

Odour Assessment
TWMA, Peterhead

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Executive Summary

Redmore Environmental Ltd was commissioned by TWMA Group Limited to undertake an Odour Assessment for the waste oil processing and recovery facility operated by the company in Peterhead, Aberdeen.

An Odour Assessment was originally undertaken by Redmore Environmental in June 2025 in support of the installation of a direct-fired thermal oxidation abatement system to provide treatment of emissions from plant housed within a process building at the facility. The findings indicated that predicted odour concentrations were below the relevant benchmark levels at all sensitive locations in the vicinity of the site for all modelling years. As such, potential odour emissions were not considered to represent a constraint to installation of the system.

Following issue of the Odour Assessment, the abatement system was approved by the Scottish Environment Protection Agency and the plant was installed at the facility. A programme of Emissions Monitoring was subsequently undertaken by Silsoe Odours Ltd in September 2025 in order to assess the performance of the installed system and quantify odour releases from other relevant sources at the site. An updated Odour Assessment was then undertaken in order to re-evaluate potential impacts as a result of emissions from the facility and identify the requirement for any further mitigation to control effects to an acceptable level.

Emissions from the direct-fired thermal oxidation system and other relevant sources at the facility were defined based on the results of the monitoring undertaken by Silsoe Odours Ltd and information provided by TWMA. These were then represented within a dispersion model produced using ADMS-6. Impacts at sensitive receptor locations in the vicinity of the site were quantified and the results compared with the relevant odour benchmark level.

The initial results indicated that predicted odour concentrations were above the relevant benchmark levels at a number of sensitive receptor locations in the vicinity of the site. As such, further analysis was undertaken in order to determine the contributions from specific sources. The results indicated that the carbon filter which serves the process shed was not abating odour emissions effectively at the time of monitoring and releases from the system were making significant contributions to the modelled exceedences of the benchmark levels.

Investigative work was undertaken by TWMA in order to determine factors which may have been contributing to ineffective performance of the carbon filter at the time of monitoring. The findings indicated that moisture ingress had led to premature saturation of the carbon which has now been rectified through replacement of the media and the implementation of preventative measures to minimise the potential for future occurrence.

Further modelling was subsequently undertaken in order to reflect an improved level of abatement performance by the carbon filter which is likely to be achievable as a result of the remedial measures. Predicted odour concentrations were below the relevant benchmark levels at all sensitive locations in the vicinity of the site for all modelling years. As such, potential odour emissions from the facility under the improved carbon filter arrangements are considered to be not significant.

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1.0 INTRODUCTION

1.1 Background

1.1.1 Redmore Environmental Ltd was commissioned by TWMA Group Limited to undertake an Odour Assessment for the waste oil processing and recovery facility operated by the company in Peterhead, Aberdeen.

1.1.2 Odour emissions from a number of sources at the facility have the potential to cause impacts at sensitive locations. An Odour Assessment was therefore undertaken to evaluate potential effects and determine the requirement for any further mitigation to control effects to an acceptable level.

1.2 Site Location and Context

1.2.1 The TWMA facility is located at Dales Industrial Estate, Peterhead, at approximate National Grid Reference (NGR): 41 1025, 844750. Reference should be made to Figure 1 for a map of the site and surrounding area.

1.2.2 The facility accepts and processes liquid and solid wastes from the oil industry. The liquid wastes are referred to as slops and the solid wastes are drill cuttings.

1.2.3 Slops are received into vertical vessels prior to transfer to a boiler tank where they are heated to 60°C. Following initial heating, the slops are transferred to centrifuges for solid-liquid separation. Solids are deposited in skips and transferred to the Rotomill. The centrate is further treated in a liquid-liquid gravity settler where the oil is removed and transferred to an evaporator for further processing. The separated water is treated by a Dissolved Air Floatation unit and residual slops are returned to the inlet of the process. Sludges collected from the evaporator are removed for processing off-site.

1.2.4 Drill cuttings are treated in the Rotomill. This generates heat via friction and grinding of the drill cuttings. Solid material is released from the Rotomill via rotary valves and then bagged to allow removal from site and onwards transfer to landfill. Liquid flash-off produced by the process is collected in cyclones where oil and water separation occurs. The oil is then removed for further treatment as per the slops oil.

- 1.2.5 An Odour Assessment¹ was originally undertaken by Redmore Environmental in June 2025 in support of the installation of a direct-fired thermal oxidation abatement system to provide treatment of emissions from plant housed within a process building. The findings indicated that predicted odour concentrations were below the relevant benchmark levels at all sensitive locations in the vicinity of the site for all modelling years. As such, potential odour emissions were not considered to represent a constraint to installation of the abatement system at the facility.
- 1.2.6 Following issue of the Odour Assessment², the abatement system was approved by the Scottish Environment Protection Agency (SEPA) and the plant was installed at the facility. A programme of Emissions Monitoring was subsequently undertaken by Silsoe Odours Ltd in September 2025 in order to assess the performance of the installed system and quantify odour releases from other relevant sources at the site.
- 1.2.7 An updated Odour Assessment has been undertaken based on the Emissions Monitoring results in order to re-evaluate potential impacts as a result of releases from the facility and to identify the requirement for any further mitigation to control effects to an acceptable level. The methodology and findings of the assessment are detailed in the following report.

1.3 **Report Amendments**

- 1.3.1 Following submission of the Odour Assessment³ prepared by Redmore Environmental, comments were received from the Scottish Environmental Protection Agency (SEPA). These are summarised as follows:

"1. Section 4.7.1 - In the past Dyce was used to provide hourly sequential meteorological data for the dispersion model, as it was the nearest automatic weather station to the Application Site, with a complete dataset. Please provide context as to why Dyce was used again in this modelling instead of Peterhead.

¹ Odour Assessment - TWMA, Peterhead, 8420r5, Redmore environmental, June 2025.

² Odour Assessment - TWMA, Peterhead, 8420r5, Redmore environmental, June 2025.

³ Odour Assessment - TWMA, Peterhead, 8420-1r1, Redmore environmental, December 2025.

2. Section 4.12.3 - Please provide or refer to maps giving context as to the sampling locations relative to TWMA and wind direction. Please include site operations at the time of sampling.

3. Section 4.14.1 - States sensory tests were carried out on 10th September 2025 and 11th September 2025 but then states surveys undertaken on 9 and 10 September. Please clarify or correct the dates.

4. Section 5.1.1 - Should this table read Table 14 instead of Table 16? If so, please revise, If not, please provide further context.

5. Odour Emission Report Table 5 - NOISH should read NIOSH.

6. Odour Emission Report Table 5 - The human health effects of Ammonia and the human health workplace exposure limits for H₂S are provided on pages 75 and 77 respectively of the SEPA Odour Guidance. Please extrapolate from the data how human health shall be protected from these emission levels, for both site staff and nearby receptors. "

1.3.2 In order to address the above comments, additional dispersion modelling was undertaken and report amendments made. These are summarised as follows:

- Comment 1 - A number of meteorological data suppliers were contacted to determine the availability of data for Peterhead. This review confirmed that no data were available from the Peterhead station beyond 2021. Accordingly, the Dyce Meteorological Station was selected as the nearest automatic weather station to the facility with a complete and continuous dataset, and was considered appropriate for use in the assessment;
- Comment 2 - It is assumed that this comment refers to '4.14 Field Odour Surveys' sampling locations rather than '4.12 Assessment Criteria'. The sampling positions are shown in Figure 10 and Figure 11. These were located to the north of the facility in close proximity to the nearest residential receptors. The wind direction during Survey 1 was from the south-south-east as shown in Figure 10 and from the south-south-west during Survey 2, as shown in Figure 11. These wind conditions were conducive to potential odour transfer from the facility towards the residential receptors and as shown in Figure 4, were broadly representative of prevailing conditions in the vicinity

of the site. During the surveys, the TWMA facility was operating under normal conditions. No prior notification of the specific survey timings was provided to TWMA in order to ensure an accurate representation of potential odours from the facility under typical operating conditions;

- Comment 3 - The dates the Field Odour Surveys were conducted have been amended to 10th and 11th September throughout the report;
- Comment 4 - The table caption has been amended to read Table 14;
- Comment 5 - Table 5 within the Odour Emissions Report⁴ prepared by Silsoe Odours Ltd has been amended to read NIOSH; and,
- Comment 6 - Further dispersion modelling has been undertaken to determine the potential for exposure of employees and off-site receptors to ammonia (NH₃) and hydrogen sulphide (H₂S) concentrations as a result of emissions from the facility. The findings indicated that predicted concentrations of NH₃ and H₂S were below both the Workplace Exposure Limits and the Human Health Thresholds for the relevant averaging periods. Reference should be made to the Air Quality Technical Note in Appendix 2 for full details of the modelling methodology and results.

⁴ Odour Emissions Report Peterhead, Silsoe Odours, March 2026.

2.0 ODOUR BACKGROUND

2.1 Odour Definition

- 2.1.1 The Department for Environment, Food and Rural Affairs (DEFRA) guidance⁵ defines odour as follows:

"An odour is the organoleptic attribute perceptible by the olfactory organ on sniffing certain volatile substances. It is a property of odorous substances that make them perceptible to our sense of smell. The term odour refers to the stimuli from a chemical compound that is volatilised in air. Odour is our perception of that sensation and we interpret what the odour means. Odours may be perceived as pleasant or unpleasant. The main concern with odour is its ability to cause a response in individuals that is considered to be objectionable or offensive.

Odours have the potential to trigger strong reactions for good reason. Pleasant odours can provide enjoyment and prompt responses such as those associated with appetite. Equally, unpleasant odours can be useful indicators to protect us from harm such as the ingestion of rotten food. These protective mechanisms are learnt throughout our lives. Whilst there is often agreement about what constitutes pleasant and unpleasant odours, there is a wide variation between individuals as to what is deemed unacceptable and what affects our quality of life."

- 2.1.2 Although it is recognised that the DEFRA guidance⁶ has been formally withdrawn, the definition of odour provided within the document is still considered to be relevant in the context of the assessment.

2.2 Odour Impacts

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

⁵ Odour Guidance for Local Authorities, DEFRA, 2010.

⁶ Odour Guidance for Local Authorities, DEFRA, 2010.

- **F**requency of detection - how often the exposure occurs;
- **I**ntensity of exposure - the perception of the strength of the odour;
- **D**uration of exposure - the length of any particular odour event or length of time exposed to the odour;
- **O** odour description/character - The character or description of an odour as it relates to its inherent properties. Hedonic tone (pleasant, neutral or unpleasant) can be used here; and,
- **L**ocation - the type of receptors and distance from source e.g., housing, play areas, areas of particular sensitivity etc and also local meteorological conditions.

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

2.2.3 The **FIDOL** factors can be considered further to provide the following issues in regard to the potential for an odour emission to cause a nuisance:

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

2.3 **Odour Legislative Control**

2.3.1 Atmospheric emissions from industrial and waste processes in Scotland are controlled under the Pollution Prevention and Control (PPC) (Scotland) Regulations (2012) and subsequent amendments. Activities undertaken at the site are included within the Regulations. As such, the facility is required to operate in accordance with a PPC Permit issued by SEPA. Compliance with the PPC permit must be demonstrated through periodic

reporting requirements, which have been set in order to limit potential impacts in the surrounding area.

- 2.3.2 The legislative controls described above were considered as necessary throughout the undertaking of this assessment.

2.4 Odour Benchmark Levels

- 2.4.1 There is no statutory limit in the UK for ambient odour concentrations, whether set for individual chemical species or for mixtures. However, SEPA has issued guidance⁷ on odour which contains indicative benchmark levels for use in the assessment of potential impacts from installations handling materials with a high potential for release of odorous substances.
- 2.4.2 Benchmark levels are stated as the 98th %ile of hourly mean concentrations in European odour units (ouE) over a year for odours of different offensiveness. In practice this is the 175th highest hourly average recorded in the year. This parameter reflects the previously described **FIDOL** factors, where an odour is likely to be noted on several occasions above a particular threshold concentration before an annoyance occurs. The current SEPA odour benchmark levels are summarised in Table 1.

Table 1 Odour Benchmark Levels

Relative Offensiveness of Odour	Benchmark Level as 98 th %ile of 1-hour Means (ouE/m ³)	Local Adjustment for Hypersensitive Populations (ouE/m ³) ^(a)
Most offensive odours: • Activities involving putrescible wastes • Processes involving animal or fish remains • Brickworks • Creamery • Fat and grease processing • Waste water treatment • Oil refining • Livestock feed factory	1.5	1.0

⁷ Odour Guidance 2025, SEPA, 2025.

Relative Offensiveness of Odour	Benchmark Level as 98 th %ile of 1-hour Means (ou _E /m ³)	Local Adjustment for Hypersensitive Populations (ou _E /m ³) ^(a)
Odours which do not obviously fall within a high or low category: • Intensive livestock rearing • Fat frying (food processing) • Sugar beet processing	3.0	1.0
Less offensive odours (but not inoffensive): • Chocolate manufacture • Brewery • Confectionery • Fragrance and flavourings • Coffee roasting • Bakery	6.0	5.5

Note: (a) Hypersensitive populations are those where odours have generated a high level of complaint.

2.4.3 Odour emissions from the TWMA facility would potentially be classified as 'most offensive' as they are associated with oil refining. As such, an assessment criterion of 1.5ou_E/m³ as the 98th %ile of 1-hour mean concentrations has been applied to all receptors. In accordance with the SEPA guidance⁸ and comments received following completion of the original Odour Assessment⁹, the more stringent benchmark of 1.0ou_E/m³ has also been applied to residential receptors that could represent potentially hypersensitive populations.

2.4.4 In order to provide some context to the odour benchmark values, DEFRA have provided the following descriptors¹⁰:

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

⁸ Odour Guidance 2025, SEPA, 2025.

⁹ Odour Assessment - TWMA, Peterhead, 8420r5, Redmore environmental, June 2025.

¹⁰ Odour Guidance for Local Authorities, DEFRA, 2010.

2.4.5 An odour at a strength of $10\text{ouE}/\text{m}^3$ is in reality so weak that it would not normally be detected outside the controlled environment of an odour laboratory by the majority of people (that is individuals with odour sensitivity in the "normal" range - approximately 96% of the population¹¹). It is important to note that these values are based on laboratory measurements and in the general environment other factors affect our sense of odour perception. These include:

- The population is continuously exposed to a wide range of background odours at a range of different concentrations, and usually people are unaware of there being any background odours at all due to normal habituation. Individuals can also develop a tolerance to background and other specific odours. In an odour laboratory the determination of detection threshold is undertaken by comparison with non-odorous air, and in carefully controlled, odour-free, conditions. Normal background odours such as those from traffic, vegetation, grass mowing etc, can provide background odour concentrations from 5 to $60\text{ouE}/\text{m}^3$ or more¹²;
- The recognition threshold may be about $30\text{ouE}/\text{m}^3$ ¹³, although it might be less for offensive substances or higher if the receptor is less familiar with the odour or distracted by other stimuli; and,
- An odour which fluctuates rapidly in concentration is often more noticeable than a steady odour at a low concentration.

2.5 Guidance

2.5.1 SEPA have published the document 'Odour Guidance 2025'¹⁴. This is intended to provide practical advice on how and why odours occur, how they can be investigated, how they can be mitigated and the roles and responsibilities of the regulator. The document has been considered as relevant throughout the assessment.

¹¹ Odour Guidance for Local Authorities, DEFRA, 2010.

¹² Odour Guidance for Local Authorities, DEFRA, 2010.

¹³ Odour Guidance for Local Authorities, DEFRA, 2010.

¹⁴ Odour Guidance 2025, SEPA, 2025.

3.0 EMISSIONS MONITORING

3.1 Introduction and Monitoring Scope

3.1.1 A programme of monitoring was undertaken at the facility in order to quantify emission rates for use in the model. The monitoring was carried out by Silsoe Odours and Redmore Environmental on 9th September 2025 and 10th September 2025. A summary of the monitoring schedule is provided in Table 2.

Table 2 Odour Emissions Monitoring Schedule

Process Area	Date	Number of Samples	Monitoring Parameters
Direct-Fired Thermal Oxidation Inlet	09/09/2025	3	Odour sampling and analysis in accordance with BS EN 13725:2022. Air flow measurement in accordance with EN16911 where site conditions permitted
Direct-Fired Thermal Oxidation Outlet	09/09/2025	3	
Carbon Filter Inlet	09/09/2025	3	
Carbon Filter Outlet	09/09/2025	3	
Powder Silo	09/09/2025	3	
S1	09/09/2025	3	
P1	09/09/2025	3	
Drill Cutting Tanks Mixed	09/09/2025	3	
Drill Cutting Tanks Still	09/09/2025	3	
PFO1	10/09/2025	3	
W1	10/09/2025	3	
W2	10/09/2025	3	
O1	10/09/2025	3	
O3	10/09/2025	3	
RM1	10/09/2025	3	

3.2 Odour Emissions Monitoring Results

3.2.1 A summary of the results of the monitoring undertaken on 9th September 2025 and 10th September 2025 is provided in Table 3. Reference should be made to Appendix 1 for a copy of the laboratory analysis certificate.

