

Hedgerow Planting

Neighbourhood Equipped Area for Play (NEAP)

Multi Use Games Area (MUGA)

Locally Equipped Area for Play (LEAP)

Local Area for Play (LAP)

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F	Title amended to Option 1	SO	NKH	07/08/23
E	Spine Road and NDA amended	NKH	NKH	23/03/23
D	Removal of WG highway scheme	NKH	NKH	17/03/23
C	Updates following DTM 09/01/23	AG	NKH	01/02/23
B	Updates following DTM 06/12/22	AG	NKH	07/12/22
A	Updates to trees, WWTW, local centre layout and access as per client comments	AG	NKH	23/11/22
Rev	Description	Drawn	Approved	Date

TEP

THE ENVIRONMENT PARTNERSHIP

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Project
Lower Berse Farm, Ruthin Road, Wrexham

Title
Masterplan Framework - Option 1

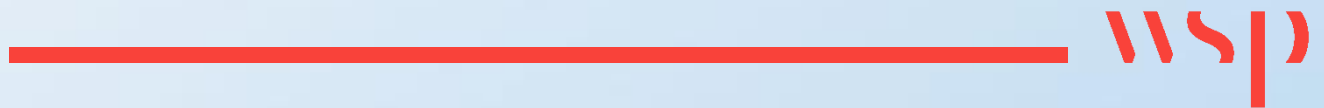
Drawing Number
D9730.001F

Scale 1:2500 @ A1	Date 21/11/2022
Drawn EL	Checked NKH
	Approved NKH

- 1 Residential development up to 1430 dwellings
- 2 Two site access points onto the A525 Ruthin Road
- 3 Two site access points onto Bersham Road
- 4 Main access roads suitable for buses with active travel walking and cycling routes, tree avenue planting and landscape verges with swales for drainage
- 5 Site for a primary school up to 2FE located close to the existing high school
- 6 Provision of a wastewater treatment plant (if necessary) at the lowest part of the site or, if the treatment plant is not required then additional housing
- 7 Local centre reflecting historic courtyard layout with Lower Berse Farmhouse and associated buildings of heritage value retained and enhanced
- 8 Development blocks to front onto existing and proposed roads and open space to create active frontages
- 9 Development overlooking Ruthin Road and set back to create a green frontage to the road
- 10 Development to sensitively integrate with Bersham Conservation Area and create a rural character along Bersham Road and Berse Lane
- 11 Variations in density and building heights to be used to create different character areas with lower density development to the south and west to respect the Conservation Area and rural character
- 12 Development set back from the existing dwelling Bryn-moel at the site centre
- 13 East-west green corridor and active travel route along the PRoW Bridleway with buffers to development and central open space
- 14 Northeast southwest green link and active travel route along PRoW connecting Bersham to Wrexham and providing a wildlife corridor
- 15 Retention of the existing watercourse as a wildlife corridor and feature providing a green link through the northern part of the site
- 16 Retention of existing landscape features to create a strong landscape framework, including important hedgerows, veteran trees, and ancient woodland
- 17 Drainage attenuation basins integrated at low parts of the site and along primary roads as swales
- 18 Land to the south of the site retained as a strategic green space and Green Wedge to Bersham
- 19 Series of distinctive and attractive green spaces through the development to create a sense of place and legibility with play provision focused along the PRoW Bridleway at the centre of the site
- 20 Ancient Woodland adjacent Berse Lane protected and sensitively integrated with development with public access restricted
- 21 Access to the western development parcel from Berse Lane or if feasible from development on the east side of Berse Lane. Consider potential access/interconnectivity between development if Berse Lane closed and becomes a Greenway, or provide emergency access and ped cycle connection
- 22 Potential to close Berse Lane and Holmstead Lane to vehicles and create Greenways as active travel walking and cycling routes

Appendix B

LETTER OF SUPPORT AND AIR QUALITY IMPACT ASSESSMENT



Letter of support

Wastewater strategy

Ruthin Road, Wrexham

Author: William Mackveley

Date: June 2023

Letter of support: Wastewater strategy

ONSITE WASTEWATER STRATEGY FOR RUTHIN ROAD, WREXHAM.

ST Connect have been appointed by Redrow Homes to work alongside their technical advisors to develop a feasible foul water drainage and treatment strategy, at their proposed development known as Ruthin Road near Wrexham. It is expected that the development will be in the region of 1,500 homes.

ST Connect

ST Connect are an Ofwat-regulated water company appointed by the Secretary of State to provide wastewater and surface water management services in England and Wales. We have a strong track record for designing, building, owning and operating wastewater treatment assets (including foul and surface sewerage infrastructure) and are part of the wider Severn Trent Group, which in its portfolio has one of the UK's largest water and sewerage companies.

We are familiar with the environmental challenges to developments resulting from both a chronic lack of available sewerage capacity, and nutrient pollution; as a result, we are helping our clients to develop effective wastewater management strategies. The company is well placed to do this, given our experience and effective relationships with the statutory environmental regulators.

Proposed wastewater treatment and disposal strategy summary

Foul sewage from all properties will be collected and conveyed through a separate foul-only sewerage system to the onsite wastewater treatment works (WwTW). Following treatment to the required standards, final effluent will be discharged into a drainage system out falling into the River Clywedog.

Having assessed all relevant site constraints and considering the scale of the development we are confident that a WwTW can be delivered and adopted on this site.

Our treatment strategy will comprise of an ST Connect designed and built onsite WwTW; which shall be adopted, maintained, and operated in the long-term by ST Connect in our capacity as the local statutory wastewater undertaker.

ST Connect would operate the WwTW complying with a Natural Resources Wales (NRW) discharge permit for Phosphorous removal level(s) in-line with the Nutrient Neutrality requirements of 0.2 mg/l Total Phosphorous (and any other parameters set by the NRW).

Asset and treatment process resilience

Detailed designs of the WwTW have not yet been commissioned, however ST Connect, will propose to construct a state-of-the-art facility, based on an advanced form of activated sludge treatment, see Design Statement below.

The system is particularly resilient to catchment contamination events or natural variation of inbound wastewater concentration, due to the significant dilution factors provided by the large balancing tank at the head of the works. The treatment processes will be configured to allow for bolt-on technologies to meet more stringent permits; should they become required in the future.

The design will include inherent capacity and asset redundancy which shall all but remove the risk of permit compliance failure. In a worst-case scenario of significant system failure, raw and/or part-treated sewage shall be isolated and tankered to a suitable off-site facility for safe treatment and disposal.

Sludge management

Organic sludges generated during the treatment process which cannot be treated onsite will be periodically removed by tanker for further processing at a nearby sludge treatment centre to generate sustainable energy from biogas. The remaining by-product, sludge cake is sold as an organic fertiliser. It should be noted that, were farmers within the River Clywedog catchment to use this source of fertiliser, it would act as a direct replacement of other sources of fertilisers (such as inorganic chemical fertilisers).

Long-term asset performance

The onsite treatment system will be designed and built to our adoptable standards, and therefore be owned and operated by ST Connect in its capacity as the local wastewater undertaker; subject to a licence variation being granted by Ofwat. The assets will therefore be considered “public” assets by NRW, which the company shall have a duty to maintain and operate effectively in perpetuity in line with its licence obligations.

The treatment system shall have in place both planned and reactive operations and maintenance arrangements to ensure the good upkeep of assets and effective wastewater treatment. In addition, the facility will benefit from remote telemetry and sensors to monitor site condition and treatment processes effectiveness.

Natural Resources Wales wastewater discharge permit

A wastewater discharge permit from NRW will be required to operate the onsite WwTW. ST Connect will apply to NRW for the required permit having undertaken the necessary studies (including a water quality and quantity study). It is important to note that as a statutory wastewater undertaker, ST Connect is able to obtain discharge permits within sewerage areas (within the geographic areas of appointment of other wastewater

undertakers, such as Welsh Water DCWW) – NRW don't distinguish between licence applications / variations made by ST Connect and those made by incumbent water companies.

Conclusion

ST Connect in its capacity as a competent sewerage undertaker, experienced in the construction and long-term operations of sewage treatment assets is satisfied that a public onsite wastewater treatment system can be designed, built, adopted, operated, and maintained within the Ruthin Road development.

We look forward to continuing to develop the wastewater treatment strategy for this development site and are happy to be able to contribute to Wrexham County Borough Council's housing delivery plans in a sustainable way.

Yours sincerely



William Mackveley
General Manager
Severn Trent Connect

Design statement

Onsite wastewater treatment works

Wastewater treatment works overview

This design statement provides an overview of the required wastewater treatment works (WwTW) at the proposed development known as Ruthin Road near Wrexham – which is to be designed in accordance with the site-specific Nutrient Neutrality requirements, where treated final effluent shall contain not more than 0.2 mg/l Total Phosphorous.

Wastewater treatment processes

Inlet flows

Wastewater arriving at the WwTW passes through the inlet works, where a series of screens remove wipes, grit, and other matter not suitable for onward treatment.

Balance tank / fermenter

The screened wastewater is transferred to the covered balance tank / fermenter (BTF). The BTF serves two distinct purposes in the treatment cycle. Firstly, it is used to balance the incoming flows prior to being passed forward for processing in the Reactors. Its second function is to act as an anaerobic fermenter; crucial to enable the Phosphorus Accumulating Organisms present in the Reactors to super absorb Phosphorus.

Reactors

The Reactors use simultaneous fill and decant, whereby the treated water is discharged using a piston effect created by the introduction of the fermented, raw, screened sewage. This influent is introduced at the bottom of the tank where it is gently mixed with the settled biomass using the hyperboloid mixer. The sludge blanket remains undisturbed, whilst the clean effluent in the top of the tank is discharged.

Once the fill/decant stage is complete, and the influent has had appropriate contact time with the biomass, the aerobic and anoxic treatment stages are carried out. The duration and timing of these phases are varied dependent on specific site conditions and permit requirements.

Sludge thickening

The sludge generated by the process can be thickened using sludge thickening equipment. Thickened sludge is held in the aerated sludge storage tank, whilst supernatant is returned to the head of works.

Aerated sludge storage

Thickened sludge is stored within this tank and periodically aerated using a coarse bubble aeration grid to prevent the sludge thickening too much at the bottom of the tank and to prevent the sludge becoming septic and causing odour issues.

Final effluent discharge

The final effluent discharged from the reactors, flows through a sample chamber prior to discharging to the River Clywedog. Should there be a restriction on the permitted discharge flow rate, then an attenuation tank can be included.

STC4000

A detailed design of the proposed Ruthin Road WwTW, designated “STC4000” has not yet been undertaken, however, the design will be based on ST Connect’s standard designs for facilities of this scale; the closest of which is the “STC3000”, which utilises the above-described treatment processes.

The rendered images below are of an STC3000 which has been proposed to serve a residential development of ca. 1,200 homes near Tonbridge, Kent.



Figure 1 STC3000 Tonbridge – overhead view



Figure 2 STC3000 Tonbridge – entrance view

Dimensions

The table below displays the dimensions of the STC3000, these can be used as a proxy for the required STC4000 facility at Ruthin Road development.

Item	Dimensions
Compound width	33m
Compound length	70m
Compound area	2,310m ²
Maximum building height (exc. access gantries)	6.4m
Maximum building height (inc. access gantries)	7.5m

Noise

A site-specific noise impact assessment (NIA) for Ruthin Road has not been undertaken with reference to an onsite WwTW. However, a NIA was undertaken in January 2022 at a demonstrator WwTW utilising the proposed treatment process to inform stakeholders on the minimum stand-off distances from these facilities. A full copy of the report can be found in Appendix 03.

There are various assets on the WwTW which generate noise; the air blowers are responsible for generating the most powerful noise emissions on the plant – accordingly they shall be housed within acoustic enclosures to provide attenuation. The risk of adverse impact to Noise

Sensitive Receptors (NSRs) is low, and subject to an appropriate level of mitigation, principally to any blower units, then it should be possible to site any properties within 50 metres of the WwTW.

Odour

A site-specific odour impact assessment (OIA) for the Ruthin Road has not been undertaken with reference to an onsite WwTW. However, an OIA was undertaken in January 2022 at a demonstrator WwTW utilising the proposed treatment process to inform stakeholders on the minimum stand-off distances from these facilities.

The study was undertaken by a competent consultant in accordance with published guidance from the Department for Environment, Food & Rural Affairs, the Environment Agency, the Institute of Air Quality Management, and statements from bodies such as the Chartered Institution of Water and Environmental Management, and UK Water Industry Research to determine the potential odour impact of the sewage treatment works on proposed developments. A full copy of the report can be found in Appendix 04.

The assets with the greatest potential for nuisance odour emissions are the inlet works, balance tank / fermenter and sludge holding tanks. These assets shall be designed and configured in a way which minimises their odour emissions. For example, the inlet works shall be covered, the balance tank / fermenter shall be sealed to the environment, and the sludge holding tanks will be aerated to prevent sludge becoming septic. As such, it is not considered that the WwTW would cause a loss of amenity, annoyance, nuisance, or complaints for future occupiers of the development in close proximity (30-50m) to the WwTW.

Performance certificates: Nutrient removal

A twelve-month trial of maximum nutrient removal (without additional tertiary treatment) at the Petersfield demonstrator WwTW was undertaken between February 2021 and February 2022. The demonstrator plant takes raw, screened sewage from Southern Water's main Petersfield WwTW, for treatment at the demonstrator facility, before treated effluent is discharged back into Southern Water's main works. The table below shows the average results throughout the study (full sample data can be found in Appendix 01). Current trials of the process with additional tertiary treatment are consistently performing below the proposed limit of 0.2 mg/l Total Phosphorus.

Table 1 Final effluent sampling averages

Determinand	Average	Units
BOD	2.45	mg/l
TSS	5.77	mg/l
Ammoniacal Nitrogen as N	0.157	mg/l
Phosphorous, Total	251.4	µg/l
Phosphate, Orthophosphate as P	0.04	mg/l
Nitrogen, Total	3.96	mg/l

Sample collection was carried out by Plantworks Systems and sent to ALS Environmental for accredited analysis. Example certificates can be found in Appendix 02

Appendix 01: Full sample data

	Date	17/02/2021	18/02/2021	22/02/2021	05/03/2021	08/03/2021	12/03/2021	15/03/2021	19/03/2021	22/03/2021	15/04/2021	05/05/2021	07/05/2021	02/06/2021	04/06/2021	11/06/2021	19/06/2021
	Time	16:30:00	16:20:00	09:20:00	16:30:00	09:30:00	16:30:00	09:15:00	16:30:00	09:30:00	09:30:00	14:30:00	14:30:00	14:30:00	14:30:00	14:30:00	14:30:00
BOD	mg/l	<10	<10	1.92		4.85	<1	3.22	<10	5.48	3.32	5.28	6.66	6.88	2.3		
TSS	mg/l	7.3	3.15	3.05	4.85	13	5.1	5.65	5.1	4.7	17.8	10.8	9.7	6.85	9.25	7.7	3.6
Amm. N	mg/l	0.271	0.039	0.047	0.06	0.177	0.05	0.031	0.057	0.103	<0.01	0.054	0.237	0.098	0.035		
TP	µg/l	301	147	133	161	521	231	272	230	156	645	398	299			215	123
Ortho-P	mg/l	<0.02	<0.02	<0.02	<0.02	0.0989	0.0656	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.0326	<0.02	<0.02	<0.02
TN	mg/l	2.14	1.4	2.18	1.44	2.54	1.62	1.9	2.22	3.35	3.24	4.19			4.1		
	Date	24/06/2021	01/07/2021	05/07/2021	06/07/2021	09/07/2021	09/07/2021	14/07/2021	19/07/2021	22/07/2021	29/07/2021	02/08/2021	09/08/2021	23/08/2021	26/08/2021	31/08/2021	01/09/2021
	Time	14:30:00	13:30:00	13:30:00	09:30:00	10:15:00	13:30:00	13:30:00	13:30:00	17:30:00	13:30:00	13:30:00	13:30:00	13:45:00	13:30:00	13:30:00	09:30:00
BOD	mg/l		6.82	<1	<1	<1	<1	<1	2.02	2.32	2.02	<1	<1	3.65	2.33	2.27	2.52
TSS	mg/l	9.15	10	8.7	7.95	<2	3.2	5.3	7.95	5.63	3.65	3.65	6.85	5.1	5.75	3.6	8.2
Amm. N	mg/l		0.205						0.032	0.059	0.014	0.023	0.012	3.17	0.049	0.018	0.013
TP	µg/l	200	379	184	198	97.1	157	187	199	262	160	156	181	239	244	190	472
Ortho-P	mg/l	<0.02	0.12						0.0232	0.0313	<0.02	<0.02	<0.02	0.0268	<0.02	<0.02	0.187
TN	mg/l		4.74	3.44	5.37	4.4	2.47	3.11	5.24	6.96	3.5	3.06	2.74	5.62	2.82	4.43	7.76
	Date	11/09/2021	13/09/2021	21/09/2021	06/10/2021	12/10/2021	15/10/2021	19/10/2021	22/10/2021	22/10/2021	29/10/2021	29/10/2021	03/11/2021	03/11/2021	03/11/2021	15/11/2021	17/11/2021
	Time	13:30:00	13:30:00	13:30:00	13:00:00	13:00:00	12:50:00	12:57:00	11:15:00	13:00:00	11:55:00	14:15:00	09:30:00	13:30:00	13:35:00	14:30:00	10:33:00
BOD	mg/l	2.04	2.37		<1	<1	2.07	<1	2.2	<1	2.77	<1	<1	<1	<1	2.16	2.16
TSS	mg/l	5.15	5.35	8.25	2.65	3.05	6.15	9.25	3.25	2.05	4.3	5.55	<2	3.1	<2	4.3	2.05
Amm. N	mg/l	0.029	0.024	0.022		0.03	0.071	0.031	0.132	0.086	0.209	0.037	0.158	0.026	0.1	0.198	0.398
TP	µg/l	180	187	116	212	116	211	260	191	132	248	207	148	148	130	255	380
Ortho-P	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.0238	<0.02	0.0721	<0.02	0.0578	<0.02	0.0457	0.0747	0.272
TN	mg/l	2.29		3.6	2.45	3.61	2.2	4.37	2.46	3.02	2.74	2.07	3.16	1.94	3.17	4.02	4.87
	Date	17/11/2021	22/11/2021	22/11/2021	25/11/2021	25/11/2021	30/11/2021	30/11/2021	04/12/2021	04/12/2021	05/12/2021	06/12/2021	05/01/2022	05/01/2022	10/01/2022	11/01/2022	12/01/2022
	Time	14:45:00	09:45:00	13:45:00	10:15:00	10:45:00	09:40:00	13:34:00	07:30:00	13:45:00	09:40:00	13:35:00	12:15:00	12:20:00	18:45:00	13:30:00	09:30:00
BOD	mg/l	2.64	2.23	2.75	<1	<1	1.87	2.4	3.58	4.8	12.7	2.99	<1		4.14	2.36	3.3
TSS	mg/l	8.2	4.8	7.35	<2	5.45	4.05	8	6.75	7.65	7.35	3.8	4.55	<2	12.3	4.05	5.15
Amm. N	mg/l	0.037	0.315	0.028	0.041	0.061	0.05	0.034	0.145	0.172	0.111	0.055	0.089		0.036	0.036	1.18
TP	µg/l	270	331	273			275	329	327	318	380	235	199	365	434	219	245
Ortho-P	mg/l	<0.02	0.137	<0.02			<0.02	<0.02	0.0483	<0.02	0.0287	<0.02	<0.02	0.206	<0.02	<0.02	<0.02
TN	mg/l	5.56	5.12	5.4			6.59	6.78	9.03	3.44	4.75	3.34	6.21			3.97	7.75
	Date	14/01/2022	14/01/2022	17/01/2022	17/01/2022	27/01/2022	27/01/2022	09/02/2022	14/02/2022	14/02/2022	17/02/2022						
	Time	09:30:00	09:35:00	09:30:00	12:30:00	09:30:00	09:30:00	13:30:00	13:55:00	14:05:00	09:30:00						
BOD	mg/l	2.44	2.4	2.48	<1	3.99		2.81	2.31		2.48						
TSS	mg/l	3.2	3.35	9.45	7.05	9.05	5.15	3.15	4.1	2.4	8.85						
Amm. N	mg/l	0.032	0.32	0.095	0.051	0.055		0.059	0.243		0.055						
TP	µg/l	137	251	315	206	470	352	229	358	277	344						
Ortho-P	mg/l	<0.02	0.0702	0.0375	<0.02	0.0421	0.138	<0.02	0.095	0.0702	<0.02						
TN	mg/l	5.31			3.88	8.28		3.39	2.94	3.52	4.52						

Appendix 02: Example certificates



Validated

CERTIFICATE OF ANALYSIS

SDG: 210316-39 Client Reference: EBNet-NUTREM Sample Analysis Report Number: 591650
 Location: NUTREM Demo Site Order Number: 1291 Superseded Report:

Results Legend			Customer Sample Ref.	SAMPLE 01	SAMPLE 02	SAMPLE 03	SAMPLE 03F		
A	ISO17025 accredited.		Depth (m)						
M	mCERTE accredited.		Sample Type	Treated Sewage (TS)	Untreated Sewage (US)	Treated Sewage (TS)	Treated Sewage (TS)		
AS	Aqueous / solid sample.		Date Sampled	12/03/2021	15/03/2021	15/03/2021	15/03/2021		
disoln	Dissolved / filtered sample.		Sample Time	16:30:00	09:00:00	09:15:00	09:15:00		
totunfil	Total / unfiltered sample.		Date Received	16/03/2021	16/03/2021	16/03/2021	16/03/2021		
	Subcontracted - refer to subcontractor report for accreditation status.		SDG Ref	210316-39	210316-39	210316-39	210316-39		
	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within a sample aren't checked for the recovery.		Lab Sample No.(s)	23905514	23905515	23905516	23905517		
FI	Trigger breach confirmed.		AGS Reference						
1-99%	Sample deviation (see appendix)								
Component	LOD/Units	Method							
Suspended solids, Total	<2 mg/l	TM022	5.1	344	5.65	2.7			
			#	#	#	#			
BOD, unfiltered	<1 mg/l	TM045	<1	227	3.22	2.3			
			@ #	#	#	#			
Ammoniacal Nitrogen as N (low level)	<0.01 mg/l	TM099	0.05	61	0.031	0.03			
			2	2	2	2			
Phosphorus (totunfil)	<20 µg/l	TM152	231	9750	272	111			
			2 #	2 #	2 #	2 #			
Phosphate (Ortho as P)	<0.02 mg/l	TM184	0.0656	5.03	<0.02	<0.02			
			#	#	#	#			
Nitrogen, Total	<1 mg/l	TM212	1.62		1.9	1.9			
			#		#	#			



Validated

CERTIFICATE OF ANALYSIS

SDG: 210715-42 Client Reference: NBIC Project Report Number: 606704
Location: NUTREM DEMO Plant Order Number: PO-0097 Superseded Report:

Results Legend			Customer Sample Ref.	SAMPLE 01	SAMPLE 02	SAMPLE 03	SAMPLE 04	SAMPLE 05	
A	ISO17025 accredited.		Depth (m)	Treated Sewage (TS)	Treated Sewage (TS)	Treated Sewage (TS)	Treated Sewage (TS)	Treated Sewage (TS)	
M	mCERTE accredited.		Sample Type	06/07/2021	06/07/2021	09/07/2021	09/07/2021	14/07/2021	
AS	Aqueous / solid sample.		Date Sampled	13:30:00	09:30:00	10:15:00	13:30:00	13:30:00	
AS-FT	Decanted / filtered sample.		Sample Time	16/07/2021	15/07/2021	15/07/2021	15/07/2021	15/07/2021	
tot.unfilt	Total / unfiltered sample.		Date Received	210715-42	210715-42	210715-42	210715-42	210715-42	
-	Subcontracted - refers subcontractor report for accreditation status.		SDG Ref	24632963	24632964	24632968	24632969	24632970	
+	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within a sample are not corrected for the recovery.		Lab Sample No.(s)						
+	Trigger breach confirmed.		AGS Reference						
-deq@	Sample deviation (see appendix)								
Component	LOD/Units	Method							
Suspended solids, Total	<2 mg/l	TM022	8.7	7.95	<2	3.2	5.3		
			#	#	#	#	#	#	
BOD, unfiltered	<1 mg/l	TM045	<1	<1	<1	<1	<1		
			@ #	@ #	@ #	@ #	@ #	@ #	
Phosphorus (tot.unfilt)	<20 µg/l	TM152	184	198	97.1	157	187		
			2 #	2 #	2 #	2 #	2 #	2 #	
Nitrogen, Total	<1 mg/l	TM212	3.44	5.37	4.4	2.47	3.11		
			#	#	#	#	#	#	



Validated

CERTIFICATE OF ANALYSIS

SDG: 220115-70

Report Number: 630420

Superseded Report:

Client Ref.: Not Specified

Location: NUTREM DEMO Plant

Results Legend		Customer Sample Ref. Depth (m) Sample Type Date Sampled Sample Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
A ISO17025 accredited. M mCERIS accredited. aq Aqueous /subltd sample. disl.H Dissolved / filtered sample. tot.L(H) Total / unfiltered sample. - Subcontracted - refer to subcontractor report for accreditation status. - % recovery of the surrogate standard to check the efficiency of the method. The results of individual components within samples are all corrected for the recovery. FI - Filter or leach confirmed 1-5000 Sample deviation (see appendix)			Treated Sewage (TS)	Treated Sewage (TS)	Treated Sewage (TS)	Treated Sewage (TS)	Treated Sewage (TS)	Treated Sewage (TS)
			05/01/2022	05/01/2022	10/01/2022	11/01/2022	12/01/2022	14/01/2022
			12:15:00	12:20:00	19:45:00	19:30:00	09:30:00	09:30:00
			15/01/2022	15/01/2022	15/01/2022	15/01/2022	15/01/2022	16/01/2022
			220115-70	220115-70	220115-70	220115-70	220115-70	220115-70
			25051754	25051755	25051757	25051758	25051760	25051761
Component	LOD/Units	Method						
Suspended solids, Total	<2 mg/l	TM022	4.55	<2	12.3	4.05	5.15	3.2
			#	#	#	#	#	#
BOD, unfiltered	<1 mg/l	TM045	<1		4.14	2.36	3.3	2.44
			@ #	@ #	@ #	@ #	#	#
Ammoniacal Nitrogen as N (low level)	<0.01 mg/l	TM099	0.089		0.036	0.036	1.18	0.032
			2		2	2	2	2
Phosphorus (tot.unfil)	<20 µg/l	TM152	199	365	434	219	245	137
			2 #	2 #	2 #	2 #	2 #	2 #
Phosphate (Ortho as P)	<0.02 mg/l	TM184	<0.02	0.206	<0.02	<0.02	<0.02	<0.02
			#	#	#	#	#	#
Nitrogen, Total	<1 mg/l	TM212	6.21			3.97	7.75	5.31
			#			#	#	#

Report for:

Severn Trent Connect

Petersfield Demonstrator Wastewater Treatment
Works

Noise Impact Assessment

Status: Final

Date: 26.01.2022

Author	 Paul Sneddon Acoustic Consultant
Reviewed and Approved By	 Graham Parry Managing Director
Report For	Severn Trent Connect
Date	26.01.2021
Version Number	A4635/N/001
Status	Final

This report has been prepared by ACCON UK Limited with all reasonable care and diligence within the terms of the contract with the client. We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above. We accept no responsibility to third parties to whom this report, or any part, thereof is made available. Any such party relies upon the report at their own risk.