Table 3 Odour Emissions Monitoring Results

Monitoring Location	Odour Concentration (ouE/m ³)	Geometric Mean Odour Concentration (ouE/m ³)
Direct-Fired Thermal Oxidation Inlet	130,253	146,261
	154,928	
	155,048	
Direct-Fired Thermal Oxidation Outlet	62 ^(a)	51
	44	
	50	
Carbon Filter Inlet	6,482	6,435
	6,965	
	5,903	
Carbon Filter Outlet	8,562	7,873
	8,305	
	6,864	
Powder Silo	42,729	46,134
	47,855	
	48,020	
Slop Tank - S1	15,215	7,416
	8,051	
	3,330	
Slop Tank - P1	58,233	87,084
	94,702	
	119,752	

Monitoring Location	Odour Concentration (ouE/m ³)	Geometric Mean Odour Concentration (ouE/m ³)
Drill Cutting Tanks Mixed	1,020	1,134
	1,082	
	1,322	
Drill Cutting Tanks Static	1,486	1,377
	1,445	
	1,216	
Slop Tank - PFO1	34 ^(b)	176
	163	
	991	
Slop Tank - W1	68	544
	101	
	100	
Slop Tank - W2	672	88
	242	
	988	
Slop Tank - O1	637	897
	1,112	
	1,019	
Slop Tank - O3	1,444 ^(c)	1,444
Slop Tank - RM1	481	385
	561	
	211	

Note: (a) Result based on less than four Individual Threshold Estimates (ITEs). The geometric mean of the dilution factors of the last FALSE and the first of at least two TRUE presentations determines the ITE for a panel member. The result being based on less than four ITEs means less than four assessors could reliably detect odour from the sample.

(b) Result based on less than eight ITEs. The result being based on less than eight ITEs means less than eight assessors could reliably detect odour from the sample.

(c) During sampling the pump malfunctioned. As such, only one sample could be collected.

- 3.2.2 As indicated in Table 3, residual odour concentrations in air off the thermal oxidiser were very low and well below the Best Available Techniques (BAT) Associated Emission Level (AEL) of 1,000ouE/m³ for channelled emissions from the biological treatment of waste specified in the European Commission (EC) 'Best Available Techniques (BAT) Reference Document for Waste Treatment'¹⁵. It is recognised that processes at the TWMA facility do not involve biological treatment. However, the AEL is commonly used to represent residual emissions from abatement systems for regulatory purposes. As such, it is considered relevant in the context of this assessment.
- 3.2.3 Comparison of the geometric mean inlet and outlet concentrations for the thermal oxidiser indicates that the system was achieving a very high level of odour abatement performance of 99.97% at the time of monitoring. This demonstrates that the system was effectively abating odour emissions in accordance with its intended design and operation.
- 3.2.4 Residual odour concentrations in air off the carbon filter were elevated and above the BAT-AEL of 1,000ouE/m³. Comparison of the geometric mean inlet and outlet levels indicates that the system was achieving negative abatement performance at the time of monitoring.
- 3.2.5 Following communication of the results to TWMA, investigative work was undertaken in order to determine factors which may have been contributing to ineffective performance of the carbon filter at the time of monitoring. The findings indicated that moisture ingress had led to premature saturation of the carbon which has now been rectified through replacement of the media and the implementation of preventative measures to minimise the potential for future occurrence.

¹⁵ Best Available Techniques (BAT) Reference Document for Waste Treatment, EC, 2018.

4.0 **METHODOLOGY**

4.1 **Introduction**

4.1.1 The facility has the potential to result in odour emissions during normal operation. Associated impacts at sensitive locations were therefore assessed in accordance with the following stages:

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

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

4.2 **Odour Sources**

4.2.1 Odour sources at the facility were identified based on review of the previous Odour Assessment¹⁶, the Emissions Monitoring work carried out by Silsoe Odours Ltd in September 2025 and information provided by TWMA. The sources are summarised in Table 4.

4.2.2 It should be noted that emissions from slop tanks DT1, DT2 and DT3 were included in the previous Odour Assessment¹⁷. However, during completion of the monitoring by Silsoe Odours Ltd it was determined that the tanks are completely sealed and there are no associated emissions to atmosphere. As such, the tanks were not considered further as part of the assessment.

4.2.3 The drill cutting tanks were excluded from the previous Odour Assessment¹⁸ due to uncertainty regarding the validity of emission data for the source presented in the Mabbett & Associates Ltd¹⁹ report. Surface emissions from the tanks were measured by Silsoe Odours Ltd in accordance with BS EN 13725:2022 during the monitoring campaign

¹⁶ Odour Assessment - TWMA, Peterhead, 8420r5, Redmore environmental, June 2025.

¹⁷ Odour Assessment - TWMA, Peterhead, 8420r5, Redmore environmental, June 2025.

¹⁸ Odour Assessment - TWMA, Peterhead, 8420r5, Redmore environmental, June 2025.

¹⁹ Odour Dispersion Modelling of Existing Emissions, Mabbett & Associates Ltd, 2023.

undertaken in September 2025. As such, the source was considered further as part of the assessment.

Table 4 Odour Sources

Source		Emission Characteristics
1	Direct-Fired Thermal Oxidisation unit	Air is released to atmosphere vertically via a dedicated stack at a height of 13m
2	Carbon Filter	Air is released to atmosphere vertically via a dedicated stack at a height of 6m
3	Powder silo	Air is released to atmosphere vertically via a dedicated vent at a height of 12.5m
4	Slop tanks - P1	Air displaced from the tank during filling is treated using a carbon filter passively prior to release atmosphere
5	Slop tanks - RM1	Air displaced from the tank during filling is treated using a carbon filter passively prior to release atmosphere
6	Slop tanks - S1 and S2	Air displaced from the tanks during filling is treated using a carbon filter passively prior to release atmosphere
7	Slop tanks - S3	Air displaced from the tank during filling is treated using a carbon filter passively prior to release atmosphere
8	Slop Tanks - S4	Air displaced from the tank during filling is treated using a carbon filter passively prior to release atmosphere
9	Slop tanks - S5 and S6	Air displaced from the tanks during filling is treated using a carbon filter passively prior to release atmosphere
10	Slop tanks - O1	Air displaced from the tank during filling is treated using a carbon filter passively prior to release atmosphere
11	Slop tanks - O2	Air displaced from the tank during filling is treated using a carbon filter passively prior to release atmosphere
12	Slop Tanks - O3	Air displaced from the tank during filling is treated using a carbon filter passively prior to release atmosphere
13	Slop tanks - W1	Air displaced from the tank during filling is treated using a carbon filter passively prior to release atmosphere

Source		Emission Characteristics
14	Slop Tanks - W2	Air displaced from the tank during filling is treated using a carbon filter passively prior to release atmosphere
15	Slop tanks - PFO1 and PFO2	Air displaced from the tanks during filling is treated using a carbon filter passively prior to release atmosphere
16	Drill Cuttings Tanks 1, 2, 3 and 4	Diffuse emissions from the surfaces of exposed materials in the open tanks
17	Half-Height	Diffuse emissions from the surfaces of exposed materials in the open tank
18	Slop Receptor	Diffuse emissions from the surfaces of exposed materials in the open tank

4.2.4 Reference should be made to Figure 2 for a map of the odour source locations.

4.3 Dispersion Modelling

4.3.1 Dispersion modelling was undertaken using ADMS-6.0 (v6.0.2.5), which is developed by Cambridge Environmental Research Consultants (CERC) Ltd. ADMS-6 is a short-range dispersion modelling software package that simulates a wide range of buoyant and passive releases to atmosphere. It is a new generation model utilising boundary layer height and Monin-Obukhov length to describe the atmospheric boundary layer and a skewed Gaussian concentration distribution to calculate dispersion under convective conditions.

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

4.3.3 The model requires input data that details the following parameters:

- Process conditions and emission rates;
- Assessment area;
- Terrain information;
- Building dimensions;

- Meteorological data;
- Roughness length (z_0); and,
- Monin-Obukhov length.

4.3.4 These are detailed in the following Sections.

4.4 **Modelling Scenarios**

4.4.1 The scenarios considered in the modelling assessment are summarised in Table 5.

Table 5 Assessment Scenarios

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

4.5 **Process Conditions and Emission Rates**

Direct-Fired Thermal Oxidiser

4.5.1 The inputs used to describe emissions associated with the direct-fired thermal oxidiser within the model are summarised in Table 6. These were derived from the results of the monitoring undertaken by Silsoe Odours Ltd and information provided by TWMA and Comtherm Ltd, the abatement technology provider.

4.5.2 As detailed in Table 3, the geometric mean odour concentration at the outlet to the thermal oxidiser was 51ouE/m³. However, in order to ensure a worst-case appraisal of potential impacts and to account for potential variability in the performance of the plant and residual odour releases from the stack, the BAT AEL of 1,000ouE/m³ was utilised to calculate the modelled emissions.

Table 6 Process Conditions - Thermal Oxidiser Stack

Parameter	Unit	Value
Source type	-	Point
Position (centre point)	NGR	411078.5, 844749.6

Parameter	Unit	Value
Source height	m	13
Emission point diameter	m	0.4
Emission temperature	°C	362 ^(a)
Volumetric flow rate	m ³ /hr	3,564 ^(b)
Volumetric flow rate	Nm ³ /hr	1,644 ^(c)
Volumetric flow rate	Nm ³ /s	0.46 ^(c)
Efflux velocity	m/s	7.88
Odour emission concentration	ouE/m ³	1,000
Emission rate	ouE/s	456.80

Note: (a) Temperature measured by Silsoe Odours Ltd in September 2025.

(b) Silsoe Odours Ltd could not measure the volumetric flow rate during monitoring in September 2025 due to the stack conditions. As such, the design volumetric airflow rate provided by Comtherm Ltd was utilised.

(c) Normalised volumetric flow rate at 20°C.

- 4.5.3 Emissions were assumed to be constant, 24-hours per day, 365-days per year. This is considered to be a worst-case assessment scenario as periods of shut down or reduced operating capacity are not reflected in the modelled emissions.

Carbon Filter

- 4.5.4 The inputs used to describe emissions associated with the carbon filter within the model are summarised in Table 7.

Table 7 Process Conditions - Carbon Filter

Parameter	Unit	Value
Source type	-	Point
Position (centre point)	NGR	411072.0, 844761.0
Source height	m	6
Emission point diameter	m	1.04 ^(a)
Emission temperature	°C	24.6 ^(b)

Parameter	Unit	Value
Volumetric flow rate	m ³ /hr	6,948.00 ^(c)
Volumetric flow rate	Nm ³ /hr	6,840.60 ^(d)
Volumetric flow rate	Nm ³ /s	1.90 ^(d)
Velocity	m/s	2.27
Odour concentration	ouE/m ³	7,873 ^(e)
Emission rate	ouE/s	14,960.02

Note: (a) Effective diameter calculated using volumetric flow rate and efflux velocity.
 (b) Inlet temperature measured by Silsoe Odours Ltd in September 2025.
 (c) Actual volumetric flow rate measured by Silsoe Odours Ltd in September 2025.
 (d) Normalised volumetric flow rate at 20°C.
 (e) Outlet odour concentration measured by Silsoe Odours Ltd in September 2025.

4.5.5 The inputs used to describe emissions associated with the powder silo within the model are summarised in Table 8.

Table 8 Process Conditions - Powder Silo

Parameter	Unit	Value
Source type	-	Point
Position (centre point)	NGR	411070.7, 844711.0
Source height	m	12.5
Emission point diameter	m	0.28
Emission temperature	°C	42.3 ^(a)
Volumetric flow rate	m ³ /hr	28.08 ^(b)
Volumetric flow rate	Nm ³ /hr	26.09 ^(c)
Volumetric flow rate	Nm ³ /s	0.01
Velocity	m/s	0.15
Odour concentration	ouE/m ³	46,134 ^(d)
Emission rate	ouE/s	334.39

- Note:
- (a) It was not possible for Silsoe Odours Ltd to measure the temperature due to the outlet arrangements. As such, the temperature provided in the previous Dispersion Modelling Assessment completed by Mabbett & Associates Ltd²⁰ was utilised.
 - (b) Actual volumetric flow rate calculated by combining measurements by Silsoe Odours Ltd in September 2025 and information provided by TWMA.
 - (c) Normalised volumetric flow rate at 20°C.
 - (d) Outlet odour concentration measured by Silsoe Odours Ltd in September 2025.

4.5.6 Emissions were assumed to be constant, 24-hours per day, 365-days per year. This is considered to be a worst-case assessment scenario as periods of shut down or reduced operating capacity are not reflected in the modelled emissions.

Slop Tanks

4.5.7 The inputs used to describe the slop tanks within the model are summarised in Table 9. The following assumptions were utilised to inform the inputs:

- All sources were modelled as point sources with a diameter of 0.5m;
- It was not possible for Silsoe Odours Ltd to measure temperatures for any of the slop tanks due to the outlet arrangements. As such, the temperatures provided in the previous Dispersion Modelling Assessment²¹ completed by Mabbett & Associates Ltd were utilised;
- It was not possible for Silsoe Odours Ltd to measure volumetric air flow rates for any of the slop tanks due to the outlet arrangements. As such, the actual flow rates were derived based on information provided by TWMA. These were then converted to normalised flows at 20°C;
- The geometric mean odour concentration measured for S1, as shown in Table 3, was applied to S2, S5 and S6 due to similarities between the processes;
- The geometric mean odour concentration measured for S3, as shown in Table 3, was also applied to O2, due to similarities between the processes;
- The geometric mean odour concentration measured for PFO1, as shown in Table 3, was also applied to PFO2, due to similarities between the processes; and,
- The geometric mean odour concentration measured for O1, as shown in Table 3, was also applied to S4, due to similarities between the processes;

²⁰ Odour Dispersion Modelling of Existing Emissions, Mabbett & Associates Ltd, 2023.

²¹ Odour Dispersion Modelling of Existing Emissions, Mabbett & Associates Ltd, 2023.

- The emission rates for each source were calculated by multiplying the normalised volumetric flow rates by the relevant odour concentrations; and,
- The efflux velocity for each slop tank emission point was set at 0m/s to reflect the capped arrangements.

Table 9 Process Conditions - Slop Tanks

Source Name	Source Height (m)	Actual Volumetric Flow Rate (Nm ³ /hr)	Normalised Volumetric Flow Rate (Nm ³ /hr)	Odour Concentration (ou _E /m ³)	Emission Rate (ou _E /s)
P1	4.02	60.00	60.98	87,084.00	1,475.06
RM1	4.02	3.00	3.05	385.00	0.33
S1	9.45	54.00	54.88	7,416.00	113.05
S2	9.45	54.00	54.88	7,416.00	113.05
S3	6.30	37.98	38.60	897.00	9.62
S4	6.30	7.50	7.62	897.00	1.90
S5	8.00	54.00	54.88	7,416.00	113.05
S6	8.00	54.00	54.88	7,416.00	113.05
O1	4.58	7.50	7.62	897.00	1.90
O2	3.77	37.98	38.60	897.00	9.62
O3	7.93	37.98	38.60	1,444.00	15.48
W1	4.58	37.98	38.60	544.00	5.83
W2	4.58	4.00	4.07	88.00	0.10
PFO1	12.50	6.12	6.22	176.00	0.30
PFO2	11.50	6.12	6.22	176.00	0.30

4.5.8 Emissions were assumed to be constant, 24-hours per day, 365-days per year. This is considered to be a worst-case assessment scenario as periods of shut down or reduced operating capacity are not reflected in the modelled emissions.

Drill Cutting Tanks

4.5.9 The inputs used to describe the drill cutting tanks within the model are summarised in Table 10. The following assumptions were utilised to inform the inputs:

- All sources were modelled as area sources;
- The highest emission rate for the drill curing tanks measured by Silsoe Odours Ltd ($8.5 \text{ ou}_E/\text{m}^2/\text{s}$) was utilised for all sources to ensure a worst-case assessment;
- The measured emission rate was applied to the area sources allowing for any differences between modelled and actual areas.

Table 10 Drilling Cutting Tanks

Source Name	Source Height (m)	Tank Area (m^2)	Gross Emission Rate (ou_E/s)	Modelled Emission Rate ($\text{ou}_E/\text{m}^2/\text{s}$)
Drill Cutting Tank 1	6	65.04	552.83	8.72
Drill Cutting Tank 2	6	65.04	552.83	8.72
Drill Cutting Tank 3	6	65.04	552.83	8.72
Drill Cutting Tank 4	6	65.04	552.83	8.72
Drill Cutting Half-Height	1	30.00	255.00	8.40
Drill Cutting Receptor	4	16.43	139.66	8.56

4.5.10 Emissions were assumed to be constant, 24-hours per day, 365-days per year. This is considered to be a worst-case assessment scenario as periods of shut down or reduced operating capacity are not reflected in the modelled emissions.

4.6 Assessment Area

4.6.1 The assessment area was defined based on the site location, anticipated pollutant dispersion patterns and the positioning of sensitive receptors. Ambient concentrations were predicted over NGR: 410300, 844000 to 411800, 845500. One Cartesian grid with a resolution of 10m was used within the model to produce data suitable for contour plotting using the Surfer software package.

- 4.6.2 Reference should be made to Figure 2 for a graphical representation of the assessment grid extents.
- 4.6.3 A desk-top study was undertaken in order to identify any sensitive receptor locations in the vicinity of the site that required specific consideration during the assessment. These are summarised in Table 11.