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1. INTRODUCTION

ACCON UK Limited (ACCON) has been commissioned by Severn Trent Connect to provide a Noise Impact Assessment to support planning applications where the Wastewater Treatment Works (WwTW) may be in close proximity to existing or proposed residential developments.

In order to assess the noise impacts from the WwTW, ACCON personnel carried out noise measurements at the Petersfield Demonstrator WwTW, as identified in **Figure 1.1**.

Figure 1.1 - Aerial view of the existing Petersfield site



A Glossary of Acoustic Terminology is provided in **Appendix 1**.

2. THE NATURE, MEASUREMENT AND EFFECT OF NOISE

Noise is often defined as sound that is undesired by the recipient. Whilst it is impossible to measure nuisance caused by noise directly, it is possible to characterise the loudness of that noise. 'Loudness' is related to both sound pressure and frequency, both of which can be measured. The human ear is sensitive to a wide range of sound levels. The sound pressure level of the threshold of pain is over a million times that of the quietest audible sound. In order to reduce the relative magnitudes of the numbers involved, a logarithmic scale of decibels (dB) is normally used, based on a reference level of the lowest audible sound.

The response of the human ear is not constant over all frequencies. It is therefore usual to weight the measured frequencies to approximate the human response. The resulting 'A' weighted decibel, dB (A), has been shown to correlate closely to the subjective human response.

When related to changes in noise, a change of ten decibels, for example, from 60 dB (A) to 70 dB (A), would represent a doubling in 'loudness'. Similarly, a decrease in noise, for example, from 70 dB (A) to 60 dB (A), would represent a halving in 'loudness'. A change of 3 dB (A) is generally considered to be just perceptible¹. **Table 2.1** details typical noise levels.

Table 2.1: Typical Noise Levels

Approximate Noise Level (dB(A))	Example
0	Limit of hearing
30	Rural area at night
40	Library
50	Quiet office
60	Normal conversation at 1 m
70	In car noise without radio
80	Household vacuum cleaner at 1 m
100	Pneumatic drill at 1 m
120	Threshold of pain

¹ Institute of Environmental Management and Assessment (2014). Guidelines for environmental noise impact assessment.

3. LEGISLATIVE/POLICY BACKGROUND

3.1. National Planning Policy Framework

The revised National Planning Policy Framework (NPPF as amended in July 2021) supersedes the 2012, 2018 and 2019 versions of the NPPF. The purpose of the planning system is to contribute to the achievement of sustainable development. There are three dimensions to sustainable development: economic, social and environmental. The environmental role is to contribute to protecting and enhancing our natural, built and historic environment; and as part of this, make effective use of land, help to improve biodiversity, use natural resources prudently, minimise waste and pollution, and mitigate to adapt to climate change including moving to a low carbon economy.

One of the core planning principles is to contribute to conserving and enhancing the natural environment and reducing pollution. Allocations of land for development should prefer land of lesser value, where consistent with other policies in the Framework. 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.

Paragraph 185 of the NPPF states:

“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. In doing so they should:

- a) Mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life (see Explanatory Note to the Noise Policy Statement for England (Department for Environment, Food and Rural Affairs, 2010));*
- b) Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.”*

Additionally, Paragraph 187 states:

“Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or ‘agent of change’) should be required to provide suitable mitigation before the development has been completed.”

3.2. Noise Policy Statement for England

The Noise Policy Statement for England (NPSE) was developed by DEFRA and published in March 2010. The vision of the NPSE is to *'Promote good health and good quality of life through the effective management of noise within the context of Government policy on sustainable development'*.

The Noise Policy Statement for England (NPSE) aims to *'through the effective management and control of environmental neighbour and neighbourhood noise within the context of Government policy on sustainable development:*

- *Avoid significant adverse impacts on health and quality of life;*
- *Mitigate and minimise adverse impacts on health and quality of life; and*
- *Where possible, contribute to the improvement of health and quality of life.'*

Based on concepts from toxicology, it introduces three 'Effect Levels' relevant to the assessment of noise. These are:

- NOEL: No Observed Effect Level: This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise;
- LOAEL: Lowest Observed Adverse Effect Level: This is the level above which adverse effects on health and quality of life can be detected; and
- SOAEL: Significant Observed Adverse Effect Level: This is the level above which significant adverse effects on health and quality of life occur.

3.3. Planning Practice Guidance

The Planning Practice Guidance for Noise (PPG-N) was published in March 2014 and most recently updated in July 2019. The PPG-N suggests that the most appropriate and cost-effective solutions to potential noise issues are best identified when good acoustic design is considered early in the planning process.

The PPG-N provides the following advice on how to determine the noise impact on development:

"Plan-making and decision making need to take account of the acoustic environment and in doing so consider:

- *Whether or not a significant adverse effect is occurring or likely to occur;*
- *Whether or not an adverse effect is occurring or likely to occur; and*
- *Whether or not a good standard of amenity can be achieved.*

In line with the Explanatory Note of the Noise Policy Statement for England, this would include identifying whether the overall effect of the noise exposure (including the impact during the construction phase wherever applicable) is, or would be, above or below the significant observed adverse effect level and the lowest observed adverse effect level for the given situation. As noise is a complex technical issue, it may be appropriate to seek

experienced specialist assistance when applying this policy.” (Paragraph 003 Reference ID 30-003-20190722)

The document goes on to acknowledge the levels of noise exposure at which an effect may occur as provided in the NPSE and introduces a fourth effect level:

- UAE: Unacceptable Adverse Effect: Extensive and regular changes in behaviour and/or an inability to mitigate the effect of noise lead to psychological stress or physical effects.

Where residential development is proposed in the vicinity of existing businesses, community facilities or other activities that produce noise, the PPG-N advises that the applicant (or ‘agent of change’) will need to clearly identify the effects of the existing businesses that may cause a nuisance (including noise) and clearly define the mitigation measures being proposed to address any potential significant adverse effects that are identified. The agent of change needs to not only consider the current activities of the business, but the permitted activities too, even if they are not occurring at the time of the application being made. The PPG-N acknowledges that *“It can be helpful for developers to provide information to prospective purchasers or occupants about mitigation measures that have been put in place, to raise awareness and reduce the risk of post-purchase/occupancy complaints.”* (Paragraph 009 Reference ID 30-009-20190722).

It is important to understand that as the PPG-N does not specifically provide any advice with respect to noise levels/limits for different sources of noise, it is appropriate to consider other sources of advice and guidance documents when considering whether new developments would be sensitive to the prevailing acoustic environment and the PPG-N signposts a number of appropriate guidance documents.

3.4. British Standard BS 4142:2014

BS 4142:2014 *Methods for rating and assessing industrial and commercial sound* provides a method for the measurement and rating of industrial or commercial type noise sources and background noise levels outside dwellings. The ‘rating level’ (defined in the BS) is used to rate the noise level of the source (this is defined as the ‘specific sound level’) outside residential dwellings.

The rating level is determined by assessing the character of the noise and applying an acoustic feature correction, if appropriate, to the specific sound level. Corrections are applied for the tonality, impulsivity, intermittency or other distinctive characteristics of the noise source which can all increase the impact of noise.

The initial assessment described in BS 4142 to determine whether an adverse impact is likely is based on establishing the difference between the rating level and the background noise level outside the residential property of interest. The British Standard states that the following points should be considered:

- *“Typically, the greater this difference, the greater the magnitude of the impact.*
- *A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.*

Noise Impact Assessment

- *A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.*
- *The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.”*

Where it is considered that the initial assessment of the impact needs to be modified due to the context in which the noise is occurring, BS 4142 suggests that all pertinent factors are taken into consideration, including:

- i. *“The absolute level of sound. For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low.*

Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night.

Where residual sound² levels are very high, the residual sound might itself result in adverse impacts or significant adverse impacts, and the margin by which the rating level exceeds the background might simply be an indication of the extent to which the specific sound source is likely to make those impacts worse.

- ii. *The character and level of the residual sound compared to the character and level of the specific sound. Consider whether it would be beneficial to compare the frequency spectrum and temporal variation of the specific sound with that of the ambient or residual sound, to assess the degree to which the specific sound source is likely to be distinguishable and will represent an incongruous sound by comparison to the acoustic environment that would occur in the absence of the specific sound. Any sound parameters, sampling periods and averaging time periods used to undertake character comparisons should reflect the way in which sound of an industrial and/or commercial nature is likely to be perceived and how people react to it.*
- iii. *The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as:*
 - i. *facade insulation treatment;*
 - ii. *ventilation and/or cooling that will reduce the need to have windows open so as to provide rapid or purge ventilation; and*
 - iii. *acoustic screening.”*

² The residual sound is defined as the ambient sound level at the assessment location in the absence of the specific sound source.

There is also a requirement within BS 4142:2014 to consider the uncertainty in the measurement and assessment procedure and it is stated that: *"The level of uncertainty associated with a measurement of sound level depends upon a number of factors, including:*

- a. the complexity of the sound source and the level of variability in sound emission from the source;*
- b. the complexity and level of variability of the residual acoustic environment;*
- c. the level of residual sound in the presence of the specific sound at the measurement location;*
- d. the location(s) selected for taking the measurements;*
- e. the distance between sources of sound and the measurement location and intervening ground conditions;*
- f. the number of measurements taken;*
- g. the measurement time intervals;*
- h. the range of times when the measurements have been taken;*
- i. the range of suitable weather conditions during which measurements have been taken;*
- j. the measurement method and variability between different practitioners in the way the method is applied;*
- k. the level of rounding of each measurement recorded; and*
- l. the instrumentation used."*

4. NOISE MEASUREMENT SURVEY

Noise measurements were carried out between 1315 hrs and 1356 hrs on Wednesday 12th January 2022 to determine the noise levels in close proximity to the existing plant at Petersfield WwTW. The purpose of the noise measurement survey was to obtain source noise levels for inclusion in a detailed noise model.

At the start of the noise measurement period the weather was dry with approximately 10% cloud cover with a daytime temperature of 12°C and wind travelling in a south-easterly direction at 1 m/s. At the end of the measurement period the weather was dry with approximately 10% cloud cover with a temperature of 12 °C with wind travelling in a south-easterly direction at 1 m/s.

4.1. Noise Monitoring

The noise measurements utilised a Rion NL-52 Sound Level Meter which holds a current certificate of calibration. Before and after the measurement period, the equipment was calibrated in order to ensure that the equipment had remained within reasonable calibration limits (+/- 0.5 dB).

Measurement Positions 1 - 7 were at the locations illustrated in **Figure 4.1** at a height of 1.2 – 1.5 m. Photographs of the measurement positions can be found in **Appendix 2** and specific source details can be found in **Table 5.1**.

Figure 4.1: Noise Measurement Locations



The ambient noise climate in close proximity to the WwTW was dominated by the various plant.

5. NOISE SOURCES

Plant on the site consists of several compressors. Each item of plant has been measured and is shown below **Table 5.1**.

Table 5.1: Source Noise Levels

Noise measurement locations	Noise Source	Distance from Source (m)	Noise Level @ 1 m (SPL) (dBA)
1	SBC Blower	1	86
2	Pump Z17B	1	66
3	Hyperclassic HMCA	1	59
4	SEW Geared Motor	1	67
5	Gamak AGM 80 8a	1	59
6	Z14A	1	57

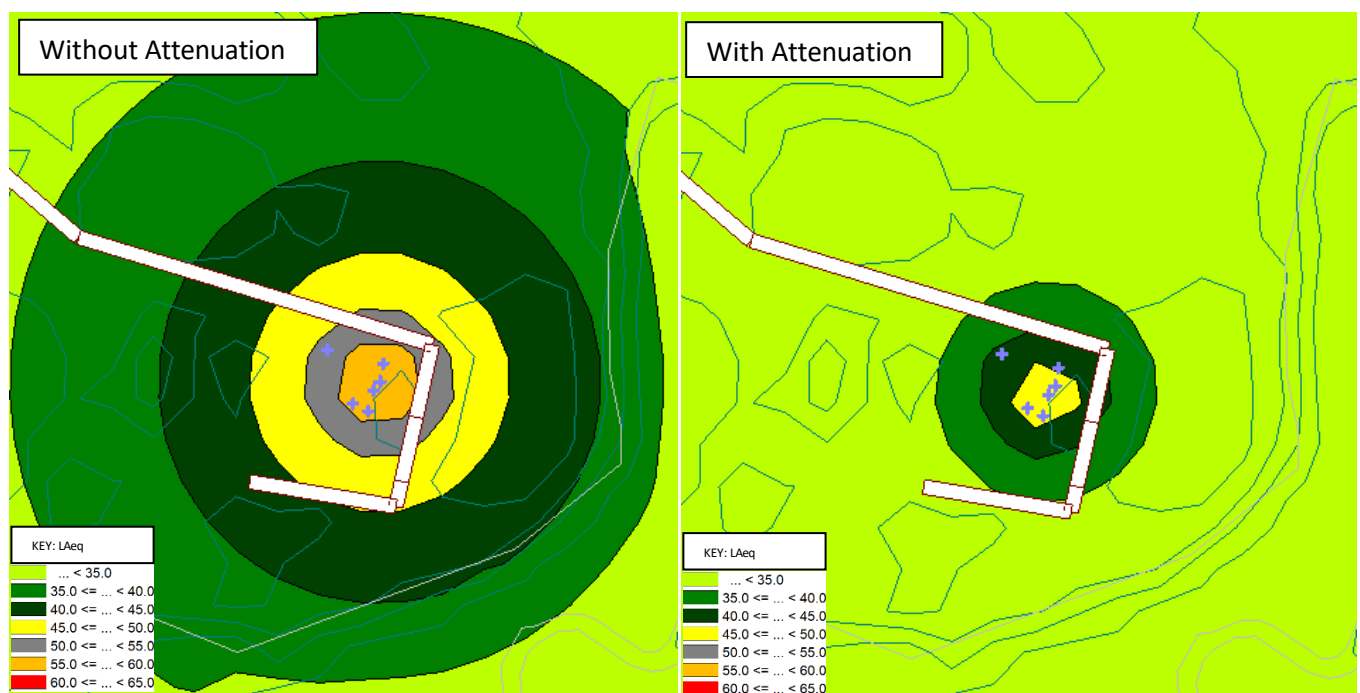
It was noted that noise generated by operational motors was the significant noise source at each of the six measurement positions.

6. NOISE MODELLING

6.1. Methodology

The CadnaA noise modelling software has been utilised to calculate the external noise levels from the WwTW. CadnaA is a three-dimensional noise model developed by DataKustik and has been extensively used by ACCON and others to develop noise models for a wide variety of situations and noise sources. CadnaA utilises ISO 9613 to predict noise from point, line and area sources.

Figure 6.1 – CadnaA noise model contour



The CadnaA image on the left of **Figure 6.1** identifies the predicted noise levels from the WwTW at Petersfield in its current operational mode, assuming that all noise generating machinery (measured on site) is active simultaneously. The significant noise source on site was the SBC Blower unit. It can be determined that noise from the site currently falls below a typical background sound level (35 dB LA₉₀) at a distance of 85 - 90 metres.

The CadnaA image on the right of **Figure 6.1** illustrates the reduction in noise egress if the SBC Blower was within an attenuating enclosure with a performance of Rw 15 dB. This would reduce the noise of the SBC Blower to a similar level to that of other motor related noise sources on the site. In the attenuated scenario, it can be determined that noise from the motors would not exceed the typical rural daytime background sound level (35 dB LA₉₀) at a distance of 30 - 35 metres

7. PLANT NOISE ASSESSMENT

7.1. BS 4142 Assessment

Subject to confirmation from an LPA, ACCON have determined that a BS4142 assessment would be an appropriate method for determining the acceptability of a WwTW.

Table 7.1 provides a notional BS 4142 assessment of noise from the WwTW.

Table 7.1: Noise Assessment of WwTW - Unattenuated

Results	LAeq (10 metres)	LAeq (20 metres)	LAeq (40 metres)	LAeq (80 metres)
Typical Background Sound Level L _{A90, 5min} (dB)	35	35	35	35
Specific Sound Level L _{Aeq, Tr} (dB)	55	49	43	36
Acoustic Feature Correction (dB)	2	2	2	2
Rating Level L _{Ar, Tr} (dB)	57	51	45	38
Difference between Rating Level and Background Sound Level (dB)	22	16	10	3
Initial Estimate of Impact	Significant adverse impact	Significant adverse impact	Significant adverse impact	Low risk of adverse impact

It can be identified from **Table 7.1** above that if the SBC blower unit remains unattenuated, the rating noise level from the WwTW meets the criteria for low risk of adverse impact at a distance of 80m.

It can be identified from **Table 7.2** that when the significant noise source on site is attenuated with an acoustic enclosure, the rating noise level from the WwTW meets the criteria for low risk of adverse impact at a distance of 30 m.

Table 7.2: Noise Assessment of WwTW – Attenuated Blower Unit

Results	LAeq (10 metres)	LAeq (20 metres)	LAeq (30 metres)
Typical Background Sound Level $L_{A90, 5min}$ (dB)	35	35	35
Specific Sound Level $L_{Aeq, Tr}$ (dB)	45	39	34
Acoustic Feature Correction (dB)	2	2	2
Rating Level $L_{Ar, Tr}$ (dB)	47	41	36
Difference between Rating Level and Background Sound Level (dB)	12	6	1
Initial Estimate of Impact	Significant risk of adverse impact	Adverse impact	Low risk of adverse impact

7.2. Uncertainty

The analysis has utilised a notional background noise level and it will therefore be important to ensure that for any specific location for a WwTW the background noise level is measured for inclusion in any subsequent BS 4142 assessment.

8. CONCLUSION

A CadnaA noise model has been prepared to predict noise emanating from the WwTW.

A BS 4142 assessment of the noise has concluded that if the significant noise sources on site are attenuated with a suitable acoustic enclosure, the risk of adverse impact to Noise Sensitive Receptors (NSRs) at a distance greater than 30 metres is low.

Where a larger WwTW installation than the demonstrator WwTW is planned and subject to an appropriate level of mitigation, principally to any blower units, then it should be possible to site any residential properties within 50 metres of the WwTW.

Appendix 1

Glossary of Acoustic Terminology

Term	Description
'A'-Weighting	This is the main way of adjusting measured sound pressure levels to take into account human hearing, and our uneven frequency response.
Decibel (dB)	This is a tenth (deci) of a bel. A decibel can be a measure of the magnitude of sound, changes in sound level and a measure of sound insulation. Decibels are not an absolute unit of measurement but are an expression of ratio between two quantities expressed in logarithmic form.
Frequency	Frequency is related to sound pitch; frequency equals the ratio between velocity of sound and wavelength.
$L_{Aeq, T}$ (Ambient /Period Sound Level)	The equivalent steady sound level in dB containing the same acoustic energy as the actual fluctuating sound level over the given period, T. T may be as short as 1 second when used to describe a single event, or as long as 24 hours when used to describe the noise climate at a specified location. $L_{Aeq, T}$ can be measured directly with an integrating sound level meter.
$L_{A90, T}$ (Background Sound Level)	The 'A'-weighted sound pressure level of the residual noise in decibels exceeded for 90 per cent of a given time. The $L_{A90, T}$ is used to describe the background noise levels at a particular location.
Sound Power Level	The total sound energy radiated by a sound source in all directions. In decibels with a reference level of 1×10^{-12} Watts
Rating Level, $L_{Ar, Tr}$	The specific sound level plus any adjustment for the characteristic features of the sound.
Residual Sound Level, $L_r = L_{Aeq, T}$	Ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound.
Specific Sound Level, $L_s = L_{Aeq, Tr}$	The equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, Tr .
T	Sometimes denoted RT, this is the reverberation time. The reverberation time is defined as the time in seconds taken for the sound pressure level to decay by 60 dB. This is measured within rooms to allow the determination of the level of acoustic absorption present.