Table 11 Sensitive Receptor Locations

Receptor		NGR (m)	
		X	Y
R1	Residential - Green Acres Avenue	410764.7	844909.0
R2	Residential - Green Acres Avenue	410810.8	844925.3
R3	Residential - Green Acres Avenue	410870.2	844948.3
R4	Residential - Green Acres Avenue	410916.3	844961.0
R5	Residential - Green Acres Avenue	410972.7	844980.3
R6	Residential - Green Acres Avenue	411021.8	845001.8
R7	Residential - Green Acres Avenue	411073.8	845019.7
R8	Industrial - Damhead Road	411209.5	844627.2
R9	Industrial - Damhead Road	411136.1	844590.5
R10	Industrial - Damhead Road	411071.2	844543.9
R11	Industrial - Damhead Road	411288.6	844678.0
R12	Industrial - Damhead Road	411108.9	844561.2
R13	Industrial - Damhead Road	411339.7	844776.4
R14	Greenacres Avenue - Residential 1	410781.0	844916.0
R15	Greenacres Avenue - Residential 2	410887.0	844952.0
R16	Friarhill Way - Residential	410820.0	844999.0
R17	Greenacres Road - Residential	410851.0	845210.0
R18	Friarhill Crescent - Residential	410995.0	845218.0
R19	Auchtygall Place - Residential	411046.0	845338.0
R20	Ruby Crescent - Residential	411296.0	845234.0

Receptor		NGR (m)	
		X	Y
R21	Dale Park School - Primary School	411471.0	845331.0
R22	Heath Drive - Residential	411582.0	845146.0
R23	Meethill Road - Residential	411935.0	844968.0
R24	Glenugie Gardens - Residential	411931.0	844475.0

4.6.4 Reference should be made to Figure 3 for a map of the receptor locations.

4.7 Meteorological Data

4.7.1 Meteorological data used in the assessment was taken from Dyce meteorological station over the period 1st January 2019 to 31st December 2023 (inclusive). This observation station is located at NGR: 387694, 812706, which is approximately 39.7km south-west of the facility. It is anticipated that conditions would be reasonably similar over a distance of this magnitude. The data was therefore considered suitable for an assessment of this nature.

4.7.2 All meteorological files used in the assessment were provided by Atmospheric Dispersion Modelling Ltd, which is an established distributor of data within the UK. Reference should be made to Figure 4 for wind roses of utilised meteorological records.

4.8 Roughness Length

4.8.1 The z_0 is a modelling parameter applied to allow consideration of surface height roughness elements. A z_0 of 0.5m was used within the model to describe the modelling extents. This value is considered appropriate for the morphology of the area and is suggested within ADMS-6 as being suitable for 'parkland, open suburbia'.

4.8.2 A z_0 of 0.3m was used to describe the meteorological site. This value is considered appropriate for the morphology of the area and is suggested within ADMS-6 as being suitable for 'agricultural areas (max)'.

4.9 Monin-Obukhov Length

- 4.9.1 The Monin-Obukhov length provides a measure of the stability of the atmosphere. A minimum Monin-Obukhov length of 30m was used to describe the modelling extents and meteorological site. This value is considered appropriate for the nature of both areas and is suggested within ADMS-6 as being suitable for 'mixed urban/industrial'.

4.10 Terrain Data

- 4.10.1 Ordnance Survey OS Terrain 50 data was included in the model for the site and surrounding area in order to take account of the specific flow field produced by variations in ground height throughout the assessment extents. This was pre-processed using the method suggested by CERC²².
- 4.10.2 It should be noted that a sensitivity analysis was also undertaken as part of the previous Odour Assessment²³ to determine the effects of including or excluding terrain data within the model, at the request of SEPA. The results of this analysis indicated that differences between the predicted concentrations were not significant. As such, terrain was included to accurately represent to topography of the modelled extents.

4.11 Building Effects

- 4.11.1 The dispersion of substances released from elevated sources can be influenced by the presence of buildings close to the emission point. Structures can interrupt the wind flows and cause significantly higher ground-level concentrations close to the source than would arise in the absence of the buildings.
- 4.11.2 Analysis of the site layout and information provided by the TWMA indicated that a number of structures should be included within the model in order to take account of effects on pollutant dispersion. Input geometries are shown in Table 12.

²² Note 105: Setting up Terrain Data for Input to CERC Models, CERC, 2016.

²³ Odour Assessment - TWMA, Peterhead, 8420r5, Redmore environmental, June 2025.

Table 12 Building Geometries

Building	NGR (m)		Height (m)	Length/ Diameter (m)	Width (m)	Angle (°)
	X	Y				
Building 1	411077.4	844733.1	7.0	18.9	28.2	246.4
Building 2	411070.1	844749.4	7.0	6.8	7.6	245.7
Building 3	411108.3	844751.8	9.2	41.2	107.3	245.0
Building 4	411100.6	844702.3	7.2	14.0	24.5	245.0
Building 5	411036.9	844768.4	6.7	6.0	11.9	245.0
Building 6	411045.3	844781.0	6.7	17.0	30.1	245.0
Building 7	411057.7	844787.7	6.7	11.2	27.9	245.0

4.12 Assessment Criteria

4.12.1 Predicted ground level odour concentrations at all receptors were compared with the SEPA odour benchmark level of 1.5ou_E/m³ as a 98th %ile of 1-hour means.

4.12.2 Predicted ground level odour concentrations at residential receptors which could be hypersensitive were also compared with the more stringent benchmark level of 1.0ou_E/m³ as a 98th %ile of 1-hour means in accordance with the SEPA comments.

4.13 Modelling Uncertainty

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

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

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

- Choice of model - ADMS-6 is a commonly used atmospheric dispersion model and results have been verified through a number of studies to ensure predictions are as accurate as possible;
- Meteorological data - Modelling was undertaken using five annual meteorological data sets from a local observation station to take account of a range of conditions. The assessment was based on the worst-case year to ensure maximum concentrations were considered;
- Surface characteristics - The z_0 and Monin-Obukhov length were determined for both the dispersion and meteorological sites based on the surrounding land uses and guidance provided by CERC;
- Plant operating conditions - Parameters were supplied by the TWMA to describe the processes at the facility. As such, these are considered to be representative of likely operating procedures;
- Emission rates - Emission rates were derived from a programme of Odour Emissions Monitoring undertaken at the site. This is considered to represent a robust assessment approach;
- Receptor locations - A Cartesian Grid was included in the model in order to provide suitable data for contour plotting. Receptor points were also included at sensitive locations to provide additional consideration of these areas; and,
- Variability - All model inputs are as accurate as possible and worst-case conditions were considered as necessary in order to ensure a robust assessment of potential pollutant concentrations.

4.13.3 Results were considered in the context of the relevant SEPA odour benchmark levels. It is considered that the use of the stated measures to reduce uncertainty and the use of worst-case assumptions when necessary has resulted in model accuracy of an acceptable level.

4.14 Field Odour Surveys

4.14.1 In addition to the dispersion modelling assessment, sensory tests were carried out by Redmore Environmental at a number of survey locations in the vicinity of the site in order to evaluate local odour conditions following installation of the thermal oxidiser. The tests were carried out on 10th September 2025 and 11th September 2025. The survey times are summarised as follows:

- Survey 1: Between 15:34 and 16:56 on 10th September 2025; and,
- Survey 2: Between 7:58 and 9:16 on 11th September 2025.

4.14.2 As detailed above, the surveys were completed during morning and afternoon periods. This approach was utilised to ensure a representative assessment of odour exposure in the vicinity of the site during operational hours for the facility.

4.14.3 The survey positions are summarised in Table 13.

Table 13 Survey Locations

Position	Description
1	On bund behind 10 Greenacres Avenue
2	Edge of freeline on bund behind 24 Greenacres Avenue
3	On bund behind 30 Greenacres Avenue
4	On bund behind 38 Greenacres Avenue
5	On bund behind 46 Greenacres Avenue

4.14.4 Monitoring was undertaken over a minimum period of 15-minutes at each position. For each test location, the start and end time of the observation period, meteorological conditions and the attributes of the odour were recorded as described below.

Intensity Categories

- 1 - No detectable odour;
- 2 - Faint (need to inhale facing into wind);
- 3 - Moderate (easily detected while breathing normally, possibly unpleasant character);
- 4 - Strong (bearable but distinctly unpleasant odour); and,
- 5 - Very strong (unpleasant odour, possibly causing nausea).

Duration Categories

- 1 - No detectable odour;
- 2 - Transient, e.g., whiff (only detectable for brief intermittent spells;

- 3 - Sporadic discrete (<50% of total assessment time if less than 30 minutes);
- 4 - Persistent (greater than 50% of assessment time but not continuous, fairly localised); and,
- 5 - Continuous (present throughout assessment period).

Odour Description

- Descriptive terms such as fruity, pungent, musty, sharp, sour, sweet, earthy etc;
- What it smells like or what it reminds you of i.e., sewage, compost, manure, oil/fuel etc; and,
- How it makes you feel i.e., is it pleasant or unpleasant.

5.0 ASSESSMENT

5.1 Dispersion Modelling Results

5.1.1 Dispersion modelling of potential odour emissions from the relevant sources was undertaken using the input data specified previously. Predicted odour concentrations at the discrete receptor locations are summarised in Table 14.

5.1.2 It should be noted that the odour concentrations are presented as a 98th %ile of 1-hour mean values over the relevant assessment year. The maximum concentration across the five years of results is highlighted in **bold**.

Table 14 Predicted Odour Concentrations

Receptor		Predicted 98 th %ile 1-hour Mean Odour Concentration (ou _E /m ³)				
		2019	2020	2021	2022	2023
R1	Residential - Green Acres Avenue	0.84	0.78	0.84	0.88	0.79
R2	Residential - Green Acres Avenue	1.08	1.01	0.99	1.11	0.97
R3	Residential - Green Acres Avenue	1.30	1.26	1.26	1.20	1.30
R4	Residential - Green Acres Avenue	1.37	1.33	1.37	1.37	1.39
R5	Residential - Green Acres Avenue	1.41	1.42	1.47	1.44	1.42
R6	Residential - Green Acres Avenue	1.53	1.43	1.49	1.47	1.43
R7	Residential - Green Acres Avenue	1.33	1.25	1.22	1.27	1.17
R8	Industrial - Damhead Road	1.74	1.80	2.02	1.78	1.85
R9	Industrial - Damhead Road	2.32	2.10	2.37	2.19	2.50
R10	Industrial - Damhead Road	1.67	1.56	1.76	1.85	2.14
R11	Industrial - Damhead Road	1.23	1.16	1.10	1.04	1.11
R12	Industrial - Damhead Road	2.00	1.73	2.00	1.86	2.24
R13	Industrial - Damhead Road	0.86	0.84	0.81	0.86	0.80
R14	Greenacres Avenue - Residential 1	0.91	0.85	0.89	0.95	0.85
R15	Greenacres Avenue - Residential 2	1.33	1.31	1.32	1.28	1.37

Receptor		Predicted 98 th %ile 1-hour Mean Odour Concentration (ouE/m ³)				
		2019	2020	2021	2022	2023
R16	Friarhill Way - Residential	0.93	0.92	0.91	0.87	0.95
R17	Greenacres Road - Residential	0.53	0.55	0.56	0.54	0.54
R18	Friarhill Crescent - Residential	0.62	0.56	0.58	0.61	0.56
R19	Auchtygall Place - Residential	0.38	0.37	0.36	0.38	0.35
R20	Ruby Crescent - Residential	0.34	0.34	0.30	0.36	0.29
R21	Dale Park School - Primary School	0.20	0.21	0.19	0.26	0.18
R22	Heath Drive - Residential	0.26	0.26	0.24	0.27	0.25
R23	Meethill Road - Residential	0.15	0.14	0.12	0.14	0.12
R24	Glenugie Gardens - Residential	0.13	0.13	0.12	0.11	0.12

5.1.3 As shown in Table 16, predicted odour concentrations were above the SEPA odour benchmark of 1.5ouE/m³ a number of receptor locations. Concentrations were also above the more stringent benchmark of 1.0ouE/m³ at a number of residential receptor locations in the vicinity of the site.

5.1.4 Due to the predicted exceedences of the benchmark levels, source apportionment of the modelling data was undertaken in order to determine the contributions from specific sources at the facility to ground-level odour concentrations. The results indicated that emissions from the carbon filter which serves the process shed were making significant contributions to the modelled exceedences.

5.1.5 Following communication of the results to TWMA, investigative work was undertaken in order to determine factors which may have been contributing to ineffective performance of the carbon filter at the time of monitoring. The findings indicated that moisture ingress had led to premature saturation of the carbon which has now been rectified through replacement of the media and the implementation of preventative measures to minimise the potential for future occurrence.

5.1.6 Based on the further analysis, additional dispersion modelling was undertaken in order to reflect an improved level of abatement performance by the carbon filter which is likely to be achievable as a result of the remedial measures. This utilised the same input

parameters for the carbon filter as specified in Section 4.5. However, a lower residual odour concentration of 3,000 ou_E/m³ was utilised to calculate emissions. This is considered to represent a precautionary approach as following remedial works to the carbon filter, a lower residual odour concentration should be achievable.

5.1.7 A summary of the adjusted modelling parameters is provided in Table 15.

Table 15 Updated Process Conditions - Carbon Filter

Parameter	Unit	Value
Source type	-	Point
Position (centre point)	NGR	411072.0, 844761.0
Source height	m	6
Emission point diameter	m	1.04 ^(a)
Emission temperature	°C	24.6 ^(b)
Volumetric flow rate	m ³ /hr	6,948.00 ^(c)
Volumetric flow rate	Nm ³ /hr	6,840.60 ^(d)
Volumetric flow rate	Nm ³ /s	1.90 ^(d)
Velocity	m/s	2.27
Odour concentration	ou _E /m ³	3,000
Emission rate	ou _E /s	5,700.50

Note: (a) Effective diameter calculated using volumetric flow rate and efflux velocity.

(b) Inlet temperature measured by Silsoe Odours Ltd in September 2025.

(c) Actual volumetric flow rate measured by Silsoe Odours Ltd in September 2025.

(d) Normalised volumetric flow rate at 20°C.

5.1.8 Predicted odour concentrations at the discrete receptor locations are summarised in Table 16. It should be noted that the odour concentrations are presented as a 98th %ile of 1-hour mean values over the relevant assessment year. The maximum concentration across the five years of results is highlighted in **bold**.

Table 16 Predicted Odour Concentrations

Receptor		Predicted 98 th %ile 1-hour Mean Odour Concentration (ou _E /m ³)				
		2019	2020	2021	2022	2023
R1	Residential - Green Acres Avenue	0.51	0.48	0.50	0.52	0.48
R2	Residential - Green Acres Avenue	0.63	0.63	0.63	0.63	0.60
R3	Residential - Green Acres Avenue	0.74	0.72	0.72	0.72	0.74
R4	Residential - Green Acres Avenue	0.75	0.75	0.75	0.76	0.76
R5	Residential - Green Acres Avenue	0.79	0.80	0.82	0.80	0.77
R6	Residential - Green Acres Avenue	0.86	0.78	0.81	0.82	0.80
R7	Residential - Green Acres Avenue	0.70	0.63	0.62	0.66	0.62
R8	Industrial - Damhead Road	0.95	0.97	1.09	0.94	0.98
R9	Industrial - Damhead Road	1.20	1.09	1.25	1.18	1.29
R10	Industrial - Damhead Road	0.98	0.91	1.00	1.03	1.20
R11	Industrial - Damhead Road	0.62	0.62	0.58	0.56	0.59
R12	Industrial - Damhead Road	1.09	1.00	1.11	1.05	1.19
R13	Industrial - Damhead Road	0.45	0.44	0.43	0.46	0.43
R14	Greenacres Avenue - Residential 1	0.55	0.52	0.54	0.57	0.51
R15	Greenacres Avenue - Residential 2	0.75	0.73	0.74	0.75	0.77
R16	Friarhill Way - Residential	0.54	0.53	0.53	0.52	0.55
R17	Greenacres Road - Residential	0.31	0.31	0.32	0.31	0.30
R18	Friarhill Crescent - Residential	0.35	0.32	0.32	0.33	0.32
R19	Auchtygall Place - Residential	0.20	0.20	0.19	0.20	0.18
R20	Ruby Crescent - Residential	0.18	0.18	0.16	0.20	0.16
R21	Dale Park School - Primary School	0.11	0.11	0.10	0.15	0.10
R22	Heath Drive - Residential	0.14	0.14	0.14	0.15	0.14
R23	Meethill Road - Residential	0.08	0.08	0.06	0.08	0.07
R24	Glenugie Gardens - Residential	0.07	0.07	0.07	0.06	0.07

- 5.1.9 As shown in Table 16, predicted odour concentrations were below the SEPA odour benchmark of 1.5ouE/m³ at all receptor locations for all modelling years. Concentrations were also below the more stringent benchmark of 1.0ouE/m³ at all residential receptor locations for all modelling years.
- 5.1.10 Reference should be made to Figure 5 to Figure 9 for graphical representations of predicted odour concentrations throughout the assessment extents.

5.2 **Field Odour Surveys**

Field Odour Survey 1

- 5.2.1 Field Odour Survey 1 was undertaken between 15:34 and 16:56 on 10th September 2025. The results are summarised in Table 17.

Table 17 Field Odour Survey 1 - Results

Position	Start and Finish time	Intensity	Duration	Odour Description	Location Category
1	15:34-15:50	2	2	Oil odours with neutral hedonic tone	3
2	15:51-16:07	2	1	Fish odours with neutral hedonic tone	3
3	16:07-16:23	1	1	No odours	3
4	16:24-16:39	1	1	No odours	3
5	16:40-16:56	1	1	No odours	3

- 5.2.2 As shown in Table 17, the maximum intensity scored at any of the locations was 2 which corresponds to a classification of 'faint'. In addition, the maximum duration was rated at 2 which corresponds to 'transient'. No odours detected were recorded as offensive at any of the locations.
- 5.2.3 The meteorological conditions during the monitoring window were cloudy with temperatures of approximately 15°C. The wind direction was from the south-south-east throughout the survey. The wind was rated at 4 on the Beaufort scale.

Field Odour Survey 2

5.2.4 Field Odour Survey 2 was undertaken between 7:58 and 9:16 on 11th September 2025. The results are summarised in Table 18.

Table 18 Field Odour Survey 2 - Results

Position	Start and Finish time	Intensity	Duration	Odour Description	Location Category
1	7:58 - 8:13	1	1	No odours	3
2	8:14-8:29	2	1	Woodsmoke odours with neutral hedonic tone	3
3	8:30-8:45	1	1	No odours	3
4	8:45-9:00	2	2	Oil odours with neutral hedonic tone	3
5	9:01-9:16	2	2	Oil odours with neutral hedonic tone	3

5.2.5 As shown in Table 18, the maximum intensity scored at any of the locations was 2 which corresponds to a classification of 'faint'. In addition, the maximum duration was rated at 2 which corresponds to 'transient'. No odours detected were recorded as offensive at any of the locations.

5.2.6 The meteorological conditions during the monitoring window were cloudy with temperatures of approximately 15°C. The wind direction was from the south-south-west throughout the survey. The wind was rated at 3 to 4 on the Beaufort scale.

Field Odour Survey Summary

5.2.7 A summary of the Field Odour Survey findings is provided in Table 19.

Table 19 Field Odour Survey Summary

Position	Why did you choose the assessment location? And if odours are present:	Why do you consider the odour offensive or not offensive?	What is the suspected source of odour at each location and why have you arrived at this conclusion?
1	The location was chosen to ensure a comprehensive assessment at the closest downwind receptors to the site. Odours were detected during Survey 1	The odour detected during Survey 1 was oil Detected odours were not considered offensive due to the faint intensity and transient duration	The oil nature of the odour indicated that the TWMA facility was the likely source
2	The location was chosen as it is the end of the treeline which may provide a barrier to the odours. Odours were detected during both surveys	The odour detected during Survey 1 was of fish. Woodsmoke odours were detected during Survey 2 Detected odours were not considered offensive due to the faint intensity and transient duration	The primary fish odour is likely attributed to Seafood Ecosse Ltd, which was upwind during the Survey 1. There was no obvious potential source for the woodsmoke odours detected during Survey 2
3	The location was chosen due to the complaints history for the facility. No odours were detected during either survey	No odours were detected at the location during either survey	No odours were detected at the location during either survey
4	The location was chosen to ensure a comprehensive assessment at the closest downwind receptors to the site. Odours were detected during Survey 2	The odour detected during Survey 2 was oil Detected odours were not considered offensive due to the faint intensity and transient duration	The oil nature of the odour indicated that the TWMA facility was the likely source
5	The location was chosen to ensure a comprehensive assessment at the closest downwind receptors to the site. Odours were detected during Survey 2	The odour detected during Survey 2 was oil Detected odours were not considered offensive due to the faint intensity and transient duration	The oil nature of the odour indicated that the TWMA facility was the likely source

5.2.8 Based on the survey results and the additional factors stated in Table 19, although potential odours from the TWMA facility were detected at the locations during the surveys, it is considered that the overall findings do not provide evidence to suggest that emissions from the site were contributing to significant odour impacts in the local area, at the time of monitoring.

6.0 **CONCLUSION**

- 6.1.1 Redmore Environmental Ltd was commissioned by TWMA Group Limited to undertake an Odour Assessment for the waste oil processing and recovery facility operated by the company in Peterhead, Aberdeen.
- 6.1.2 An Odour Assessment²⁴ was originally undertaken by Redmore Environmental in June 2025 in support of the installation of a direct-fired thermal oxidation abatement system to provide treatment of emissions from plant housed within a process building. The findings indicated that predicted odour concentrations were below the relevant benchmark levels at all sensitive locations in the vicinity of the site for all modelling years. As such, potential odour emissions were not considered to represent a constraint to installation of the abatement system at the facility.
- 6.1.3 Following issue of the Odour Assessment, the abatement system was approved by SEPA and the plant was installed at the facility. A programme of Emissions Monitoring was subsequently undertaken by Silsoe Odours Ltd in September 2025 in order to assess the performance of the installed system and quantify odour releases from other relevant sources at the site. An updated Odour Assessment was then undertaken in order to re-evaluate potential impacts as a result of emissions from the facility and identify the requirement for any further mitigation to control effects to an acceptable level.
- 6.1.4 Emissions from the direct-fired thermal oxidation system and other relevant sources at the facility were defined based on the results of the monitoring undertaken by Silsoe Odours Ltd and information provided by TWMA. These were then represented within a dispersion model produced using ADMS-6. Impacts at sensitive receptor locations in the vicinity of the site were quantified and the results compared with the relevant odour benchmark level.
- 6.1.5 The initial results indicated that predicted odour concentrations were above the relevant benchmark levels at a number of sensitive receptor locations in the vicinity of the site. As such, further analysis was undertaken in order to determine the contributions from specific sources at the facility. The results indicated that the carbon filter which serves the process shed was not abating odour emissions effectively at the time of monitoring and releases

²⁴ Odour Assessment - TWMA, Peterhead, 8420r5, Redmore environmental, June 2025.

from the system were making significant contributions to the modelled exceedences of the benchmark levels.

- 6.1.6 Investigative work was undertaken by TWMA in order to determine factors which may have been contributing to ineffective performance of the carbon filter at the time of monitoring. The findings indicated that moisture ingress had led to premature saturation of the carbon which has now been rectified through replacement of the media and the implementation of preventative measures to minimise the potential for future occurrence.
- 6.1.7 Further modelling was subsequently undertaken in order to reflect an improved level of abatement performance by the carbon filter which is likely to be achievable as a result of the remedial measures. Predicted odour concentrations were below the relevant benchmark levels at all sensitive locations in the vicinity of the site for all modelling years. As such, potential odour emissions from the facility under the improved carbon filter arrangements are considered to be not significant.

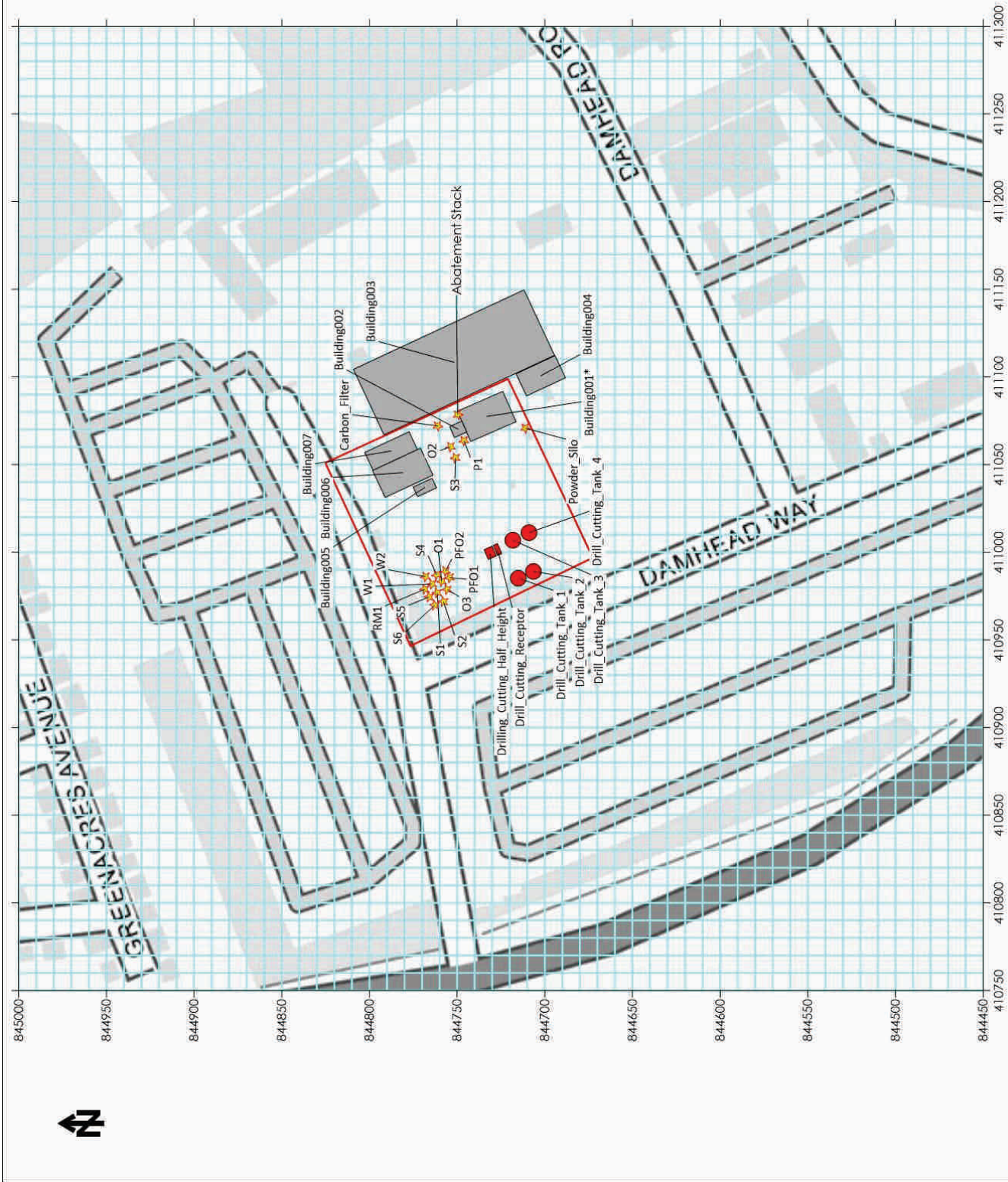
7.0 ABBREVIATIONS

AEL	Associated Emission Level
BAT	Best Available Techniques
CERC	Cambridge Environmental Research Consultants
DEFRA	Department of Environment, Food and Rural Affairs
EC	European Commission
ELV	Emission Limit Value
H ₂ S	Hydrogen Sulphide
IAQM	Institute of Air Quality Management
ITE	Individual Threshold Estimate
NGR	National Grid Reference
NH ₃	Ammonia
OU _E	European Odour Unit
PPC	Pollution Prevention and Control
SEPA	Scottish Environmental Protection Agency
Z ₀	Roughness Length
%ile	Percentile

Figures



Legend  Site Boundary	Title Figure 1 - Site Location Plan	Project Odour Assessment TWMA, Peterhead	Project Reference 8420	Client TWMA Group Limited	Contains Ordnance Survey Data © Crown Copyright and Database Act 2023 Redmore environmental www.red-env.co.uk 0161 7060075
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Legend



Site Boundary



Point Source



Area Source



Output Grid



Building

Title

Figure 2 - ADMS-6 Inputs

Project

Odour Assessment
TWMA, Peterhead

Project Reference

8420

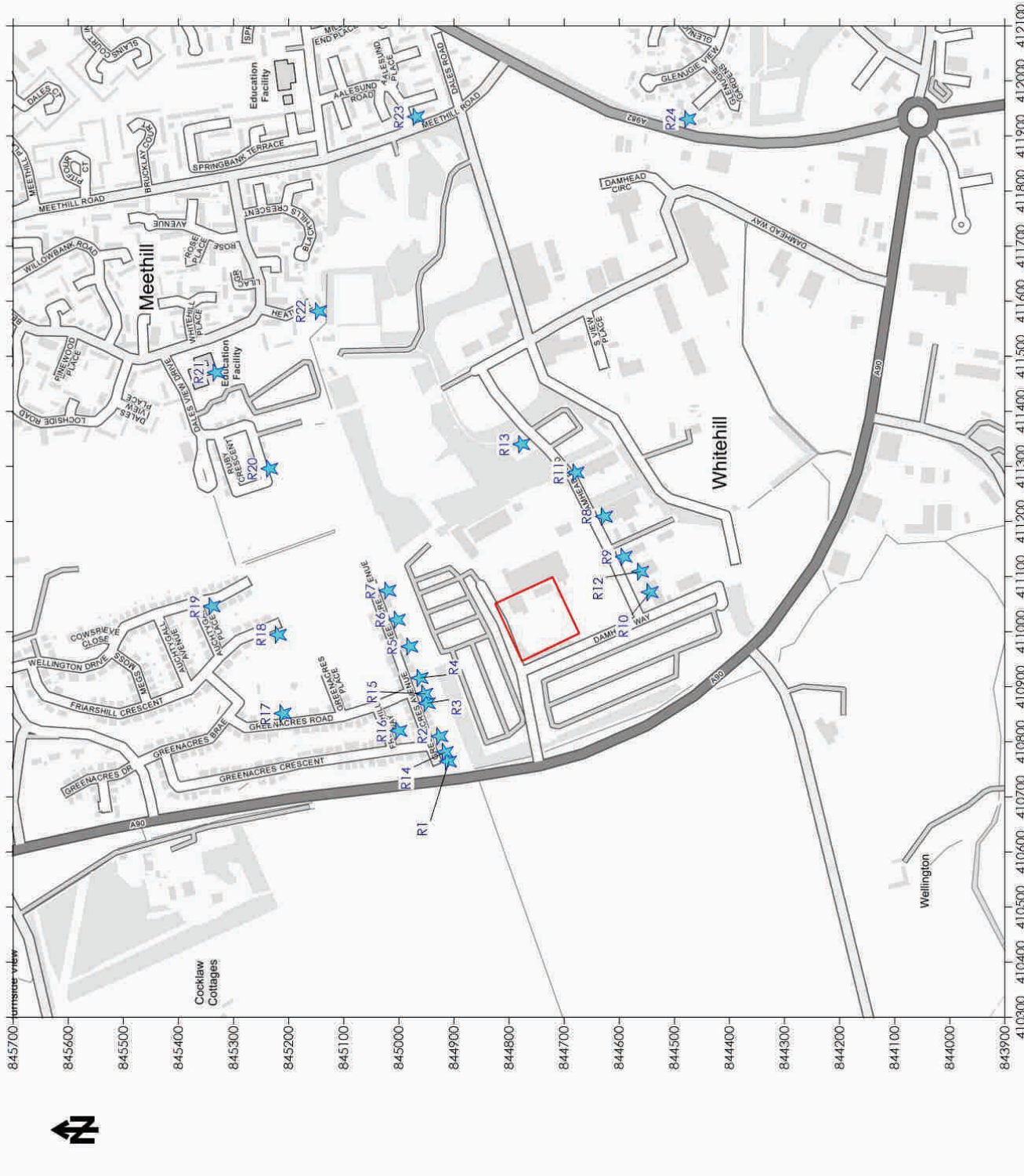
Client

TWMA Group Limited

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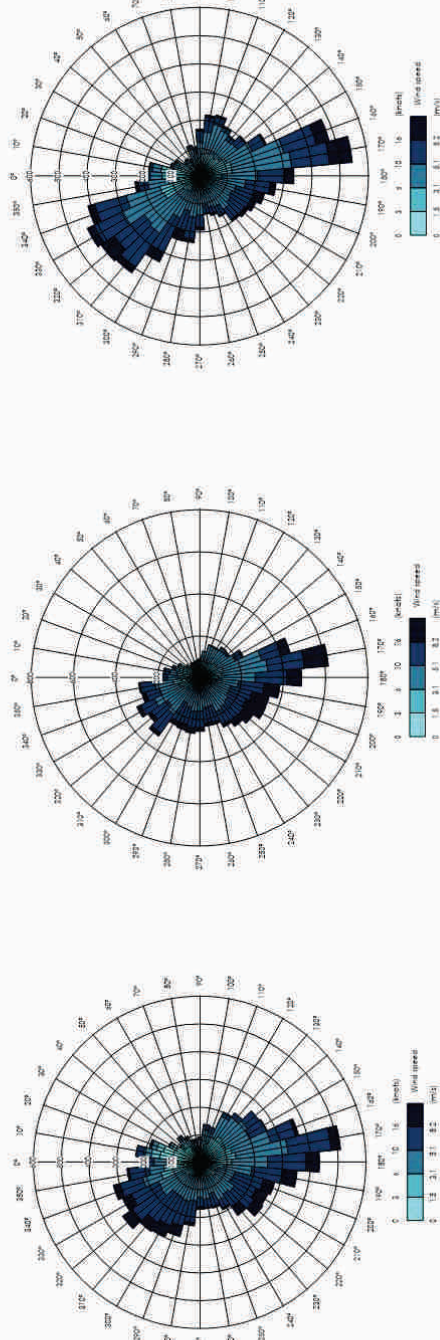


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Legend  Site Boundary  Receptor	Title Figure 3 - Sensitive Receptor Locations	Project Odour Assessment TWMA, Peterhead	Project Reference 8420	Client TWMA Group Limited	Contains Ordnance Survey Data © Crown Copyright and Database Act 2023  www.red-env.co.uk 0161 7960075
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Legend



Title
Figure 4 – Wind Roses of 2019 to 2023 Dyce Meteorological Station Data

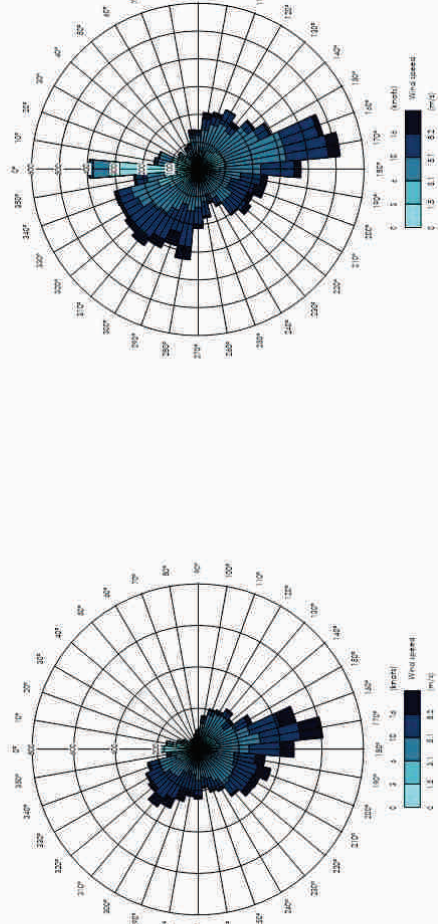
Project
Odour Assessment
TWMA, Peterhead