Appendix 2

Photographs of Measurement Positions

Figure 1 - Measurement Position 1



Figure 2 - Measurement Position 2



Figure 3 - Measurement Position 3

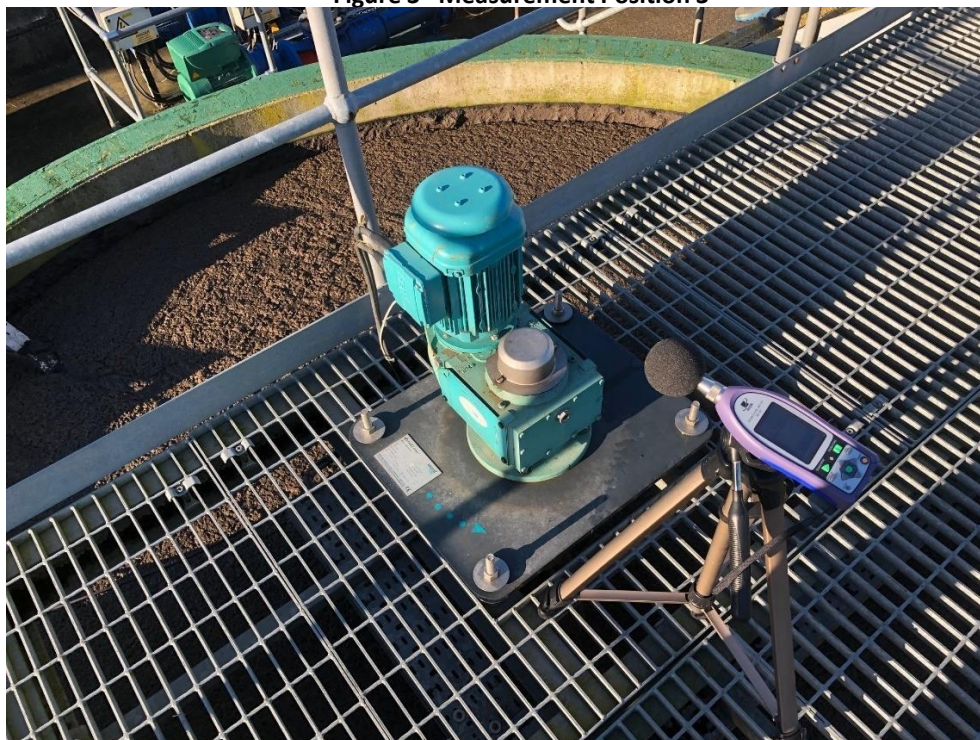


Figure 4 - Measurement Position 4

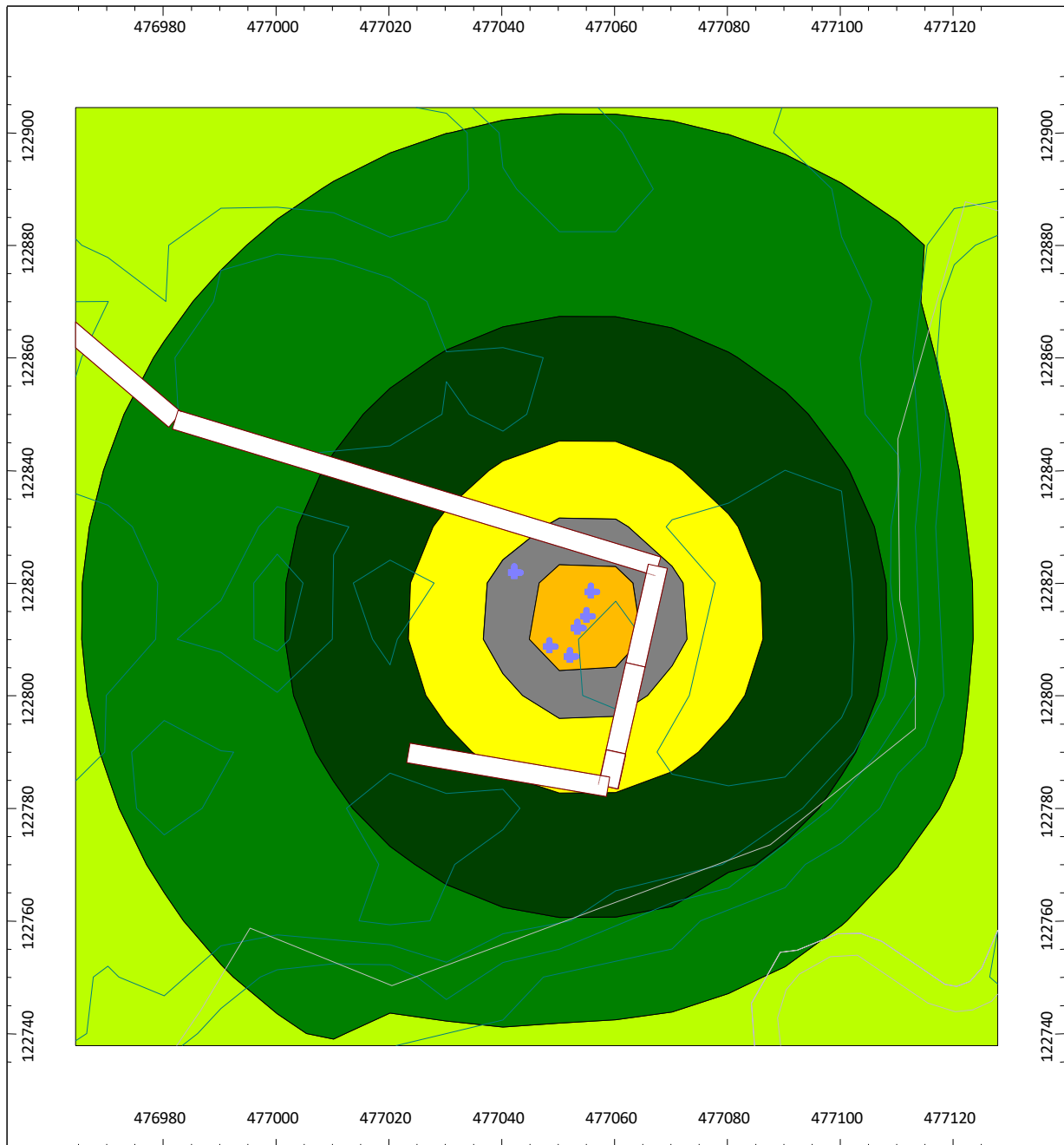


Figure 5 - Measurement Position 5

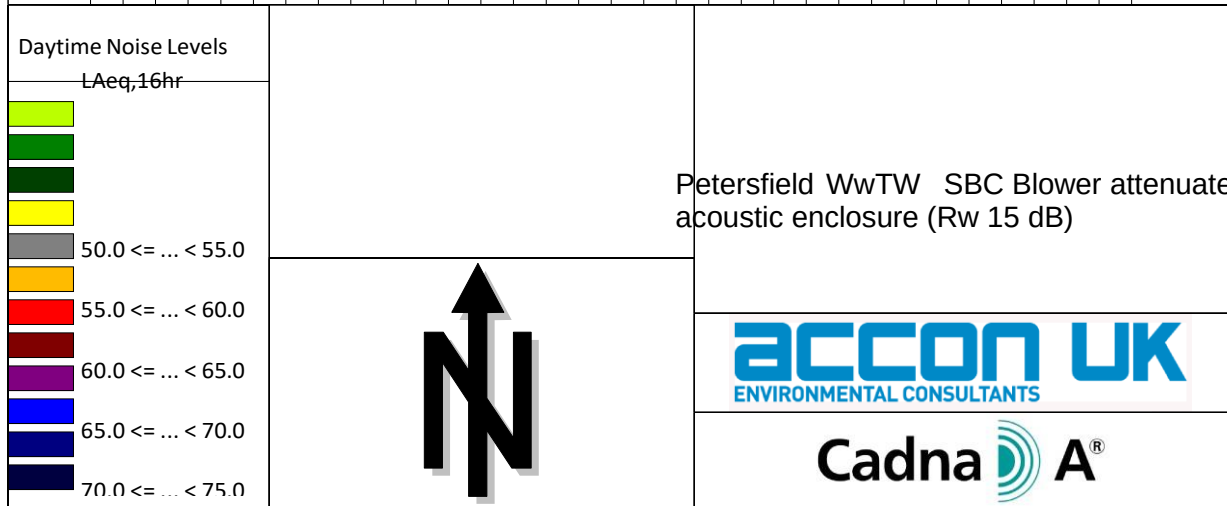
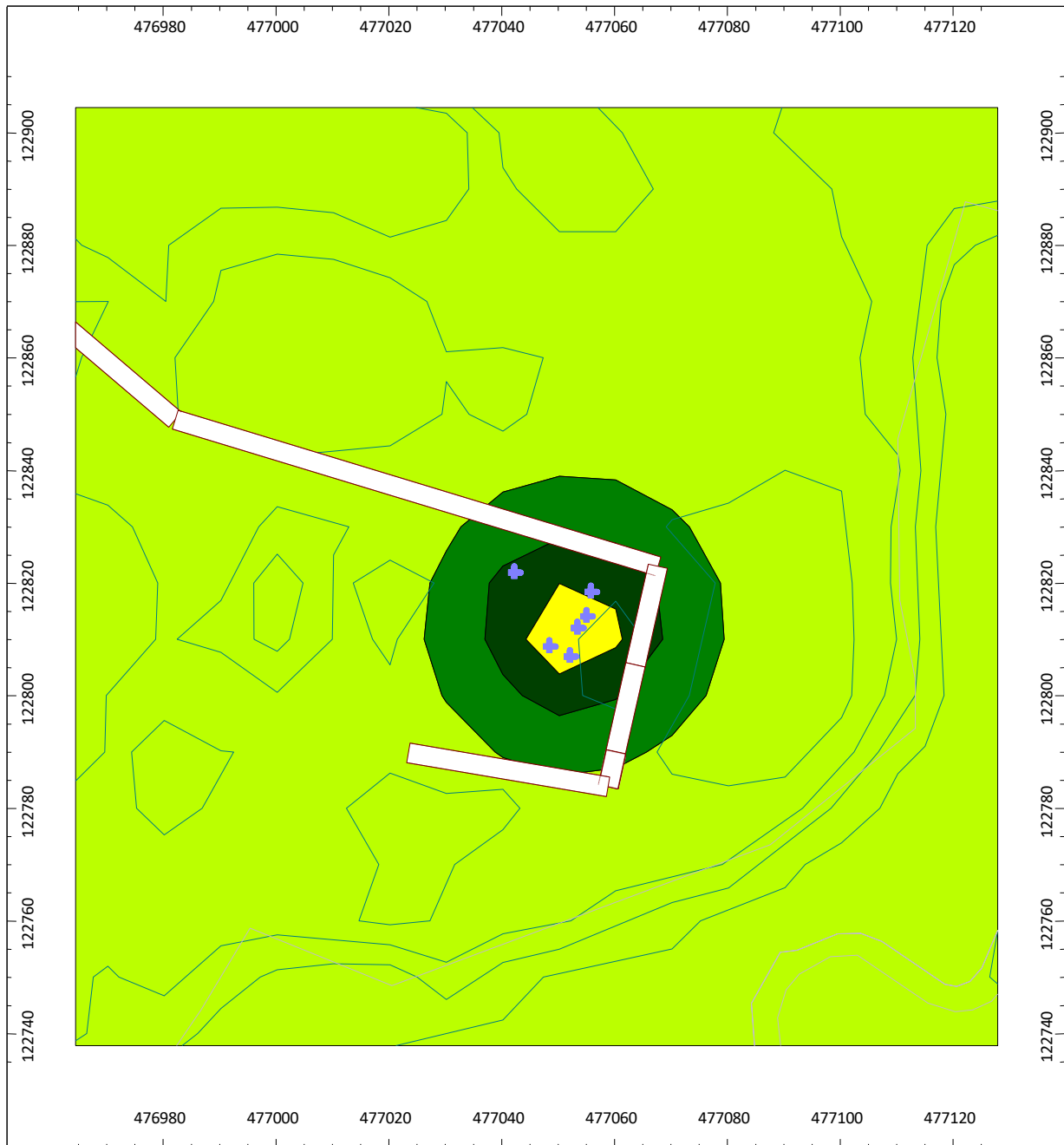


Figure 6 - Measurement Position 6





Daytime Noise Levels LAeq,16hr 50.0 <= ... < 55.0 55.0 <= ... < 60.0 60.0 <= ... < 65.0 65.0 <= ... < 70.0 70.0 <= ... < 75.0		Petersfield WwTW Unattenuated
		ACCON UK ENVIRONMENTAL CONSULTANTS Cadna A®



476980

477000

477020

477040

477060

477080

477100

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50.0 <= ... < 55.0

55.0 <= ... < 60.0

60.0 <= ... < 65.0

65.0 <= ... < 70.0

70.0 <= ... < 75.0

Report for: 476980 477000 477020 477040 477060 477080 477100 477120

Severn Trent Connect

Petersfield demonstrator wastewater
treatment works

Odour Assessment

Status: Final

Date: 25.01.2022

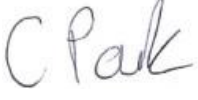
50.0 <= ... < 55.0

55.0 <= ... < 60.0

60.0 <= ... < 65.0

65.0 <= ... < 70.0

70.0 <= ... < 75.0

476980	477000	477020	477040	477060	477080	477100	477120
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1. INTRODUCTION

ACCON UK Limited (ACCON) have been commissioned by Severn Trent Connect to carry out an odour assessment to support planning applications where the waste water treatment works (WwTW) may be in close proximity to existing or proposed residential development.

In order to assess the odour impacts from the WwTW ACCON personnel have visited the Petersfield Demonstrator WwTW, the location of which site is identified in **Figure 1.1**.

Figure 1.1: Site Location Plan



- Carried out qualitative odour assessments at and in the vicinity of the WwTW;
- Carried out an odour impact assessment in accordance with published guidance from the Department for Environment, Food & Rural Affairs (DEFRA)¹, the Environment Agency (EA)², the Institute of Air Quality Management (IAQM)³ and statements from bodies such as the Chartered Institution of Water and Environmental Management (CIWEM) and the UK Water

¹ 'Odour Guidance for Local Authorities', DEFRA (2010)

² IPPC H4 'Odour Management', Environment Agency (2011)

³ 'Guidance on the assessment of odour for planning' IAQM (2014)

Industry Research (UKWIR) to determine the potential odour impact of the sewage treatment works on the proposed development.

2. ODOUR BACKGROUND, POLICY, LEGISLATION AND GUIDANCE

Odour Legislation and Guidance considered in this Assessment

The following legislation and guidance were utilised as part of this assessment:

- Odour Guidance for Local Authorities', DEFRA (2010);
- IPPC H4 'Odour Management', Environment Agency (2011);
- 'Guidance on the assessment of odour for planning' IAQM (2014);
- Chartered Institute for Water and Environmental Management (CIWEM) Policy Statement (2011);
- Odour Control in Sewage Treatment (Technical Reference Document 01/WW/13/3) UK Water Industry Research (UKWIR) (2001); and
- Planning Precedent Decisions

Odour Background

2.1.1. Odour Definition

The DEFRA guidance 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."

Odour is perceived by our brains in response to chemicals present in the air we breathe. Odour is the effect that those chemicals have upon us. Humans have a particularly developed sense of smell and they can detect odour even when chemicals are present in very low concentrations. Most odours are a mixture of many chemicals that interact to produce what we detect as an odour.

Different life experiences and natural variation in the population can result in different sensations and emotional responses by individuals to the same odorous compounds. Because the response to odour is synthesised in our brains, other senses such as sight and taste, and even our upbringing, can influence our perception of odour and whether we find it acceptable, objectionable or offensive

2.1.2. Odour Units

The concentration at which an odour is just detectable to a 'typical' human nose is referred to as the 'threshold' concentration. 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.

Odours are a complex mixture of compounds and the concentration of the mixture is expressed in European odour units per cubic metre ($\text{ou}_\text{E}\text{m}^{-3}$ or $\text{ou}_\text{E}/\text{m}^3$) as defined by European standard BSEN 13725:2003 'Air quality. Determination of odour concentration by dynamic olfactometry'.

An odour at strength of $1 \text{ ou}_\text{E} \text{ m}^{-3}$ would only be detectable within the confines of an odour laboratory by the majority of the population. As odour concentrations increase, they become more noticeable. The following published guideline values⁴ provide context to odour concentrations;

- $1 \text{ ou}_\text{E}\text{m}^{-3}$ = the point of detection;
- $5 \text{ ou}_\text{E}\text{m}^{-3}$ = is a faint odour;
- $10 \text{ ou}_\text{E}\text{m}^{-3}$ = is a distinct odour.

In the general environment however, the population are exposed to levels of 'background' odours from road traffic, vegetation and numerous other activities which can produce background odour concentrations between 5 to $60 \text{ ou}_\text{E}\text{m}^{-3}$.