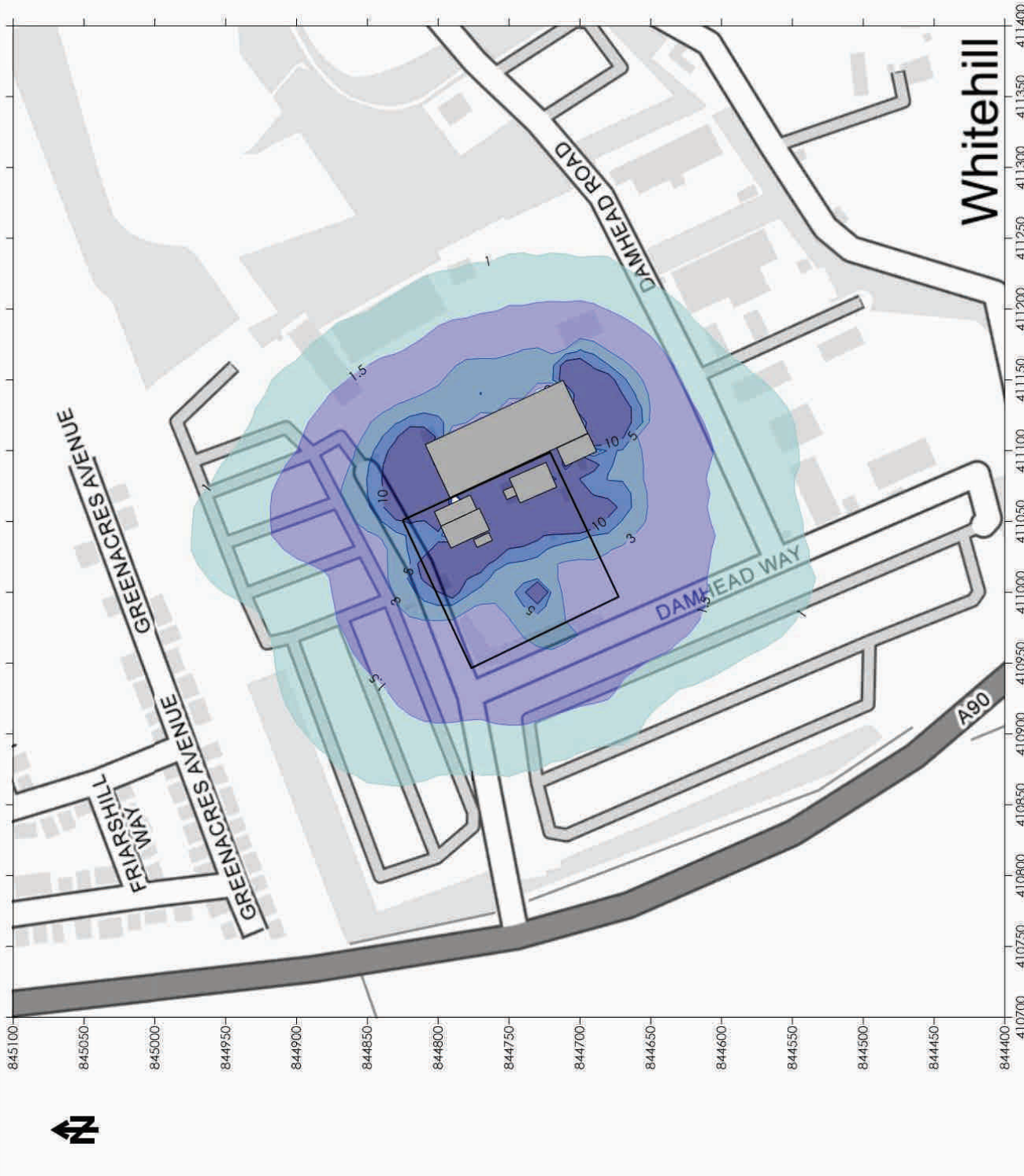
Project Reference
8420

Client
TWMA Group Limited

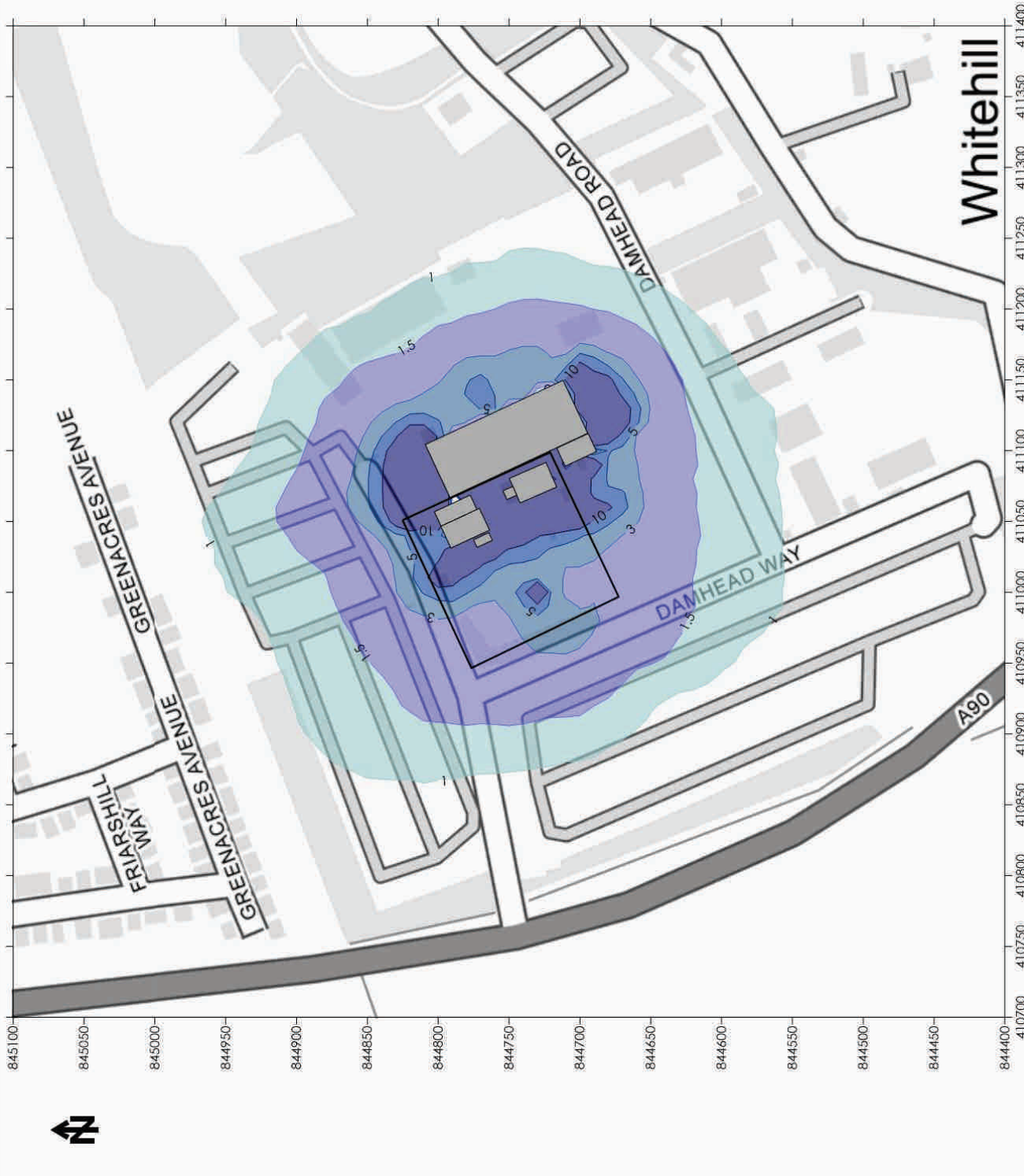


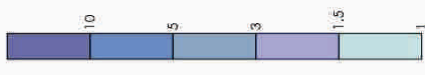
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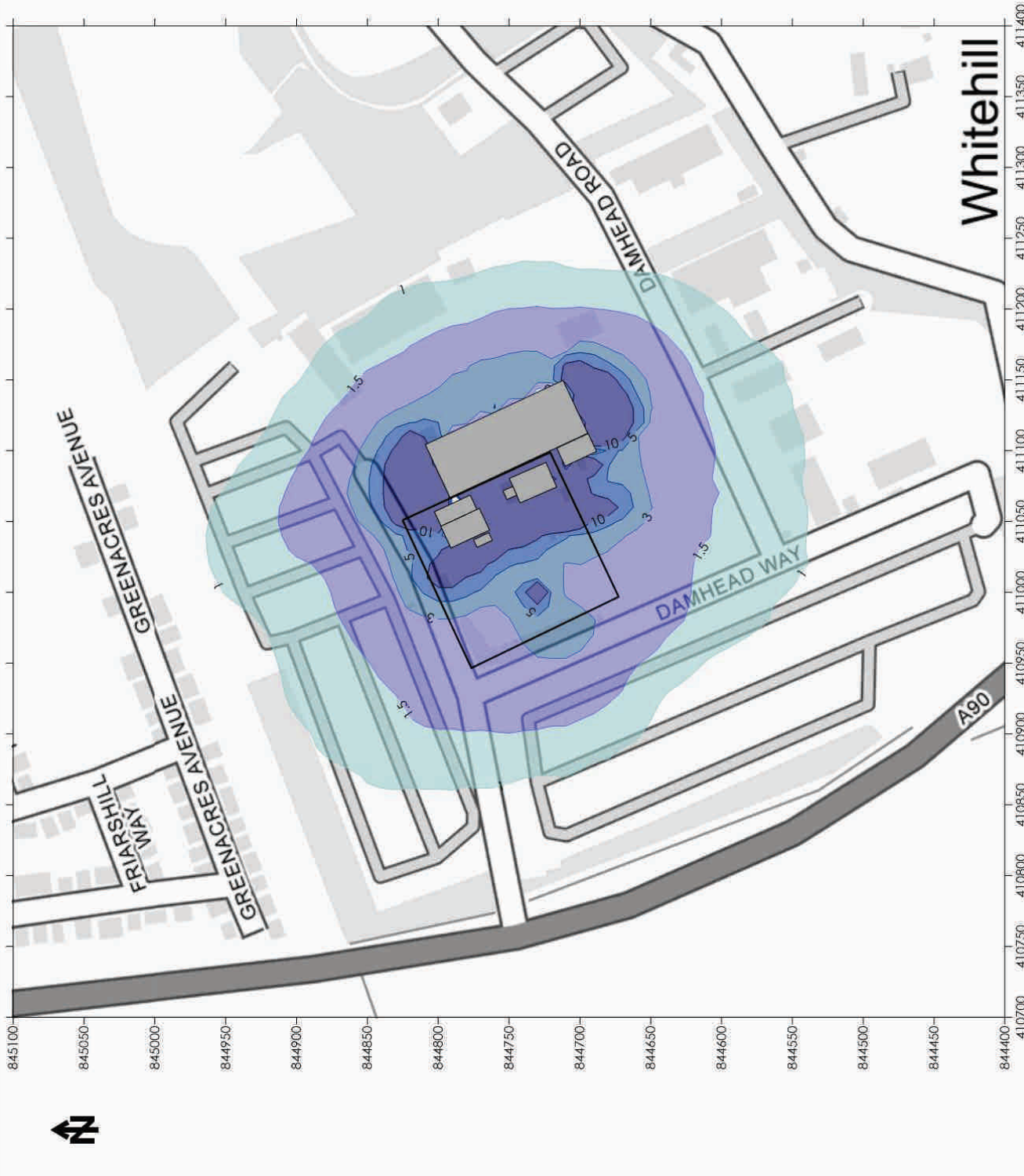




Legend	Title	Project	Project Reference	Client
 Site Boundary	Figure 3 - Predicted 98th %ile 1-hour Mean Odour Concentrations (ou/m³) 2019 Meteorological Data	Odour Assessment TWMA, Peterhead	8420	TWMA Group Limited
 98 th %ile 1-hour Mean Odour Concentration (ou/m³)				Contains Ordnance Survey Data © Crown Copyright and Database Act 2023
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				www.red-env.co.uk 0161 7060075



Legend	Title	Project	Project Reference	Client
 Site Boundary	Figure 8 - Predicted 98th %ile 1-hour Mean Odour Concentrations (ou/m³) 2020 Meteorological Data	Odour Assessment TWMA, Peterhead	8420	TWMA Group Limited
 98th %ile 1-hour Mean Odour Concentration (ou/m³)				Contains Ordnance Survey Data © Crown Copyright and Database Act 2023
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Legend

Site Boundary

98th %ile 1-hour Mean Odour Concentration (ou/m³)

10
5
3
1.5
1

Title

Figure 7 - Predicted 98th %ile 1-hour Mean Odour Concentrations (ou/m³)
2021 Meteorological Data

Project

Odour Assessment
TWMA, Peterhead

Project Reference

8420

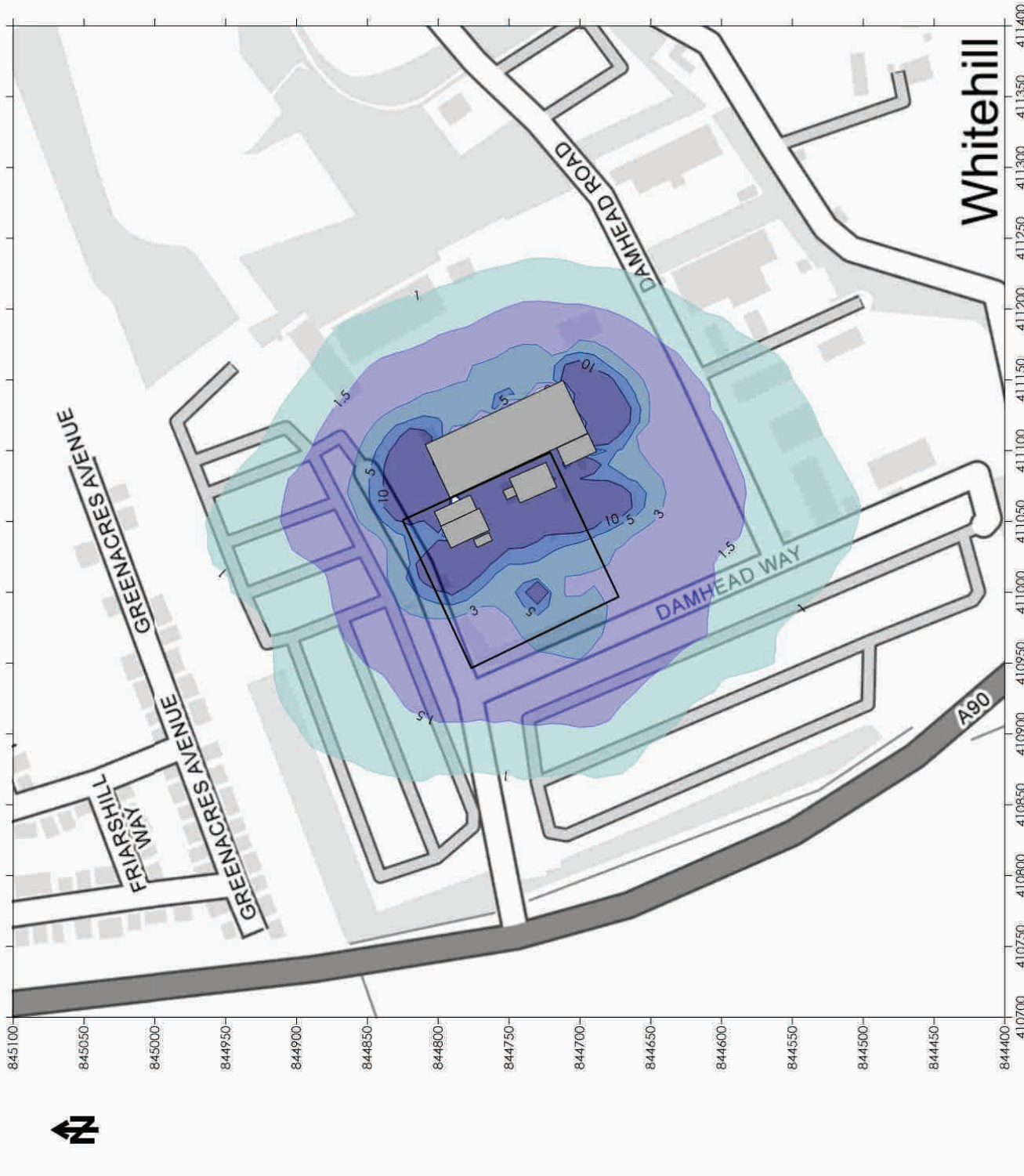
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Legend



Site Boundary



98th %ile 1-hour
Mean Odour
Concentration
(ou/m³)

Title

Figure 9 - Predicted 98th %ile 1-hour
Mean Odour Concentrations
(ou/m³)
2023 Meteorological Data