The units for exposure to odour is given in terms of a percentile of averages over the course of a year. The current accepted method of assessing the impact of odour concentration in the UK at present is a 98th percentile (C_{98}) of hourly averages. This allows for 2% (175 hours) of the year to be above the limit criterion.

2.1.3. Odour Exposure

Before an adverse effect (such as disamenity, annoyance, nuisance or complaints) can occur, there must be odour exposure. For odour exposure to occur all three links in the source-pathway-receptor chain must be present:

- i. An emission source - a means for the odour to get into the atmosphere.
- ii. a pathway - for the odour to travel through the air to locations off site, noting that:
 - anything that increases dilution and dispersion of an odorous pollutant plume as it travels from source to receptor will reduce the concentration at the receptor, and hence reduce exposure.
 - increasing the length of the pathway (e.g. by releasing the emissions from a high stack or at a distance) will – all other things being equal – increase the dilution and dispersion.
- iii. The presence of receptors (people) that could experience an adverse effect, noting that people vary in their sensitivities to odour.

⁴ IPPC H4 'Odour Management', Environment Agency (2011)

The scale of exposure (the impact) is determined by the parameters collectively known as the FIDO factors (Frequency, Intensity, Duration and Offensiveness; these are described in **Table 3.1**. The magnitude of the effect experienced is determined by the scale of exposure (**FIDOL**) and the sensitivity of the receptor (**L**, denoting the location, which is often taken to be a surrogate for the sensitivity and incorporates the social and psychological factors that can be expected for a given community.) **Figure 2.1** depicts how the human appraisal of the **FIDOL** factors and social and psychological factors determines whether an odour has an adverse odour impact and an objectionable effect. Different combinations of the **FIDO** factors can result in different exposures at a location. For example, odours may occur as a one-off, as frequent short bursts, or for longer, less- frequent periods, and may be said to give 'acute' or 'chronic' exposures respectively.

Table 2.1: Description of the FIDOL factors

Frequency	How often an individual is exposed to odour
Intensity	The individual's perception of the strength of the odour
Duration	The overall duration that individuals are exposed to an odour over time.
Odour unpleasantness	Odour unpleasantness describes the character of an odour as it relates to the 'hedonic tone' (which may be pleasant, neutral or unpleasant) at a given odour concentration/intensity. This can be measured in the laboratory as the hedonic tone, and when measured by the standard method and expressed on a standard nine-point scale it is termed the hedonic score.
Location	The type of land use and nature of human activities in the vicinity of an odour source. Tolerance and expectation of the receptor. The 'Location' factor can be considered to encompass the receptor characteristics, receptor sensitivity, and socio-economic factors.

Source: IAQM, 2014

2.1.4. Adverse Effects of Odour

The odour effect to be concerned with is the negative appraisal by a human receptor of the odour exposure. This appraisal, occurring over a matter of seconds or minutes, involves many complex psychological and socio-economic factors. Once exposure to odour has occurred, the process can lead to adverse effects such as loss of amenity, annoyance, nuisance and possibly complaints. It is important to emphasise the technical differences between annoyance and nuisance:

- Annoyance – the adverse effect occurring from an immediate exposure; and
- Nuisance – the adverse effect caused cumulatively, by repeated events of annoyance.

Accordingly, in determining whether a site is suitable for development where a WWTW may be installed it is important to understand the scale of the potential odour, over what period it may occur and importantly whether it will migrate from the source to the sensitive receptors on a regular basis such as to cause a loss of amenity or nuisance. Additionally, it is also important to understand the extent to which any exposure at a sensitive receptor, i.e. a proposed residential development, would occur.

Table 2.2: Receptor sensitivity to odours

High sensitivity receptor	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 sensitivity receptor	Surrounding land where: • Users would expect to enjoy a reasonable level of amenity, but wouldn't reasonably expect to enjoy the same level of amenity as in their home; or • People wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land. Examples may include places of work, commercial/retail premises and playing/recreation fields.
Low sensitivity receptor	Surrounding land where: • The enjoyment of amenity would not reasonably be expected; or • There is transient exposure, where the people would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land. Examples may include industrial use, farms, footpaths and roads.

Source: IAQM, 2014

2.1.5. Odour from Wastewater Treatment Works

There are many chemical species that have been detected in sewage treatment works odours. In addition to hydrogen sulphide and other pollutants such as ammonia, there are a wide variety of organic sulphides and organic nitrogen-based compounds along with some oxygenated organic compounds and organic acids.

In addition to these compounds, there are many potential substances which may be released depending upon the quality of the influent, for example if it includes industrial effluent. The range of contaminants potentially present in industrial effluent is extensive but those which are likely to be of concern are already odorous liquids (such as sewage from food production), warm effluent which may accelerate anaerobic conditions and volatile organic compounds such as solvents and petroleum derivatives. The primary odours from sewage treatment works are biogenic due to the degradation of organic matter by microorganisms under anaerobic conditions. The development of anaerobic conditions in sewage is often referred to as 'septicity'. Septicity can be onset by elevated temperature, high biological oxygen demand, high sulphate levels and the presence of reducing chemicals. Anaerobic activity leads to the production of methane, hydrogen sulphide (H₂S), ammonia (NH₃), organic sulphur, thiols (mercaptans), amines, indole and skatole. During the fermentation phase of anaerobicity, volatile fatty acids, alcohols, aldehydes and ketones can be produced.

However, odour which is not typical of anaerobic conditions can also be generated by other mechanisms in a treatment works including:

- Volatile substances in the influent such as petroleum derivatives, solvents;

- Air stripping of volatile compounds and odours particularly from industrial effluent often at inlet works or during aeration;
- Aerobic odours – which are often described as a ‘musty’ odour; and
- Ammonia odour from reactions after liming of sludges or when sludges become re-wetted.

Hydrogen sulphide is often referred to as the cause of odour from sewage treatment works. Whilst hydrogen sulphide may be a principal component of the odour cocktail, there are other compounds which cannot be ignored. Because it is relatively easy to measure, H₂S is often used as a target indicator for odour but there are important limitations to this technique.

Odour Standards and Benchmarks

There are a number of sources of ‘standards’ for odour unit concentrations and the assessment of impacts. Malodours from WWTW (particularly where sludge is used and processed) are considered to be potentially highly offensive and therefore careful consideration should be given to the placement of potential receptors.

2.1.6. Planning Precedents

There are a number of planning precedents that are able to inform this assessment. The first of these is the Newbiggin-by-the-Sea⁵ Planning Inspectorate decision in 1993. The appeal addressed what was an appropriate odour exposure limit at a sensitive receptor and the appeal concluded that: “Whilst a particularly sensitive person could detect an emission level as low as 20u_Em⁻³, it seems to be that adoption of a level of 50u_Em⁻³ for the appeal site is both reasonable and cautious.”

The decision in this Planning Inspectorate case was the origin of the now well-established empirical standard of 50u_Em⁻³ (98th percentile - C₉₈, 1-hour), which has been widely used in the sewage sectors in the UK to assess the likelihood of community annoyance. This impact criteria has been successfully applied within similar assessments, where odour from WWTW has been assessed at adjacent residential receptors^{6,7,8}.

At a WWTW managed by Southern Water, ACCON received the following comment from the EHO at the Local Planning Authority for that site:

“Further to the Technical Note produced in response to concerns expressed about odour, it is my view that the site is not ideal for residential development, however the developer has provided an assessment that predicts that odour will be within acceptable limits (C98, 1-hour <30u_E/m³). On this basis I am unable to object to the development on the grounds of odour.”

⁵ Department of the Environment (July 1993) Appeal by Northumbrian Water Ltd: *Land Adjacent to Spital Burn, Newbiggin-by-the-sea, Northumberland*. Case ref: APP/F2930/A/92 206240.

⁶ Planning Inspectorate – Appeal Reference: APP/P0240/A/09/2110667

⁷ Planning Inspectorate – Appeal Reference: APP/E3525/A/11/2145235.

⁸ High Court of Justice (2011). EWHC 3253 (TCC).

2.1.7. IAQM Guidance (2014, updated July 2018)

The IAQM document provides guidance on the odour impacts for planning purposes. As such, it gives details of relevant descriptors of effects and impacts, so that modelled odour concentrations can be quantified. **Table 2.3** compares the receptor sensitivity and relative odour exposure and provides a magnitude of effect.

Table 2.3: IAQM suggested descriptors for magnitudes of odour effects

		Receptor Sensitivity		
Relative Odour Exposure (Impact)		Low	Medium	High
	Very Large	Moderate adverse	Substantial adverse	Substantial adverse
	Large	Slight adverse	Moderate adverse	Substantial adverse
	Medium	Negligible	Slight adverse	Moderate adverse
	Small	Negligible	Negligible	Slight adverse
	Negligible	Negligible	Negligible	Negligible

Applicable to odours at the "most offensive" end of the relative-unpleasantness spectrum

2.1.8. Assessment of Community Response to Odorous Emissions

Environment Agency (EA) Research and Development Technical Report P4-095/TR (2002) provides a scientific background to assist in identifying defensible numerical limits for regulating exposure to odours in the UK. This report recognises that the $C_{98, 1\text{-hour}} < 5 \text{ ou}_{\text{EM}}^{-3}$ exposure level is currently applied in the UK with the legal objective of avoiding nuisance. Not all aspects of sewage treatment have the potential to generate odour which is likely to be offensive and therefore have the potential to generate complaints.

2.1.9. UKWIR Research⁹

The UK Water Industry Research (UKWIR) organisation undertook research into the correlation between modelled odour impacts and the spatial distribution of odour complaints in the areas surrounding nine STW in the UK. The report includes the likely amount of complaints for a given odour concentration and concludes:

"The main source of research into odour impacts in the UK has been the sewage industry and the most in-depth study published study in the UK of the correlation between modelled odour impacts and human response (dose-effect) was published by UK Water Industry Research (UKWIR) in 2001. This was based on a review of the correlation between reported odour complaints and modelled odour impacts in relation to 9 sewage treatment works in the UK with ongoing odour complaints. The findings of this research (and subsequent UKWIR research) indicated the following:

- *At modelled exposures of below $C_{98, 1\text{-hour}} 5 \text{ ou}_{\text{EM}}^{-3}$, complaints are relatively rare, at only 3% of the total registered;*

⁹ Odour Control in Sewage Treatment (Technical Reference Document 01/WW/13/3) UK Water Industry Research (UKWIR) (2001)

- *At modelled exposures between $C_{98, 1\text{-hour}} 50\text{ou}_E\text{m}^{-3}$ and $C_{98, 1\text{-hour}} 100\text{ou}_E\text{m}^{-3}$, a significant proportion of total registered complaints occur; 38% of the total;*
- *The majority of complaints occur in areas of modelled exposure greater than $C_{98, 1\text{-hour}} 100\text{ou}_E\text{m}^{-3}$, 59% of the total."*

Therefore, the UKWIR research findings are consistent with the 'Newbiggin' standard and other planning precedents (**Section 2.1.6**) as any potential odour impact and annoyance is effectively controlled for the vast majority of the population at a 98th percentile hourly mean odour impacts of $50\text{ou}_E\text{m}^{-3}$ or less.

2.1.10. Environment Agency H4 Odour Guidance

The EA published guidelines on odour regulation, assessment and control (H4: Odour Management) in March 2011. In Appendix 3 (of H4), modelled odour concentration benchmark levels are presented for odours of varying degrees of offensiveness.

The guidance recommends that preferably five years of meteorological data (and a minimum of three), should be used to calculate the 98th percentile of the hourly mean odour concentrations, to assess varying meteorological conditions.

2.1.11. Chartered Institute for Water and Environmental Management (CIWEM)

CIWEM released a Policy Position Statement regarding odour in February 2011. The statement provides appropriate assessment criteria and benchmarks to determine the potential for odour nuisance and was as follows:

"Given the differing odour impact criteria available, the selection of the most appropriate criterion should be determined by the objective of the assessment (whether this be against a standard of avoidance of nuisance or 'significant pollution') and the nature of the odour under assessment. It is, therefore, the view of CIWEM that these and other odour impact criteria should be regarded as indicative guidelines and cannot be applied as over-arching statutory numerical standards. CIWEM considers that the following framework is the most reliable that can be defined on the basis of the limited research undertaken in the UK at the time of writing:

- *$C_{98, 1\text{-hour}} > 100\text{ou}_E\text{m}^{-3}$ – complaints are highly likely and odour exposure at these levels represents an actionable nuisance;*
- *$C_{98, 1\text{-hour}} > 50\text{ou}_E\text{m}^{-3}$, – complaints may occur and depending on the sensitivity of the locality and nature of the odour this level may constitute a nuisance; and*
- *$C_{98, 1\text{-hour}} < 30\text{ou}_E\text{m}^{-3}$, – 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."*

3. ASSESSMENT METHODOLOGY

Sniff Testing Methodology

The odours from the WwTW were assessed against a fixed framework, which covers weather conditions, odour intensity, strength, frequency and characteristics. A number of locations were identified on and around the Petersfield Demonstrator WwTW for assessment to account for typical odour exposure depending on the wind speed and direction. Each location was assessed for a fixed period of time (10 minutes) to enable the assessment of frequency.