Project

Odour Assessment
TWMA, Peterhead

Project Reference

8420

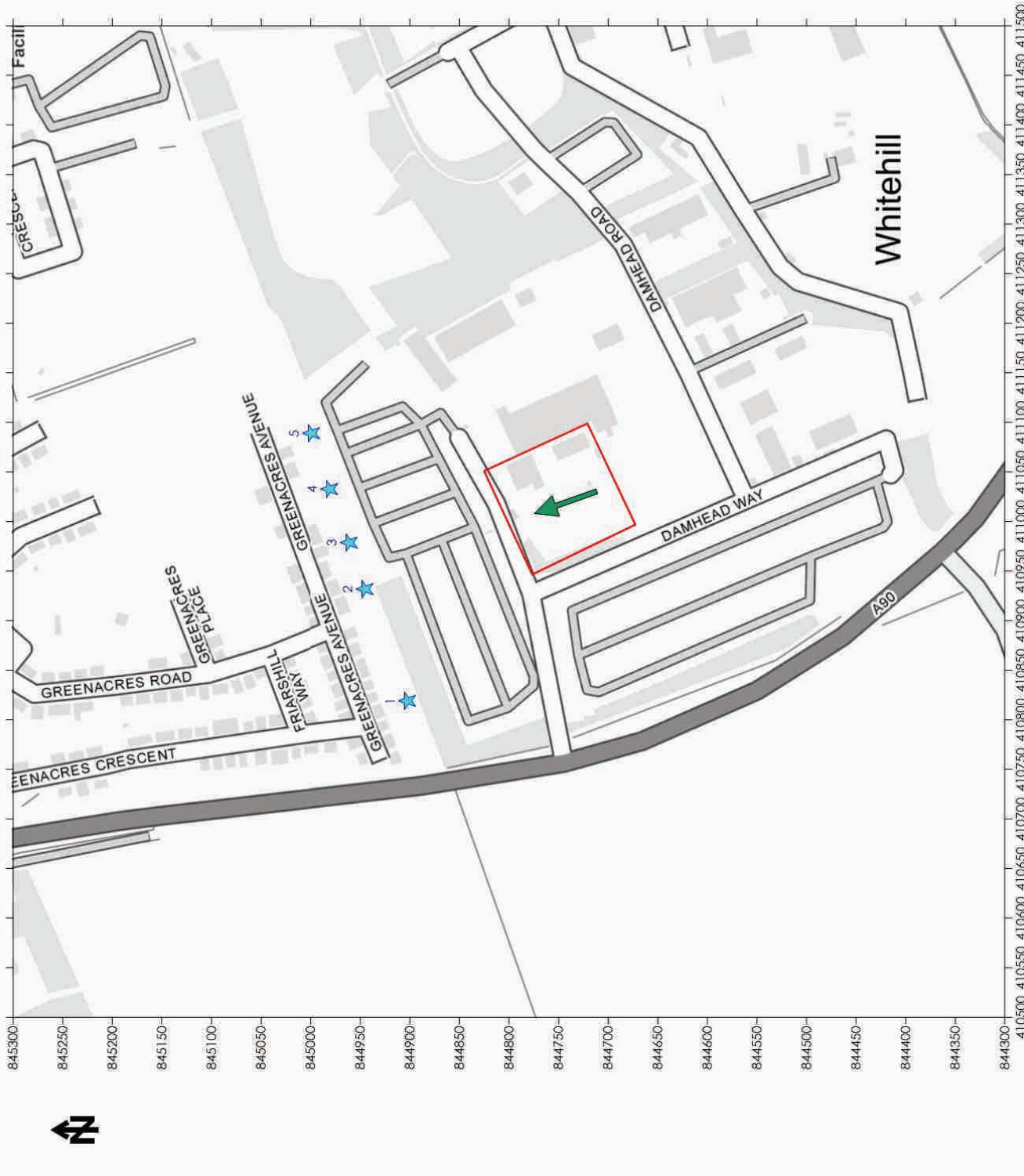
Client

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Legend



Site Boundary



Survey Position



South-south-east
wind direction on
10th September
2025

Title

Figure 10 - Field Odour Survey
Positions and Wind Direction
10th September 2025

Project

Odour Assessment
TWMA, Peterhead

Project Reference

8420

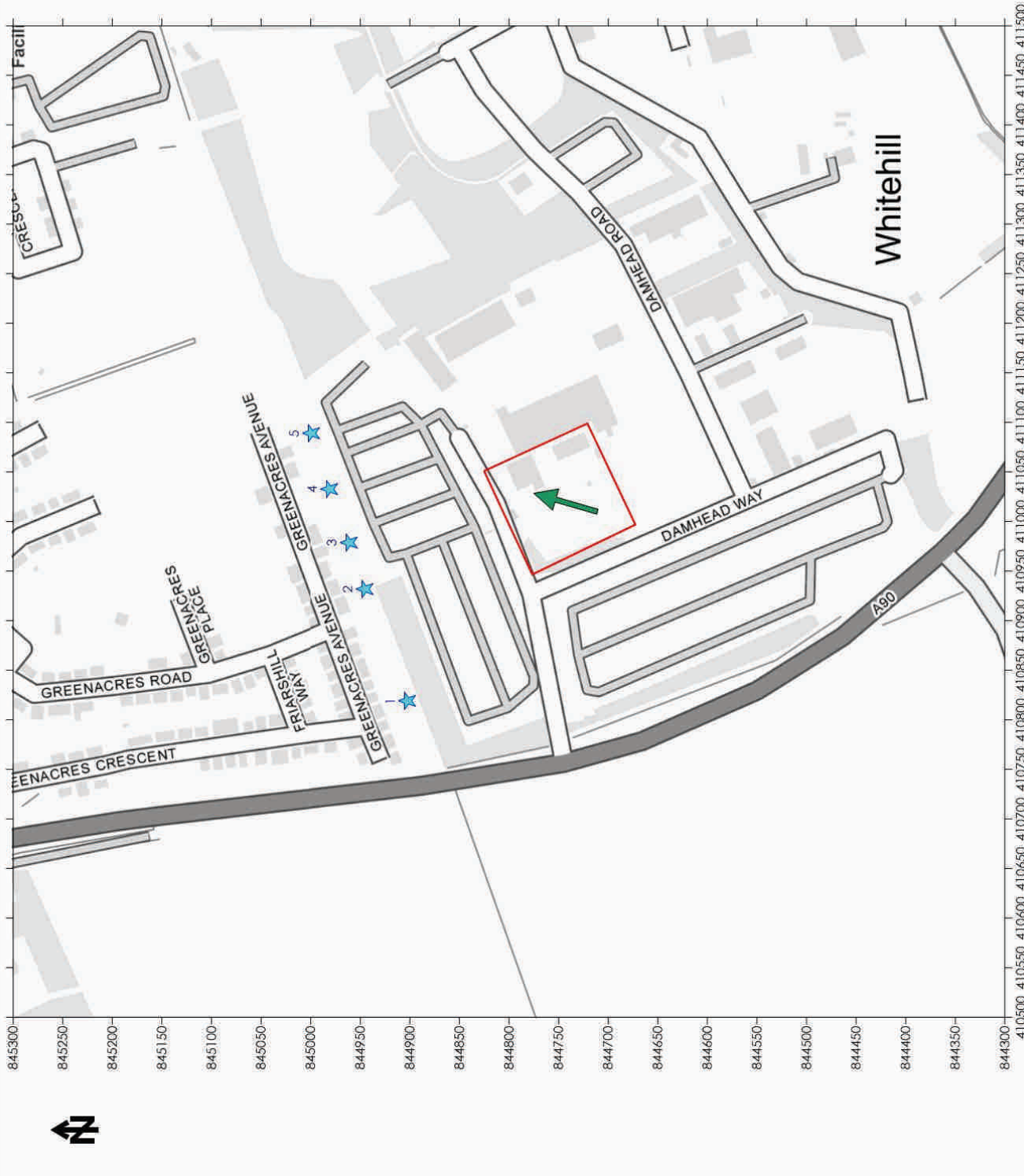
Client

TWMA Group Limited

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Legend	 Site Boundary	 Survey Position	 South-south-west wind direction on 11th September 2025
Title	Figure 11 - Field Odour Survey Positions and Wind Direction 11th September 2025		
Project	Odour Assessment TWMA, Peterhead		
Project Reference	8420		
Client	TWMA Group Limited		
Contains Ordnance Survey Data © Crown Copyright and Database Act 2023			
 Redmore environmental			

Appendix 1 - Laboratory Analysis Certificate

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SILSOE
ODOURS



ODOUR EMISSIONS REPORT Peterhead

CLIENT: REDACTED, Redmore Environmental
SITE/PROJECT: TWMA Peterhead
SAMPLING DATE: 9th and 10th September 2025
REPORT DATE: 31 March 2026
REFERENCE: CR/SO2865/25/redmore013 v3
AUTHOR: REDACTED

ODOUR MEASUREMENT & CONSULTANCY SERVICES

Building 42 • Wrest Park • Silsoe • Bedfordshire • MK45 4HP
01525 860222

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Silsoe Odours Ltd.

Silsoe Odours Ltd is an odour laboratory in Bedfordshire offering complete odour management and consultancy services.

We are accredited by UKAS (Lab. 0609) for sampling of odorous air, odour concentration measurements by dynamic olfactometry as specified in BSEN13725:2022 and air flow measurements in ducts and stacks.

Copyright

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1. Introduction

Silsoe Odours Ltd was commissioned to undertake onsite odour monitoring at Peterhead for Redmore Environmental. Sampling was undertaken on the 9th & 10th September 2025.

Address of the site:

Total Waste Management Alliance,
Dales Industrial Estate,
Peterhead,
Scotland AB42 3JF,
GB

1.1. Description of site work

Samples were taken from various sources across the site as agreed with Redmore Environmental prior to sampling.

All sources were sampled in triplicate.

This report sets out the findings of the survey.

2. Methodology for Sampling

2.1. Accreditation

Silsoe Odours Ltd. is UKAS accredited (Testing Laboratory 0609) our sampling procedures are UKAS accredited and documented in Odour Lab Procedure OL3 which incorporates BSEN13725:2022 “Stationary source emissions — Determination of odour concentration by dynamic olfactometry and odour emission rate”.

All sampling equipment is included in the UKAS accreditation and is calibrated by UKAS calibration laboratories (where available).

Table 1: Techniques and Accreditation

Measurement	Sampling and analysis methods	Accreditations
Odour	Sampling and analysis: BS EN 13725:2022	UKAS (sampling and analysis)
Hydrogen sulphide	Jerome analysis	UKAS
Flow & temperature	ISO 16911	UKAS

Table 2: Table of equipment and calibration status

Equipment	Make and model	ID	Calibration date
Olfactometer	Olfasense GmbH TO-Evolution	TOEVO1040	20-Feb-25
Thermometer	RS thermometer	170801311	09-05-2025
Anemometer	TSI Air velocity meter	TA4102431002	19-Sept-24
Rotating Vane Anemometer	TPI DC580	27309070578	26-Sept-24

2.2. Planned Sampling Locations

Silsoe Odours planned to collect a total of 48 odour samples.

Table 3: Sampling Locations

Sampling point	Number of samples	Sampling method
Powder silo	3	Headspace Sample
Carbon Filter Inlet and Outlet	6	Point sample
Drill Cutting Tanks (Mixed & Still)	6	Lindvall Hood Sample
S1 Tank	3	Headspace Sample
Thermal Oxidation (TOX) Inlet and Outlet	6	Point Sample with stack pre-diluter
P1 (outlet vent)	3	Headspace Sample
PFO1 (outlet vent)	3	Headspace Sample
W1 and W2 (outlet vent)	3	Headspace Sample
O1 (outlet vent)*	3	Headspace Sample
RM1 (outlet vent)	3	Headspace Sample
O3 (outlet vent)	3	Headspace Sample
S3 and S4**	3	Headspace Sample
S5 and S6**	3	Headspace Sample

* During our sampling, the pump supplying the O3 tank broke, therefore we could only collect 1 of 3 samples

** No access points to either tank outlets, thus samples couldn't be collected

2.3. Sampling method for point sources

The lung method is used to sample point sources. A sample tube is inserted into the sampling location that is connected via a tap to a sample bag inside a barrel, air in the barrel is extracted with a pump lowering the pressure inside the barrel enabling the bag to fill with the sample.

For the Drill cuttings tank, the **Lindval hood method** was used to collect the samples, this method followed the guidance in the EA draft H4 document (2003 version) and BSEN13725:2003 to provide an emission rate from surface sources. Sampling was undertaken by covering a portion of the surface with a suitable ventilated hood. A Lindval type sampling hood of approximately 0.6m² was used and ventilated with odour free air at a known volumetric flow rate. An odour sample was then collected at the outlet of the canopy. The rate of air injected into the hood was monitored and adjusted for each sample and used to calculate a specific odour emission rate per unit area per second (E_{sp}) as follows:

$$E_{sp} = C_{hood} \times L \times V$$

Where; C_{hood} is the odour concentration measured from the sample bag.

L is the hood factor, which is equal to the flow path cross sectional area (m^2) of the hood divided by the covered area (m^2).

V is the velocity (m/s) of air presented through the hood.

The hood was used on liquid in the aeration tanks and floats were used to suspend the hood on the liquid surface.

2.4. Laboratory Odour Analysis

The Principle of Olfactometry technique is as follows:-

The odour concentration of a gaseous sample of odorants is determined by presenting a panel of selected and screened human subjects with that sample, varying the concentration by diluting with neutral (odourless) gas, in order to determine the dilution factor at the 50% detection threshold ($Z_{50} \equiv \bar{Z}_{ITE,pan}$).

At that dilution factor the odour concentration is 1 ouE/ m^3 by definition. The odour concentration of the examined sample is then expressed as a multiple (equal to the dilution factor at Z50) of one European Odour Unit per cubic metre [ouEm-3] at standard conditions for olfactometry.

The Silsoe Odours Ltd laboratory operate a forced choice olfactometer, it has two outlet ports from one of which the diluted odour flows and clean odour-free air flows from the other.

The measurement starts with a dilution of the sample large enough to make the odour concentration beyond the panel members' thresholds, the concentration is increased by factor between 1.4 and 1.5 in each successive presentation. The port carrying the odorous flow is chosen randomly by the control sequence on each presentation. The assessors indicate from which of the ports the diluted odour sample is flowing using a personal keyboard. They also indicate whether their choice was a guess whether they had an "inkling" or whether they were certain they chose the correct port. Only when the correct port is chosen, and the panel member is certain that their choice was correct, is it taken as a TRUE response. At least two consecutive TRUE responses must be obtained for each panel member. The geometric mean of the dilution factors of the last FALSE and the first of at least two TRUE presentations determines the individual threshold estimate (ITE) for a panel member. The odour concentration, ouEm-3, for a sample, is calculated from the geometric mean of at least two ITEs for each panel member.

3. Survey Results

The actual sampling locations are shown in the Fig 1.



Figure 1: Approximate sampling locations, numbers are referred to in Table 3

The results of the survey are presented in Table 3 below. The Laboratory testing report is presented in Appendix 1.

Table 4: Survey Results

	Source	Temperature (°C)	Geometric mean odour concentration, ouE m ³	Air flow, m ³ /s	Emission rate ouE/m ³ /s at
1	Powder Silo		46,134	0.0033	
2	Carbon Filter Inlet	24.6	6,435	1.930	
3	Carbon Filter Outlet		7,873	1.930	
4	Drill Cuttings tank Mixed	18.1	1,134		6.9
5	Drill Cuttings tank Still	18.1	1,377		8.5
6	S1 Tank while tanker filling here		7,416		
7	TOX Inlet	19.1	146,261	0.0387	
8	TOX Outlet	362	51	**	
9	P1		87,084	Headspace sample **	
10	PFO1		176	Headspace sample 0.0017***	
11	W1		544	Headspace sample **	
12	W2		88	Headspace sample **	
13	O1		897	Headspace sample **	
14	RM1		385	Headspace sample **	
15	O3****		1,444****	Headspace sample **	

*More than 40litre emitted with every 12puffs. Equal to 3.33l/s

**awaiting data from Redmore

***reported pump flow rate

****only one sample collected

Table 5: Compound Results

	Source	Hydrogen sulphide, ppm (Jerome J605)	NIOSH 6013 Hydrogen Sulphide, ppm	NIOSH 6013 Hydrogen Sulphide, mg/m ³	NIOSH 6013 Ammonia, ppm	NIOSH 6013 Ammonia, mg/m ³
1	Powder Silo	0.3900	*	<1.7	3.71	2.58
2	Carbon Filter Inlet	0.2067	*			Not measured
3	Carbon Filter Outlet	0.1967	*	<1.7	0.32	0.220
4	Drill Cuttings Still tank	0.0073				
5	Drill Cuttings Mixed tank	0.0047	*	<1.7	0.76	0.529
6	S1 Tank	0.0520	*	<1.7	0.43	0.298
7	TOX Inlet	6.0333	2.15	3.0	1.42	0.988
8	TOX Outlet	0.0030	*	<1.7	*	<0.067
9	P1	0.2067	*	<1.7	9	6.28
10	PFO1	0.0029	*	<1.7	*	<0.067
11	W1	0.0023	*	<1.7	*	<0.067
12	W2	0	2.87	4	*	<0.067
13	O1	0.0022	*	<1.7	*	<0.067
14	RM1	0.0028	*	<1.7	*	<0.067
15	O3*	0				

* below the LDL of the technique

Table 6: Thermal Oxidation Inlet Gastec results

Mean Ammonia Gastec, ppm	Mean Hydrogen Sulphide Gastec, ppm
1.0	5.87

A1. Appendix 1 – Laboratory results

Olfactometric measurements

Silsoe Odours Limited

Client: Redmore Environmental

Location: Peterhead

Measurement Date: 10 and 11 September 2025

Contract report number:	CR/SO2865/25/redmore013
Customer reference:	Peterhead
Measurements carried out by:	REDACTED
1. Contact:	
2. Odour source:	
3. Sampler:	REDACTED
4. Sampling date:	09 September 2025 10 September 2025
5. Laboratory temperature, CO ₂ , and RH	23.3°C; 685 ppm; 50.1 % 22.9°C; 741 ppm; 50.5 %
6. Measurement date	10 September 2025 11 September 2025
7. Presentation mode:	Forced choice
8. Olfactometer:	Olfasense GmbH TO-Evolution
9. Pre-Dilution Gas Meter:	Durecom KG-2 2017-009020
10. Reference odorant/accepted reference value	n-butanol. 60 ppm / 40ppb
11. Calibration Status of Laboratory	A _{od} = 0.03; r = 0.14 A _{od} = 0.02; r = 0.13
12. Uncertainty estimate	Coverage interval 700<C _{od} <1374
13. Method:	Following Odour Lab Procedure OL3 which incorporates BSEN13725:2022 "Stationary source emissions — Determination of odour concentration by dynamic olfactometry and odour emission rate". Nalophan NA bags 25µm thick
14. Special remarks:	
15. Approved by	Compiled by
REDACTED	REDACTED
REDACTED, Quality Manager.	REDACTED, Olfactometry Operator