3.1.1. Assessment Quality Assurance

To ensure that the odour assessment was carried out to a satisfactory standard the following quality assurance steps were taken:

- A suitably qualified and trained odour assessor (assessed against EN13725);
- An objective method of describing and measuring odours
- A standardised monitoring process and data reporting

In addition, the quality of the assessment was managed by utilising the following guidelines as detailed in 'Guidance on the assessment of odour for planning' IAQM, (2014):

- *The odour assessor should not carry out the assessment if they have a cold, sore throat, sinus trouble, etc;*
- *The odour assessor should not be hungry or thirsty;*
- *The odour assessor should not work within half an hour of the end of their last meal;*
- *The odour assessor should not smoke or consume strongly flavoured food or drink, including coffee, for at least half an hour before the field odour survey is carried out, or during the survey;*
- *The odour assessor should not consume confectionery or soft drinks for at least half an hour before the field odour survey is carried out, or during the survey;*
- *Scented toiletries, such as perfume/aftershave should not be used on the day of the field odour survey;*
- *The vehicle used during the field odour survey should not contain any deodorisers;*
- *If the odour assessor has had to travel a long distance, then a rest period should be taken before starting the survey; and*
- *To reduce the likelihood of odour fatigue, assessors should always carry out the field odour survey before making any works site visit, inspection or walk-through survey.*

Odour Benchmarks

As outlined in **Section 2.1.4**, receptor sensitivity and possible exposure to potential odours will vary depending on the land-use of the site. The land use will change the expectation of users of the land depending on the level of amenity and the time spent at the location.

As such, this assessment has considered the following criteria when assessing the impacts of the WwTW on any proposed development. This enables the quantification of a 'stand-off' distance from the WwTW depending on the land-use and sensitivity of the proposed receptor. The criteria have been determined from the recommendations of the CIWEM, IAQM guidance and planning precedents outlined in **Section 2.1**.

- High sensitivity receptors – considered suitable for any development, including residential: Applied benchmark of less than $C_{98, 1\text{-hour}} 30u_E/m^3$;
- Medium sensitivity receptors – considered suitable for places of work, commercial/retail premises and playing/recreation fields: Applied benchmark of greater than $C_{98, 1\text{-hour}} 30u_E/m^3$ but less than $C_{98, 1\text{-hour}} 50u_E/m^3$; and
- Low sensitivity receptors – considered suitable for non-sensitive uses where exposure would be only transient, e.g. industrial use, farms, footpaths, car-parks and roads: Applied benchmark of greater than $C_{98, 1\text{-hour}} 50u_E/m^3$.

Accordingly, where a WwTW is proposed near occupiers of existing or proposed residential property the use is considered to be "high sensitivity receptors".

IAQM – Significance Criteria

Based upon the IAQM matrix and descriptors as presented within **Table 3.1**. **Table 3.1** outlines the relationship between modelled odour exposure level and the relevant receptor sensitivity. It should be noted that **Table 3.1** below is a conservative estimate of the impacts based on highly offensive odours. Therefore, less offensive odours would in all likelihood require a higher level of exposure to elicit the same response.

Table 3.1: IAQM odour effect descriptors for impacts predicted by modelling

Odour Exposure Level ou_E/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

4. QUANTIFICATION OF ODOUR EMISSIONS

WwTW Process Overview

The advanced activated sludge treatment process is distinctly different to other waste water treatment works in that odour emissions from the principal sources appears to be relatively low. Whilst, odour at other times of the year may be slightly elevated, for example when temperatures are elevated, it seems highly unlikely based on ACCON's experience that a WwTW of the size and configuration of the Petersfield Demonstrator WwTW could result in offensive odour likely to result in a loss of amenity or a nuisance beyond 10 – 15 metres from the site boundary.

Where the size of the WwTW will be larger than the demonstrator WwTW, as a precautionary measure based on a professional judgement, a maximum offset distance from the site boundary of 30 - 50 metres should be adopted for sensitive receptors.

5. RESULTS

Qualitative Assessment

A qualitative odour assessment was carried out on the 12th January 2022. Whilst any qualitative assessment can only ever represent a 'snapshot in time' of the operational and meteorological conditions on the day, it does provide very useful observations in respect of how odorous the WwTW is and the extent to which odour could migrate offsite.

The two people carrying out the sniff testing on the site have previously had their detection threshold tested by Spectrum Environmental Limited and Silsoe Odours Limited. Their detection threshold was determined at 36.5ppb and 29.9ppb respectively for n-butanol (EN13725). What this means in practice is that both assessors have a range of odour sensitivity that covers the general population. Therefore, their judgements can be relied upon to determine the extent to which odour might be considered offensive such as to result in a nuisance or a loss of amenity to potential occupiers of the proposed property.

Full access to the WwTW was made available and therefore it was possible to carry out sniff testing around the WwTW and immediately above the various sources of odour. The principal identified sources of odour were the reactors and to a much lesser extent the balance tank.

Appendix 2 outlines each of the locations where sniff testing was carried out. **Table 5.1** outlines meteorological conditions on the day of the site visit.

Table 5.1: Meteorological Conditions on Assessment Days

Date	Average Temperature	Average Wind Speed	Average Wind Direction
12 th January 2022	12°C	1m/s	South westerly

Odour was detectable immediately adjacent the reactors and specifically when aeration was occurring. Additionally, odour was easily detectable above the reactors. At the balance tank odour was only just detectable.

Offsite depending on location odour was not detectable beyond a distance of 10 metres regardless of being upwind or downwind of the odour sources.

It is ACCON's consideration that the worst-case odour intensity value of 3, would be equivalent to a modelled odour level of 3ouE/m³.

6. CONCLUSIONS

ACCON have carried out an odour assessment of the Demonstrator WwTW at Petersfield. Sniff testing was carried out by qualified personnel in order to determine the odour intensity of the existing WwTW operation.

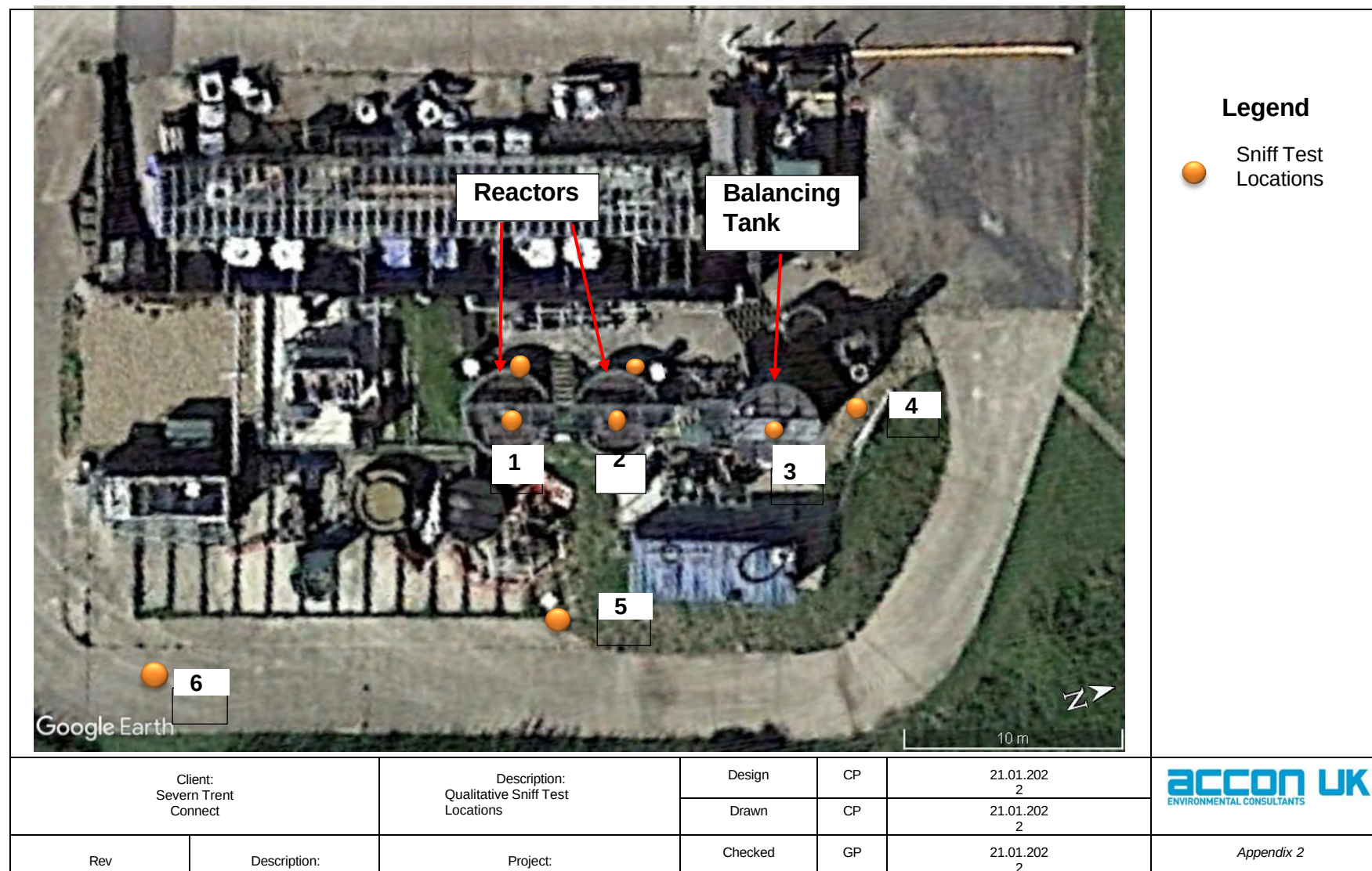
It is ACCON's view that beyond the boundary of the plant odour would be highly unlikely to result in a loss of amenity at sensitive receptors e.g. occupiers of residential property.

Assuming that the emission rates remained typical for the WwTW process it is very unlikely, that even when air temperatures are elevated during the summer months, that odour from the process would be at a level as to exceed $30 \mu\text{g}/\text{m}^3$ and would in all likelihood be lower still.

The combination of sniff testing and professional judgement has created a broad assessment of the potential odour from the WwTW process and the potential impact on any proposed residential development in close proximity to a WwTW. As such, it is not considered that the WwTW would cause a loss of amenity, annoyance, nuisance or complaints for future occupiers of residential development in close proximity to a WwTW process, where it operates in a similar mode to the WwTW at Petersfield. Additionally, where the WwTW is designed to a larger capacity then an offset distance of 30-50 metres is recommended.

APPENDICES

Appendix 2: Qualitative Sniff Testing Locations



: A	FINAL	Petersfield WwTW	Approved	GP	21.01.202 2	Scale Not to Scale
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Appendix 5: Odour Report Forms – ‘Qualitative Sniff Tests’

Odour Report Form – Adapted from IPPC H4 ‘Odour Management’, Environment Agency (2011)

Odour Report Form	Date: 12.01.2022	Project: Petersfield WwTW		
Test Location	1. Immediately adjacent reactor	2. Immediately adjacent Reactor	3. Above balancing tank	4. At ground level
Commencement Time (Hrs)	1310	1315	1320	1330
Weather Conditions	Sunny with SW low wind			
Temperature	12°C			
Wind Speed/Direction	0.5m/s, occasional gusts up to 1m/s			
Distance to Source	0.5m	0.5m	1.5m	2.5m to closest source, 9m to closest reactor
Plant Operational?	Yes			
Intensity (VDI 3882, Part 14)	1 - 2	3	0 - 1	0
Duration	Constant – no aeration	Constant with aeration occurring	Constant	Constant
Notes and Odour Characteristics	None	Sweet sewage smell	Just detectable. Tank has lid.	No detectable odour

Intensity Ref: German Standard VDI 3882, Part 14

0 No odour, **1** Very faint odour, **2** Faint odour, **3** Distinct odour, **4** Strong odour, **5** Very strong odour,
6 Extremely strong odour

Odour Report Form	Date: 12.01.2021	Project: Petersfield WWTW		
Test Location	5. At ground level approximately 7.5m from reactors	1. 1.5m above reactor	2. 1.5m above reactor	5. At ground level approximately 7.5m from reactors
Commencement Time (Hrs)	1335	1340	1345	1350
Weather Conditions	Sunny with SW low wind			
Temperature	12°C			
Wind Speed/Direction	0.5m/s, occasional gusts up to 1m/s			
Distance to Source	7.5m	1.5m	1.5m	7.5m
Plant Operational?	Yes			
Intensity (VDI 3882, Part 14)	0	2	2	3 - 4
Duration	Constant	Constant	Constant not aerating	Constant
Notes and Odour Characteristics	No odour detectable	Very faint odour detectable – not offensive	Not offensive	None detectable

Intensity Ref: German Standard VDI 3882, Part 14

0 No odour, **1** Very faint odour, **2** Faint odour, **3** Distinct odour, **4** Strong odour, **5** Very strong odour,
6 Extremely strong odour

Status: Final

Odour Report Form	Date: 12.01.2021	Project: Petersfield WWTW		
Test Location	2. Immediately adjacent Reactor			
Time	1325			
Weather Conditions	Sunny with SW low wind			
Temperature	12°C			
Wind Speed/Direction	0.5m/s, occasional gusts up to 1m/s			
Distance to Source	0.5m			
Plant Operational?	Yes			
Intensity (VDI 3882, Part 14)	2 - 3			
Duration	Constant – no aeration			
Notes and Odour Characteristics	Distinct sewage smell			

Intensity Ref: German Standard VDI 3882, Part 14

0 No odour, **1** Very faint odour, **2** Faint odour, **3** Distinct odour, **4** Strong odour, **5** Very strong odour,
6 Extremely strong odour

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Appendix C

WIND ROSES



Figure C-1 - Wind Rose (Hawarden 2016)

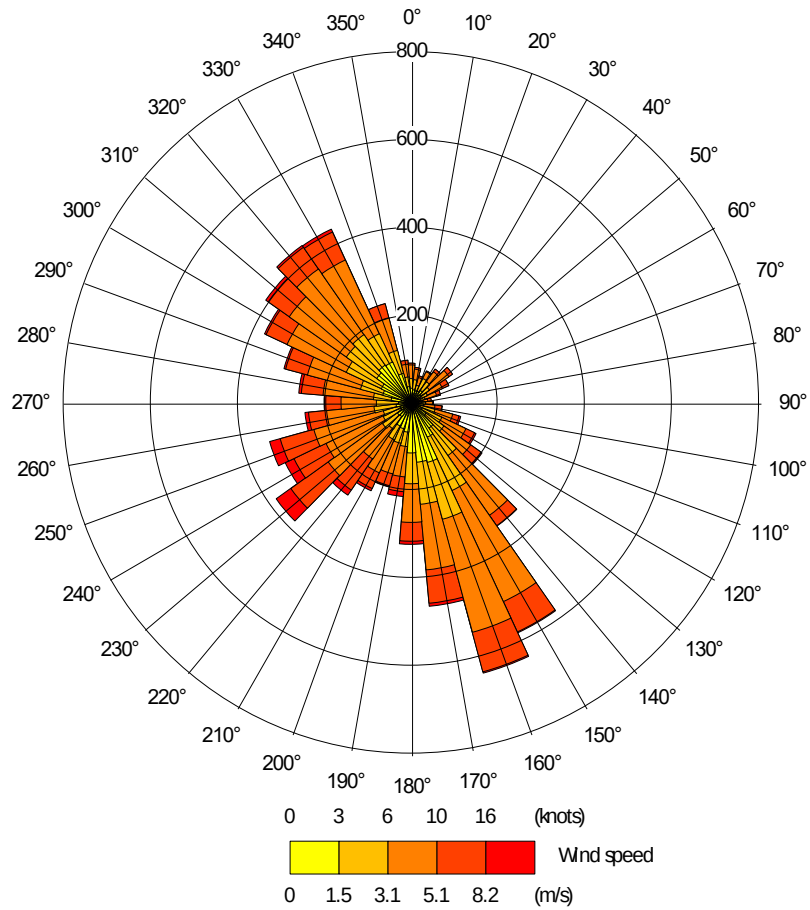


Figure C-2 - Wind Rose (Hawarden 2017)

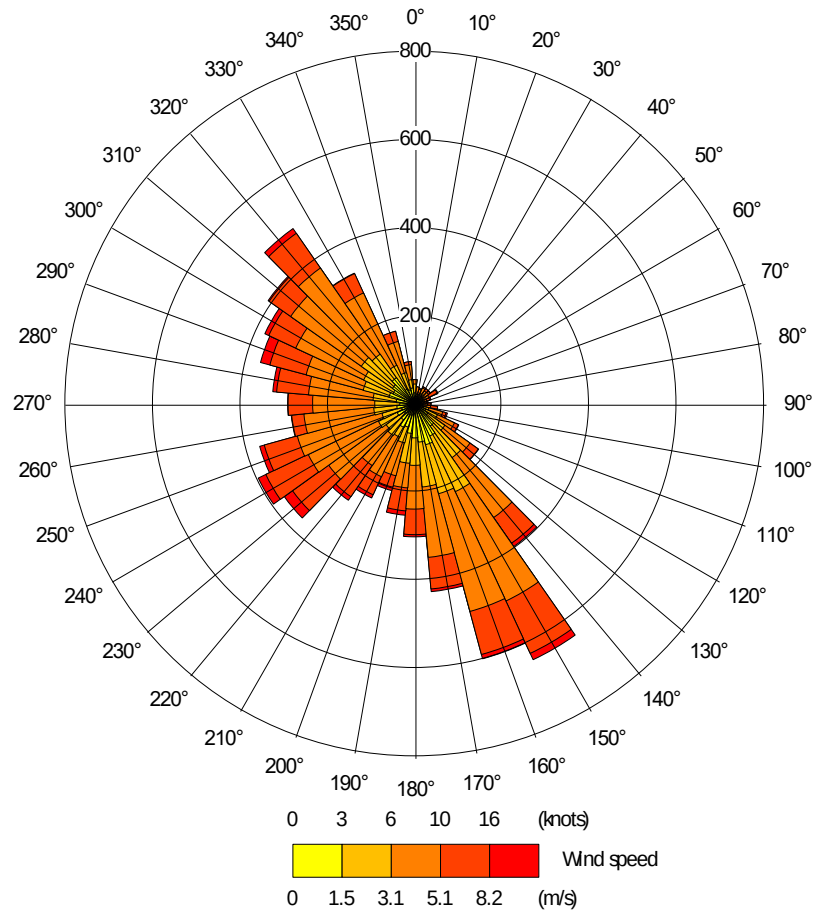


Figure C-3 - Wind Rose (Hawarden 2018)

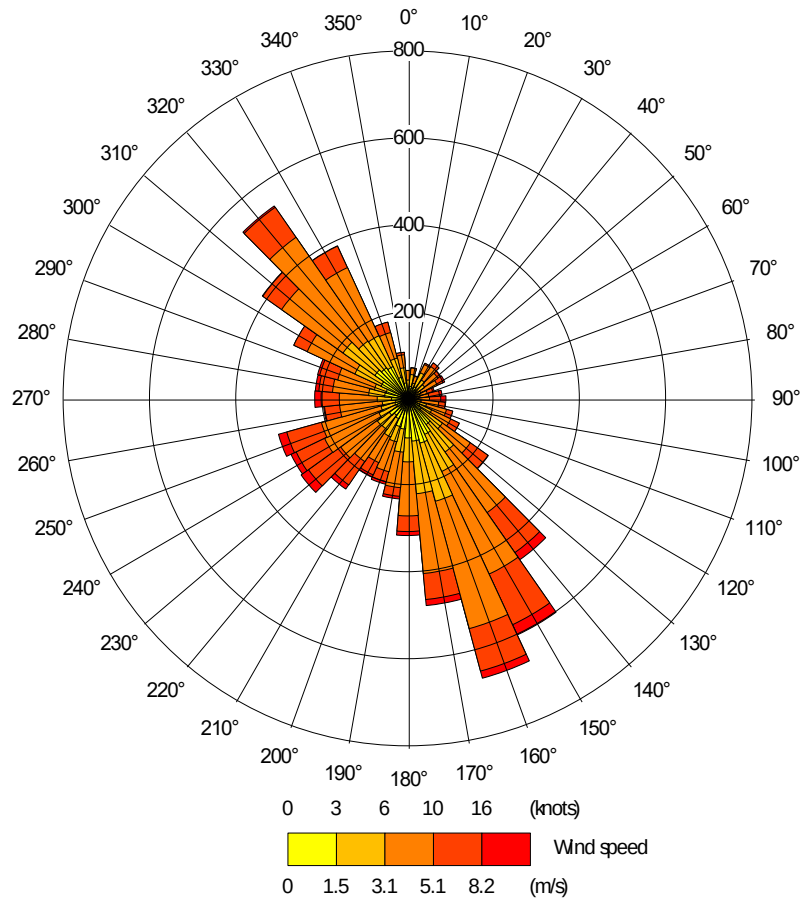


Figure C-4 - Wind Rose (Hawarden 2019)

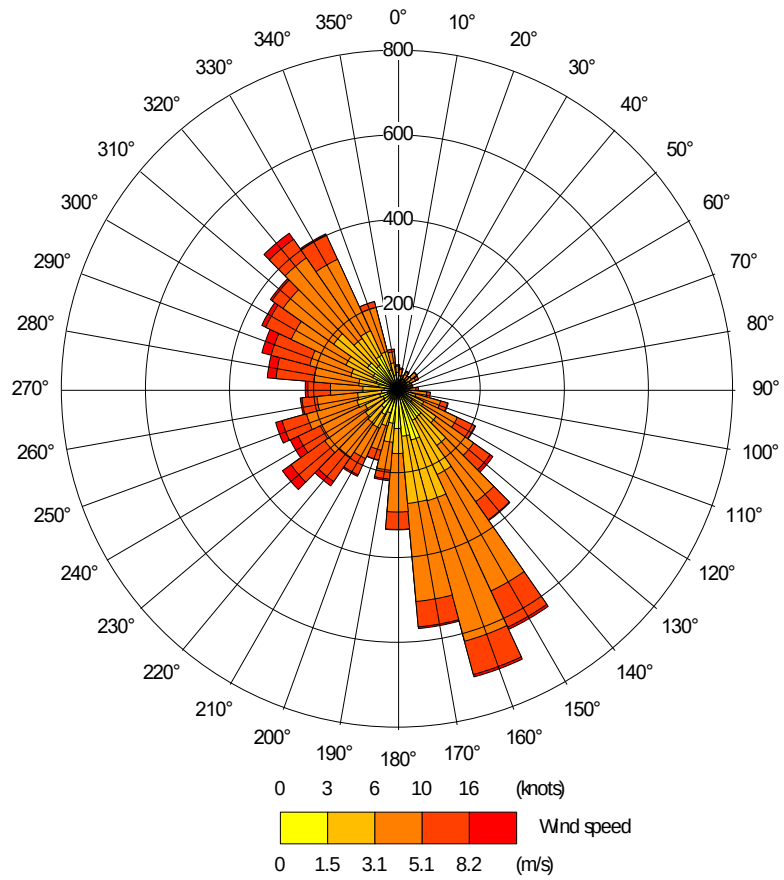
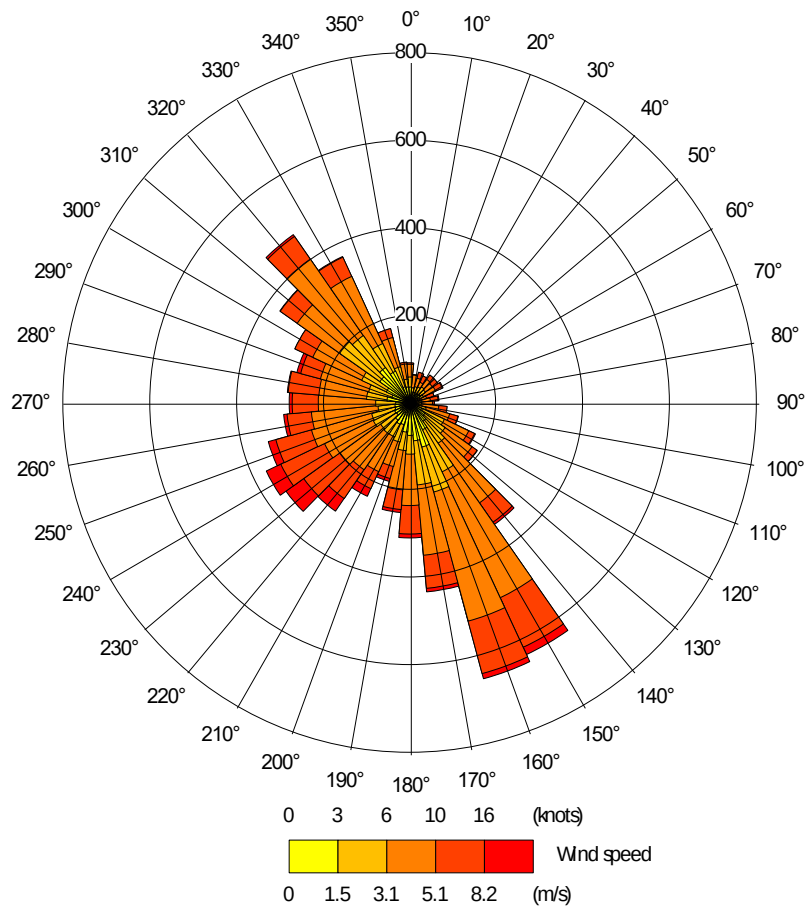


Figure C-5 - Wind Rose (Hawarden 2020)





7 Lochside View
Edinburgh Park
Edinburgh, Midlothian
EH12 9DH

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