"This laboratory is accredited in accordance with the recognised International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer joint ISO-ILAC-IAF communiqué dated April 2017)"

Results:

Table 1.1: Results for Redmore – Peterhead odour samples analysed on 10 September 2025

Samples collected 09/09/25 at:	Samples analysed 10/09/25 at:	Sample No.	Sample Source and Position	S. O. H ₂ S ppm	Odour Panel Threshold, ouE m ⁻³	Lab. Pre- dilution factor	Odour concentration of sample, ouE m ⁻³ (Including laboratory pre- dilution)
12:28	14:29	20250910 P1	Powder Silo	0.38	42,729	None	42,729
12:30	14:37	20250910 P2	Powder Silo	0.39	47,855	None	47,855
12:32	14:43	20250910 P3	Powder Silo	0.40	48,020	None	48,020
13:00	13:38	20250910 P4	Carbon Filter In	0.21	6,482	None	6,482
13:08	13:48	20250910 P5	Carbon Filter In	0.20	6,965	None	6,965
13:19	13:57	20250910 P6	Carbon Filter In	0.21	5,903	None	5,903
13:00	13:11	20250910 P7	Carbon Filter Out	0.20	8,562	None	8,562
13:08	13:20	20250910 P8	Carbon Filter Out	0.21	8,305	None	8,305
13:19	13:29	20250910 P9	Carbon Filter Out	0.18	6,864	None	6,864
13:45	10:10	20250910 P10	Drill Cutting Mixed	0.007	1,020	None	1,020
13:50	10:18	20250910 P11	Drill Cutting Mixed	0.004	1,082	None	1,082
13:56	10:25	20250910 P12	Drill Cutting Mixed	0.003	1,322	None	1,322
14:08	10:33	20250910 P13	Drill Cutting Still	0.008	1,486	None	1,486
14:14	10:41	20250910 P14	Drill Cutting Still	0.007	1,445	None	1,445
14:21	10:48	20250910 P15	Drill Cutting Still	0.007	1,216	None	1,216
16:18	12:44	20250910 P16	Tank S1	0.12	15,215	None	15,215
13:23	12:50	20250910 P17	Tank S1	0.023	8,051	None	8,051
16:42	13:00	20250910 P18	Tank S1	0.013	3,330	None	3,330
17:02	11:34	20250910 P19	TOX In	6.3	1,290	1:100	130,253
17:05	11:11	20250910 P20	TOX In	5.7	1,534	1:100	154,928
17:10	11:25	20250910 P21	TOX In	6.1	1,535	1:100	155,048
17:02	09:44	20250910 P22	TOX Out	0.004	62**	None	62**
17:05	09:49	20250910 P23	TOX Out	0.004	44	None	44
17:10	09:57	20250910 P24	TOX Out	0.001	50	None	50
17:43	14:23	20250910 P25	P1	0.18	58,233	None	58,233
17:49	14:49	20250910 P26	P1	0.22	9,470	9:1	94,702
17:56	14:57	20250910 P27	P1	0.22	11,975	9:1	119,752

The following data is not covered by our UKAS Accreditation:

None

Deviation from the standard:

* Result based on less than 8 ITEs

** Result based on less than 4 ITEs

Table 2: Results for Redmore – Peterhead odour samples analysed on 11 September 2025

Samples collected 10/09/25 at:	Samples analysed 11/09/25 at:	Sample No.	Sample Source and Position	S. O. H ₂ S ppm	Odour Panel Threshold, ou _E m ⁻³	Lab. Pre- dilution factor	Odour concentration of sample, ou _E m ⁻³ (Including laboratory pre- dilution)
09:10	11:38	20250911 P1	PFO 1	0.00	34*	None	34*
09:18	11:44	20250911 P2	PFO 1	0.00	163	None	163
09:26	11:52	20250911 P3	PFO 1	0.00868	991	None	991
09:36	10:24	20250911 P4	W2	0.00316	672	None	672
09:44	10:54	20250911 P5	W2	0.00	242	None	242
09:52	10:34	20250911 P6	W2	0.00377	988	None	988
10:00	09:56	20250911 P7	W1	0.00	68	None	68
10:09	10:03	20250911 P8	W1	0.00	101	None	101
10:15	10:10	20250911 P9	W1	0.00	100	None	100
10:30	11:09	20250911 P10	O1	0.00	637	None	637
10:36	11:28	20250911 P11	O1	0.00333	1,112	None	1,112
10:44	11:17	20250911 P12	O1	0.00314	1,019	None	1,019
11:36	12:26	20250911 P13	RM1	0.00516	481	None	481
11:42	12:18	20250911 P14	RM1	0.00328	561	None	561
11:48	12:10	20250911 P15	RM1	0.00	211	None	211
13:00	12:37	20250911 P16	O3	0.00	1,444	None	1,444

The following data is not covered by our UKAS Accreditation:

None

Deviation from the standard:

* Result based on less than 8 ITEs

** Result based on less than 4 ITEs

A2. Compound Analysis certificates

Analysis of ammonia from absorption tubes

Results Summary

Report No.: 25-07930-1

Customer Reference: Not Supplied

Customer Order No: TWMA PETERHEAD



0605

Customer Sample No	Powder - 374350048 5	Carbon Out - 374350049 0	Drill Cuttings Mix - 374350042 6	Tank S1 - 374350048 6	TOX Out - 374350048 9	P1 - 374350048 2	TOX In - 374350045 3	BLANK
Customer Sample ID	Powder	Carbon Out	Drill Cuttings Mix	Tank S1	TOX Out	P1	TOX In	BLANK
RPS Sample No	323218	323219	323220	323221	323222	323223	323224	323225
Sample Matrix	TUBE	TUBE	TUBE	TUBE	TUBE	TUBE	TUBE	TUBE
Sampling Date	09/09/2025	09/09/2025	09/09/2025	09/09/2025	09/09/2025	09/09/2025	09/09/2025	09/09/2025

Determinand	CAS No	Codes	SOP	RL	Units								
volume of air sampled		N	N/A	n/a	L	3.00	3.00	3.00	3.00	3.00	3.00	3.00	
ammonia	7664-41-7	U	A6	0.2	ug	7.7	0.7	1.6	0.9	< 0.2	18.8	3.0	< 0.2
ammonia	7664-41-7	N	A6	0.001	mg/m3	2.58	0.220	0.529	0.298	< 0.067	6.28	0.988	

Results Summary

Report No.: 25-07929-1

Customer Reference: Not Supplied

Customer Order No: TWMA PETERHEAD



0605

Customer Sample No	PFO 1 - 374350048 3	W2 - 374350048 1	W7 - 374350048 7	O1 - 374350048 8	RM1 - 374350045 5
Customer Sample ID	PFO 1	W2	W1	W1	RM1
RPS Sample No	323213	323214	323215	323216	323217
Sample Matrix	TUBE	TUBE	TUBE	TUBE	TUBE
Sampling Date	10/09/2025	10/09/2025	10/09/2025	10/09/2025	10/09/2025

Determinand	CAS No	Codes	SOP	RL	Units								
volume of air sampled		N	N/A	n/a	L	3.00	3.00	3.00	3.00	3.00			
ammonia	7664-41-7	U	A6	0.2	ug	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2			
ammonia	7664-41-7	N	A6	0.001	mg/m3	< 0.067	< 0.067	< 0.067	< 0.067	< 0.067			

Analysis of hydrogen sulphide from charcoal tubes

t: 0161 703 9170 w: www.cawood.co.uk/marchwood

Marchwood, Unit 5, 60 Smithfold Lane, Worsley, Gr Manchester M28 0GP



**Analysis of hydrogen sulphide from charcoal tube(s)
(226-09) by IC**

MSSL sample ref:	25-93833-001	25-93833-002	25-93833-003	25-93833-004
Customer sample ref:	1 - Powder / 3470020029	7 - Carbon Out / 3470021619	10 - Drill cutting mix / 3470020031	16 - Tank S1 / 3470020925
Customer sampling volume (L):	6	6	6	6

Determinand	Units	LOD	Acc.				
Hydrogen sulphide ⁽¹⁾	µg	10	N	<10	<10	<10	<10
	mg/m ³	Calc.	N	<1.7	<1.7	<1.7	<1.7

MSSL sample ref:	25-93833-005	25-93833-006	25-93833-007	25-93833-008
Customer sample ref:	22 - TOX Out / 3470020033	24 - Tank P1 / 3470020034	19 - Tox IN / 3470003700	2 - PF01 / 3470020030
Customer sampling volume (L):	6	6	6	6

Determinand	Units	LOD	Acc.				
Hydrogen sulphide ⁽¹⁾	µg	10	N	<10	<10	18	<10
	mg/m ³	Calc.	N	<1.7	<1.7	3.0	<1.7

MSSL sample ref:	25-93833-009	25-93833-010	25-93833-011	25-93833-012
Customer sample ref:	4 - W2 / 3470020922	8 - W1 / 3470021627	10 - O1 / 3470021629	14 - RM1 / 3470020926
Customer sampling volume (L):	6	6	6	6

Determinand	Units	LOD	Acc.				
Hydrogen sulphide ⁽¹⁾	µg	10	N	24	<10	<10	<10
	mg/m ³	Calc.	N	4.0	<1.7	<1.7	<1.7

ODOUR MEASUREMENT & CONSULTANCY SERVICES

MSSL sample ref:	25-93833-013	25-93833-014
Customer sample ref:	Blank / 347003705	Blank / 3470003703
Customer sampling volume (L):	-	-

Determinand	Units	LOD	Acc.		
Hydrogen sulphide ⁽¹⁾	µg	10	N	<10	<10
	mg/m ³	Calc.	N	-	-

⁽¹⁾ Results have been blank-corrected.

Appendix 2 - TWMA, PETERHEAD - AIR QUALITY TECHNICAL NOTE

TWMA, PETERHEAD - AIR QUALITY TECHNICAL NOTE

Background

Redmore Environmental Ltd was commissioned by TWMA Group Limited to undertake an Odour Assessment¹ for the waste oil processing and recovery facility operated by the company in Peterhead, Aberdeen. This was undertaken to re-evaluate potential impacts as a result of releases from the facility following the installation of a direct-fired thermal oxidation abatement system and completion of a programme of Emissions Monitoring at the site.

Following submission of the Odour Assessment, the Scottish Environment Protection Agency (SEPA) provided the following notice requiring further information:

"The human health effects of Ammonia and the human health workplace exposure limits for H₂S are provided on pages 75 and 77 respectively of the SEPA Odour Guidance. Please extrapolate from the data how human health shall be protected from these emission levels, for both site staff and nearby receptors."

Further dispersion modelling has been undertaken to predict potential ammonia (NH₃) and hydrogen sulphide (H₂S) concentrations within the site boundary and at sensitive receptor locations arising from emissions associated with the facility in order to address SEPA's request. In addition, TWMA has provided further information detailing the measures that are implemented at the facility to ensure that unacceptable exposure of employees to NH₃ and H₂S does not occur.

A summary of the modelling methodology and results is presented in the following Technical Note, together with a description of the exposure control measures specified by TWMA. This should be read in conjunction with the Odour Assessment² previously completed by Redmore Environmental Ltd.

¹ Odour Assessment - TWMA, Peterhead, 8420-1, Redmore Environmental Ltd, December 2025.

² Odour Assessment - TWMA, Peterhead, 8420-1, Redmore Environmental Ltd, December 2025.

Methodology

Introduction

NH₃ and H₂S emissions from sources at the facility have the potential to result in the exposure of employees and sensitive receptors in vicinity of the site. As such, dispersion modelling was undertaken in order to quantify potential concentrations of the pollutants at relevant locations. A summary of the methodology is provided in the following Sections.

Dispersion Model

Dispersion modelling was undertaken using ADMS-6.0 (v6.0.2.5), which is developed by Cambridge Environmental Research Consultants (CERC) Ltd. ADMS-6 is a short-range dispersion modelling software package that simulates a wide range of buoyant and passive releases to atmosphere. It is a new generation model utilising boundary layer height and Monin-Obukhov length to describe the atmospheric boundary layer and a skewed Gaussian concentration distribution to calculate dispersion under convective conditions.

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

The model requires input data that details the following parameters:

- Process conditions and emission rates;
- Assessment area
- Terrain information;
- Building dimensions;
- Meteorological data;
- Roughness length (z_0); and,
- Monin-Obukhov length.

For consistency, the dispersion modelling utilised the same inputs as those specified in the Odour Assessment³ previously prepared by Redmore Environmental Ltd, which has been accepted by SEPA. However, emissions for the sources were re-defined to reflect NH₃ and H₂S releases based

³ Odour Assessment - TWMA, Peterhead, 8420-1, Redmore Environmental Ltd, December 2025.

on the results of monitoring carried out by Silsoe Odours and Redmore Environmental on 9th September 2025 and 10th September 2025.

Reference should be made to the previous Odour Assessment⁴ for full details of the modelling parameters. The process conditions and emission rates utilised as part of the NH₃ and H₂S modelling are summarised in the following Sections.

Emission Sources

A summary of the emission sources considered as part of the modelling is provided in Table 1.

Table 1 Emission Sources

Source		Emission Characteristics
1	Direct-Fired Thermal Oxidisation unit	Air is released to atmosphere vertically via a dedicated stack at a height of 13m
2	Carbon Filter	Air is released to atmosphere vertically via a dedicated stack at a height of 6m
3	Powder silo	Air is released to atmosphere vertically via a dedicated vent at a height of 12.5m
4	Slop tanks - P1	Air displaced from the tank during filling is treated using a carbon filter passively prior to release atmosphere
5	Slop tanks - RM1	Air displaced from the tank during filling is treated using a carbon filter passively prior to release atmosphere
6	Slop tanks - S1 and S2	Air displaced from the tanks during filling is treated using a carbon filter passively prior to release atmosphere
7	Slop tanks - S3	Air displaced from the tank during filling is treated using a carbon filter passively prior to release atmosphere
8	Slop Tanks - S4	Air displaced from the tank during filling is treated using a carbon filter passively prior to release atmosphere
9	Slop tanks - S5 and S6	Air displaced from the tanks during filling is treated using a carbon filter passively prior to release atmosphere
10	Slop tanks - O1	Air displaced from the tank during filling is treated using a carbon filter passively prior to release atmosphere
11	Slop tanks - O2	Air displaced from the tank during filling is treated using a carbon filter passively prior to release atmosphere
12	Slop Tanks - O3	Air displaced from the tank during filling is treated using a carbon filter passively prior to release atmosphere

⁴ Odour Assessment - TWMA, Peterhead, 8420-1, Redmore Environmental Ltd, December 2025.

Source		Emission Characteristics
13	Slop tanks - W1	Air displaced from the tank during filling is treated using a carbon filter passively prior to release atmosphere
14	Slop Tanks - W2	Air displaced from the tank during filling is treated using a carbon filter passively prior to release atmosphere
15	Slop tanks - PFO1 and PFO2	Air displaced from the tanks during filling is treated using a carbon filter passively prior to release atmosphere
16	Drill Cuttings Tanks 1, 2, 3 and 4	Diffuse emissions from the surfaces of exposed materials in the open tanks
17	Half-Height	Diffuse emissions from the surfaces of exposed materials in the open tank
18	Slop Receptor	Diffuse emissions from the surfaces of exposed materials in the open tank

Emission Rates

A summary of the NH₃ and H₂S emission rates utilised to represent the point sources identified in Table 1 is provided in Table 2. These were derived from the results of monitoring carried out by Silsoe Odours and Redmore Environmental Ltd on 9th September 2025 and 10th September 2025, as well as the inputs utilised as part of the previous Odour Assessment⁵.

It should be noted that the following assumptions were applied in derivation of the emission rates:

- For H₂S monitoring, all concentrations measured in accordance with the National Institute of Occupational Safety and Health (NIOSH) standard 6013 were below the Limit of Detection (LOD) for the analytical procedure for all sources assessed. As such, H₂S concentrations measured by Silsoe Odours using the Jerome J605 analyser were converted to mg/m³ and utilised to calculate emission rates for all sources;
- For a number of sources, NH₃ concentrations measured using NIOSH Method 6013 were below the LOD for the analytical procedure. In the absence of alternative NH₃ data for the sources, they were excluded from the assessment on the basis that any emissions would be negligible and unlikely to materially influence predicted concentrations at on-site or off-site receptors.

⁵ Odour Assessment - TWMA, Peterhead, 8420-1, Redmore Environmental Ltd, December 2025.

Table 2 Emission Inputs - Point Sources

Source Name	Emission Concentration (mg/m ³)		Emission Rate (g/s)	
	NH ₃	H ₂ S	NH ₃	H ₂ S
Thermal Oxidiser	-(a)	0.002	-(a)	9.14E-07
Carbon Filter	0.220	0.270	4.18E-04	5.13E-04
Powder Silo	2.670	0.560	1.94E-05	4.06E-06
P1	6.480	0.300	1.10E-04	5.08E-06
RM1	-(a)	0.004	-(a)	3.39E-09
S1	0.430	0.052	6.56E-06	7.93E-07
S2	0.430	0.052	6.56E-06	7.93E-07
S3	0.067	1.700	7.18E-07	1.82E-05
S4	-(a)	0.003	-(a)	6.35E-09
S5	0.430	0.052	6.56E-06	7.93E-07
S6	0.430	0.052	6.56E-06	7.93E-07
O1	-(a)	0.003	-(a)	6.35E-09
O2	0.067	1.700	7.18E-07	1.82E-05
O3	-(b)	-(b)	-(b)	-(b)
W1	-(a)	0.003	-(a)	3.22E-08
W2	-(a)	4.140	-(a)	4.67E-06
PFO1	-(a)	0.004	-(a)	6.91E-09
PFO2	-(a)	0.004	-(a)	6.91E-09

Note: (a) Measured NH₃ concentration was below the LOD for the analysis procedure. As such, an emission rate was not derived, and the source was not considered further as part of the assessment.

(b) All results below the LOD the analysis procedure. As such, emission rates were not derived, and the source was not considered further as part of the assessment.

Emissions from the sources were assumed to occur constantly 24-hours per day, 7-days per week, 365-days per year. This is considered to represent a worst-case assessment approach as periods of reduced operating capacity have not been considered.

The emission inputs used to describe the drill cutting tanks within the model are summarised in Table 3. It should be noted that the following process was utilised to derive area specific NH₃ and H₂S emission rates for use in the modelling:

- The odour emission rate specified for 'Drill Cutting Tank Mixed' in the Silsoe Odours report was divided by the geometric mean odour concentration to derive a volumetric flow rate;
- The volumetric flow rate was then multiplied by the measured H₂S and NH₃ concentrations for the source to derive gross emission rates for the pollutants; and,
- The emission rates were divided by the tank areas to derive area specific emission rates in g/m²/s for input to the model.

Table 3 Emission Inputs - Drill Cutting Tanks

Source Name	Emission Concentration (mg/m ³)		Modelled Emission Rate (g/m ² /s)	
	NH ₃	H ₂ S	NH ₃	H ₂ S
Drill Cutting Tank 1	0.547	0.007	3.42E-06	4.37E-08
Drill Cutting Tank 2	0.547	0.007	3.42E-06	4.37E-08
Drill Cutting Tank 3	0.547	0.007	3.42E-06	4.37E-08
Drill Cutting Tank 4	0.547	0.007	3.42E-06	4.37E-08
Drill Cutting Half-Height	0.547	0.007	3.29E-06	4.21E-08
Drill Cutting Receptor	0.547	0.007	3.35E-06	4.29E-08

Emissions from the sources were assumed to occur constantly 24-hours per day, 7-days per week, 365-days per year. This is considered to represent a worst-case assessment approach as periods of reduced operating capacity have not been considered.

Assessment Criteria

A summary of the assessment criteria utilised as part of analysis of the modelling results is provided in the following Sections.

Employee Exposure

Appendix 1 of the 'SEPA Odour Guidance'⁶ specifies long-term and short-term Workplace Exposure Limits (WELs) for H₂S. These are consistent with the WELs prescribed in the Health and Safety Executive (HSE) guidance 'EH40/2005 Workplace Exposure Limits'⁷ which are expressed as 15-minute (short-term) and 8-hour (long-term) time weighted average (TWA) concentrations.

The SEPA guidance does not specify WELs for NH₃. As such, short-term and long-term criteria for the pollutant were derived from the previously stated HSE document. A summary of the exposure limits is provided in Table 4.

Table 4 Workplace Exposure Limits

Pollutant	WEL		
	Unit	Value	Averaging Period
NH ₃	mg/m ³	18	8-hour
	mg/m ³	25	15-minutes
H ₂ S	mg/m ³	7	8-hour
	mg/m ³	14	15-minutes

The potential for exposure of employees to H₂S and NH₃ concentrations was assessed through analysis of the maximum predicted concentrations over the relevant averaging periods across the entire modelling domain, and comparison to the criteria outlined in Table 4. This ensured a worst-case assessment and that all potential areas of exposure across the site were considered. Reference should be made to the previous Odour Assessment⁸ undertaken by Redmore Environmental for full details of the modelling area.

Sensitive Receptors

Appendix 1 of the SEPA guidance⁹ also provides thresholds for human health effects. For the purpose of the dispersion modelling, the most precautionary values reported for both H₂S and NH₃ were selected to assess the potential for impacts at sensitive locations in the vicinity of the site. These are summarised in Table 5.

⁶ SEPA Odour Guidance, Version 2.1, SEPA, 2025.

⁷ EH40/2005 Workplace Exposure Limits, HSE, 2020.

⁸ Odour Assessment - TWMA, Peterhead, 8420-1, Redmore Environmental Ltd, December 2025.

⁹ SEPA Odour Guidance, Version 2.1, SEPA, 2025.

It should be noted that the SEPA guidance does not specify averaging periods for pollutant health effects other than the previously stated WELs. As such, for the purpose of the modelling, an averaging period of 1-minute was assumed. This represents a precautionary approach, as it assumes that the health effect associated with the relevant threshold value could occur over a very short-term exposure period, thereby providing a conservative assessment of potential impacts.

Table 5 Threshold Limits

Pollutant	Unit	Lowest Human Health Threshold	Averaging Period
NH ₃	mg/m ³	284	1-minute
H ₂ S	mg/m ³	28	1-minute

The potential for exposure of sensitive receptors to H₂S and NH₃ concentrations was assessed through analysis of the maximum predicted concentrations of the pollutants at the relevant locations and comparison to the criteria outlined in Table 5. Reference should be made to the previous Odour Assessment¹⁰ undertaken by Redmore Environmental for full details of the receptor locations.

Modelling Scenarios

A summary of the modelling scenarios is provided Table 6.

Table 6 Modelling Scenarios

Scenario	Pollutants	Modelled As	
		Short Term	Long Term
Employee Exposure	H ₂ S and NH ₃	100 th %ile 15-minute mean concentration	100 th %ile 8-hour mean concentration
Sensitive Receptors	H ₂ S and NH ₃	100 th %ile 1-minute mean concentration	-

Predicted pollutant concentrations were summarised in the following formats:

- Process Contribution (PC) - Predicted pollutant concentration as a result of emissions from the facility only; and,

¹⁰ Odour Assessment - TWMA, Peterhead, 8420-1, Redmore Environmental Ltd, December 2025.

- Predicted Environmental Concentration (PEC) - Total predicted pollutant concentration as a result of emissions from the facility and existing baseline levels.

Baseline Pollution Levels

An annual mean NH₃ concentration of 0.7µg/m³ obtained from the Air Pollution Information System website¹¹ was utilised to represent baseline levels at the site and receptor locations. There is currently no UK baseline monitoring data available for H₂S. As such, a background concentration of 0µg/m³ has been assumed for the pollutant in the assessment in the absence of suitable information.

It is not possible to add short-term peak baseline and process concentrations. This is because the conditions which give rise to peak ground-level concentrations of substances emitted from an elevated source at a particular location and time are likely to be different to the conditions which give rise to peak concentrations due to emissions from other sources. This point is addressed in SEPA guidance H1¹², which advises that an estimate of the maximum combined pollutant concentration can be obtained by adding the maximum predicted short-term concentration due to emissions from the source to twice the annual mean baseline concentration. This approach was adopted throughout the assessment.

Modelling Results

Employee Exposure Results

The maximum predicted H₂S and NH₃ concentrations at any point within the modelling extents for any meteorological data set are summarised in Table 7.

Table 7 Maximum Predicted Pollutant Concentrations

Pollutant	Averaging Period	WEL (mg/m ³)	PC (mg/m ³)	PC Proportion of WEL (%)	PEC (mg/m ³)	PEC Proportion of WEL (%)
NH ₃	100 th %ile 8-hour rolling	18	0.013	0.1	1.413	7.9
	100 th %ile 15-minute	25	0.016	0.1	1.416	5.7

¹¹ <http://www.apis.ac.uk/>.

¹² IPPC H1: Integrated Pollution Prevention and Control (IPPC) Environmental Assessment and Appraisal of BAT, SEPA, 2003.

Pollutant	Averaging Period	WEL (mg/m ³)	PC (mg/m ³)	PC Proportion of WEL (%)	PEC (mg/m ³)	PEC Proportion of WEL (%)
H ₂ S	100 th %ile 8-hour rolling	7	0.003	0.0	0.003	0.0
	100 th %ile 15-minute	14	0.006	0.0	0.006	0.0

As shown in Table 7, there were no predicted exceedences of any WELs at any location within the assessment extents for any pollutant or averaging period of interest.

Sensitive Receptor Locations

Ammonia

Predicted 100th %ile 1-minute mean NH₃ concentrations at the receptor locations are summarised in Table 8. The maximum PEC across the five years of results is highlighted in **bold**.

Table 8 Predicted 100th %ile 1-minute Mean NH₃ PECs

Receptor		Predicted 100 th %ile 1-minute Mean NH ₃ PEC (mg/m ³)				
		2019	2020	2021	2022	2023
R1	Residential - Green Acres Avenue	1.40024	1.40025	1.40024	1.40025	1.40025
R2	Residential - Green Acres Avenue	1.40027	1.40026	1.40029	1.40031	1.40025
R3	Residential - Green Acres Avenue	1.40028	1.40027	1.40028	1.40031	1.40028
R4	Residential - Green Acres Avenue	1.40028	1.40028	1.40029	1.40028	1.40030
R5	Residential - Green Acres Avenue	1.40027	1.40027	1.40027	1.40034	1.40029
R6	Residential - Green Acres Avenue	1.40024	1.40025	1.40024	1.40025	1.40026
R7	Residential - Green Acres Avenue	1.40026	1.40023	1.40023	1.40024	1.40024
R8	Industrial - Damhead Road	1.40034	1.40033	1.40034	1.40035	1.40034
R9	Industrial - Damhead Road	1.40041	1.40042	1.40044	1.40052	1.40043
R10	Industrial - Damhead Road	1.40041	1.40043	1.40042	1.40041	1.40041
R11	Industrial - Damhead Road	1.40028	1.40029	1.40029	1.40029	1.40029
R12	Industrial - Damhead Road	1.40044	1.40040	1.40043	1.40051	1.40041
R13	Industrial - Damhead Road	1.40026	1.40027	1.40029	1.40028	1.40029

Receptor		Predicted 100 th %ile 1-minute Mean NH ₃ PEC (mg/m ³)				
		2019	2020	2021	2022	2023
R14	Greenacres Avenue - Residential 1	1.40025	1.40025	1.40025	1.40028	1.40027
R15	Greenacres Avenue - Residential 2	1.40031	1.40028	1.40029	1.40029	1.40029
R16	Friarhill Way - Residential	1.40021	1.40021	1.40020	1.40021	1.40022
R17	Greenacres Road - Residential	1.40013	1.40013	1.40013	1.40013	1.40013
R18	Friarhill Crescent - Residential	1.40014	1.40013	1.40014	1.40014	1.40014
R19	Auchtygall Place - Residential	1.40011	1.40011	1.40011	1.40011	1.40011
R20	Ruby Crescent - Residential	1.40013	1.40014	1.40013	1.40014	1.40013
R21	Dale Park School - Primary School	1.40010	1.40010	1.40010	1.40010	1.40010
R22	Heath Drive - Residential	1.40011	1.40011	1.40011	1.40011	1.40011
R23	Meethill Road - Residential	1.40008	1.40008	1.40008	1.40008	1.40008
R24	Glenugie Gardens - Residential	1.40008	1.40008	1.40008	1.40006	1.40008

As shown in Table 8, 100th %ile 1-minute mean NH₃ PECs were well below the threshold of 284mg/m³ at all sensitive receptor locations for all modelling years.

Hydrogen Sulphide

Predicted 100th %ile 1-minute mean H₂S concentrations at the receptor locations are summarised in Table 9. The maximum PEC across the five years of results is highlighted in **bold**.

Table 9 Predicted 100th %ile 1-minute Mean H₂S PECs

Receptor		Predicted 100 th %ile 1-minute Mean H ₂ S PEC (mg/m ³)				
		2019	2020	2021	2022	2023
R1	Residential - Green Acres Avenue	0.00009	0.00009	0.00009	0.00009	0.00009
R2	Residential - Green Acres Avenue	0.00010	0.00010	0.00010	0.00010	0.00010
R3	Residential - Green Acres Avenue	0.00011	0.00012	0.00012	0.00011	0.00012
R4	Residential - Green Acres Avenue	0.00013	0.00013	0.00013	0.00013	0.00013
R5	Residential - Green Acres Avenue	0.00012	0.00012	0.00012	0.00012	0.00012
R6	Residential - Green Acres Avenue	0.00012	0.00013	0.00013	0.00013	0.00013

Receptor		Predicted 100 th %ile 1-minute Mean H ₂ S PEC (mg/m ³)				
		2019	2020	2021	2022	2023
R7	Residential - Green Acres Avenue	0.00012	0.00012	0.00012	0.00012	0.00012
R8	Industrial - Damhead Road	0.00019	0.00020	0.00020	0.00022	0.00021
R9	Industrial - Damhead Road	0.00022	0.00023	0.00021	0.00022	0.00023
R10	Industrial - Damhead Road	0.00015	0.00015	0.00015	0.00015	0.00016
R11	Industrial - Damhead Road	0.00015	0.00015	0.00015	0.00015	0.00015
R12	Industrial - Damhead Road	0.00018	0.00017	0.00017	0.00018	0.00017
R13	Industrial - Damhead Road	0.00012	0.00012	0.00012	0.00012	0.00012
R14	Greenacres Avenue - Residential 1	0.00009	0.00010	0.00010	0.00010	0.00010
R15	Greenacres Avenue - Residential 2	0.00012	0.00012	0.00012	0.00012	0.00012
R16	Friarhill Way - Residential	0.00009	0.00009	0.00009	0.00009	0.00009
R17	Greenacres Road - Residential	0.00005	0.00005	0.00005	0.00005	0.00005
R18	Friarhill Crescent - Residential	0.00006	0.00006	0.00006	0.00006	0.00006
R19	Auchtygall Place - Residential	0.00004	0.00005	0.00005	0.00005	0.00005
R20	Ruby Crescent - Residential	0.00005	0.00005	0.00005	0.00005	0.00005
R21	Dale Park School - Primary School	0.00004	0.00004	0.00004	0.00004	0.00004
R22	Heath Drive - Residential	0.00004	0.00004	0.00004	0.00004	0.00004
R23	Meethill Road - Residential	0.00003	0.00003	0.00003	0.00003	0.00003
R24	Glenugie Gardens - Residential	0.00003	0.00003	0.00003	0.00003	0.00003

As shown in Table 9, 100th %ile 1-minute mean H₂S PECs were well below the threshold of 28mg/m³ at all sensitive receptor locations for all modelling years.

Summary

As detailed in the previous Section, the dispersion modelling results indicated that there are no predicted exceedences of the relevant WELs for NH₃ and H₂S at any location within the assessment extents for any averaging period of interest. As such, it is considered that there is a low risk of exposure of employees to NH₃ and H₂S concentrations as a result of emissions from the facility.

Notwithstanding the low level of risk predicted, appropriate control measures are utilised at the TWMA facility in order to ensure that unacceptable exposure of employees to NH₃ and H₂S concentrations does not occur as a result of emissions. Further details of the measures are provided in the following Section.

The modelling results also indicated that 100th %ile 1-minute mean H₂S and NH₃ PECs were well below the most precautionary human health thresholds at all sensitive receptor locations for all assessment years. As such, it is concluded there is a negligible risk of health impacts as a result of H₂S and NH₃ emissions from the facility at all off-site receptor locations.

TWMA Employee Exposure Control Measures

In order to limit the risk of exposure of employees to hazardous gases such as NH₃ and H₂S, TWMA have developed the following procedures which set out appropriate measures:

- TWMA-465-PRO Slops Acceptance, Pre-Analysis, Storage and Discharge - The TWMA site does not accept slops direct from the quayside. As such, slops are checked and treated (if required) for H₂S prior to admission to site. If the site is required to accept slops direct from the quayside, the Appendix of this document provides methodology to ensure this is undertaken safely;
- TWMA-511-PRO Group Medical and Health Surveillance Program - The annual health surveillance requirements for site operators are detailed on page 7 of this document. This includes details of respiratory surveillance to be undertaken on an appropriate basis;
- TWMA -845-PRO-Hazard Awareness and Recognition Toolbox Talk Card (HART Card) - The HART card is the formal method of communication used on site at the start of each shift. It details any changes to the working environment to be considered for that day. It should be noted that this is undertaken in conjunction with task specific risk assessments;
- TWMA-1127-WI Qualitative Face Fit Testing - Face fit testing is undertaken every two years to ensure that the Personal Protective Equipment (PPE) supplied is well fitting and suited for purpose; and,
- TWMA-213-PRO-Gas Testing Procedure - When confined space entry is required on site for either maintenance or inspection, third party contractors are brought in to ensure experienced, fully trained personnel are undertaking the work.

Collectively, these procedures provide a structured framework to minimise the potential for employee exposure to hazardous gases during routine and non-routine operations.

Abbreviations

CERC	Cambridge Environmental Research Consultants
H ₂ S	Hydrogen Sulphide
HSE	Health and Safety Executive
LOD	Limit of Detection
NH ₃	Ammonia
NIOSH	National Institute of Occupational Safety and Health
PC	Process Contribution
PEC	Predicted Environmental Concentration
PPE	Personal Protective Equipment
SEPA	Scottish Environment Protection Agency
TWA	Time-Weighted Average
WEL	Workplace Exposure Level
Z ₀	Roughness length
