ODOUR IMPACT ASSESSMENT

Graphite Resources (DEP) Ltd
EPR/KB3939RR

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1. INTRODUCTION

1.1. Background

Sol Environment Ltd has been commissioned to undertake an assessment of the likely local odour impacts arising from the operation of a waste treatment facility located at the Derwenthaugh Industrial Estate in Blaydon, Gateshead to the southwest of Newcastle Upon Tyne (the facility). The Site location is presented in Figure 1.1.

The site is currently permitted under EPR/KB3939RR to process 320,000 tonnes per annum of non-hazardous waste arising from a waste transfer station. The permit is for the treatment of waste though autoclaves along with two pyrolysis units, four gas engines and a materials recycling facility (MRF). The assessment is to support the permit a variation application for the installation. The permit variation is to change the type and quantity of waste treated and the application is for 100,000 tonnes per annum of clinical and other wastes for sterilisation through the autoclaves, two pyrolysis units, nine associated gas engines and a drier.

There are five Simdean odour control units which treat air from various processes at the site.

1.2. Proposed Site Activities

The site is currently permitted under EPR/KB3939RR to operate a mechanical heat treatment plant with associated material recycling facility (MRF) and a two-line pyrolysis plant with associated gas fired CHP engines.

The mechanical heat treatment plant currently consists of a three-line rotating steam autoclave process. It is proposed to install two new autoclave units which will be in line with clinical waste regulations to allow the processing and sterilisation of clinical and medical wastes. The remaining two autoclave units currently onsite will be mothballed. The sterilised waste will then be processed through the dryer and metals separation unit prior to being utilised as feedstock in the onsite pyrolysis units or exported off site for use as a Refuse Derived Fuel (RDF), as necessary.

The purpose of this permit variation is to address the following:
- To enable the installation and operation of front-end reception and handling equipment to allow the enclosed shredding and sterilisation clinical wastes;
- The autoclaving and pressure sterilization of shredded clinical wastes;
- Modifications to the material recovery plant to include a drying plant;
- Update the technological description and associated heat and energy mass balance of the pyrolysis units to account for the changes in fuel types;
- An increase in the total number of gas engine CHP plant; and
- Reduction and rationalization of the annual permitted wastes through the site in alignment with the likely maximum front end and back end plant processing capacity.

The site currently accepts mixed MSW wastes for treatment through the autoclaves and MRF prior to export offsite. The introduction of the clinical waste stream will have minimal potential for additional odour due to the very low biomass content of the material (the waste is predominantly wastes plastics, vinyls, dressings etc). All clinical waste material will be fully segregated, bagged and fully enclosed through the delivery, shredding and processing stages.

Despite this, all handling, storage and steam sterilising of these waste streams have the potential to cause odorous emissions without fully implemented and operational odour control mitigation and management.

Clinical waste are delivered to the dedicated internal reception hall within the main Building. By necessity and in accordance with the Clinical Waste Regulations, all clinical wastes are delivered bagged and the majority within bins. Wheeled bin deliveries will be transferred into the bin storage area or loaded directly onto a bin lifter system and conveyed into the processing plant. Any storage of clinical wastes within bins will typically be for less than 1 day and will not exceed a period longer than 1 week (7 days).

To ensure proper heat treatment, all wastes are shredded prior to autoclaving. This is an entirely enclosed process with shredded wastes conveyed directly to an enclosed interim container and undergoing immediate treatment. The interim container allows the accumulation of a full autoclave load prior to loading of the equipment. Typically, the capacity of the autoclaves takes a maximum of 2 hours to accumulate. The site will manage shredding operations so that no shredded waste will be stored during periods of shutdown.

Following waste conveyance into the autoclaves, they are pressurised with steam at 160°C and at approximately 6 barg pressure. All wastes are processed for approximately 45 minutes within the rotating autoclave, during which all biomass material is converted to a cellulose fibre and plastics are sterilised.

At the end of the steam sterilisation process, the autoclave is de-pressurised and all steam extracted through the accumulator and re-condensed. Any non-condensable gases are extracted and directed to the pyrolysis units where any odorous compounds are thermally destroyed prior to discharge to atmosphere.

The resultant sterilised waste is further processed through a drier and metal separation unit to separate recyclates prior to conveyance to one of the three fuel bunkers for use as a feedstock for the pyrolysis units.

All emissions from the drier are directed to the onsite Scrubbing Air Handling System prior to discharge to atmosphere.

The pyrolysis plant produces syngas from the heating of wastes in the absence of oxygen. Following downstream gas clean up, the syngas is then utilised within onsite gas engines to produce electricity for

use onsite and export to the grid. A by-product of this process is char which is collected and exported offsite for recycling as aggregate.

1.3. Potential Sources of Odour

It is understood that there have been complaints relating to odour in the past, but this has been due to the lack of a thermal oxidiser to minimise the release of odours. For the future operation of the installation, the most odorous air (e.g. non-condensable gases from the autoclaves) will be thermally treated by the pyrolyser or the flare. Air from less odorous sources will be treated via the existing Simdean odour control units.

The proposed waste types that will be accepted by the site do not have a significant potential for odour generation. Therefore, as a result of this permit variation, the site will be processing smaller quantities of less odorous waste, thereby reducing the potential for odour compared to the currently permitted activities.

Furthermore, the fundamental design of the facility has a hierarchy of odour control and abatement measures to ensure that the potential for odour impacts is eliminated. This includes detailed waste acceptance procedures to ensure that no odourous waste is accepted on site.

This Odour Impact Assessment identifies that the potential odour sources are the five Simdean odour control units. An odour management plan for the installation is also being submitted to the Environment Agency as part of the permit variation application. This provides details of the fundamental design of the facility and includes a hierarchy of odour control and abatement measures to ensure that the potential for odour impacts are eliminated.

A glossary of common air quality and odour terminology is provided in **Appendix A.**
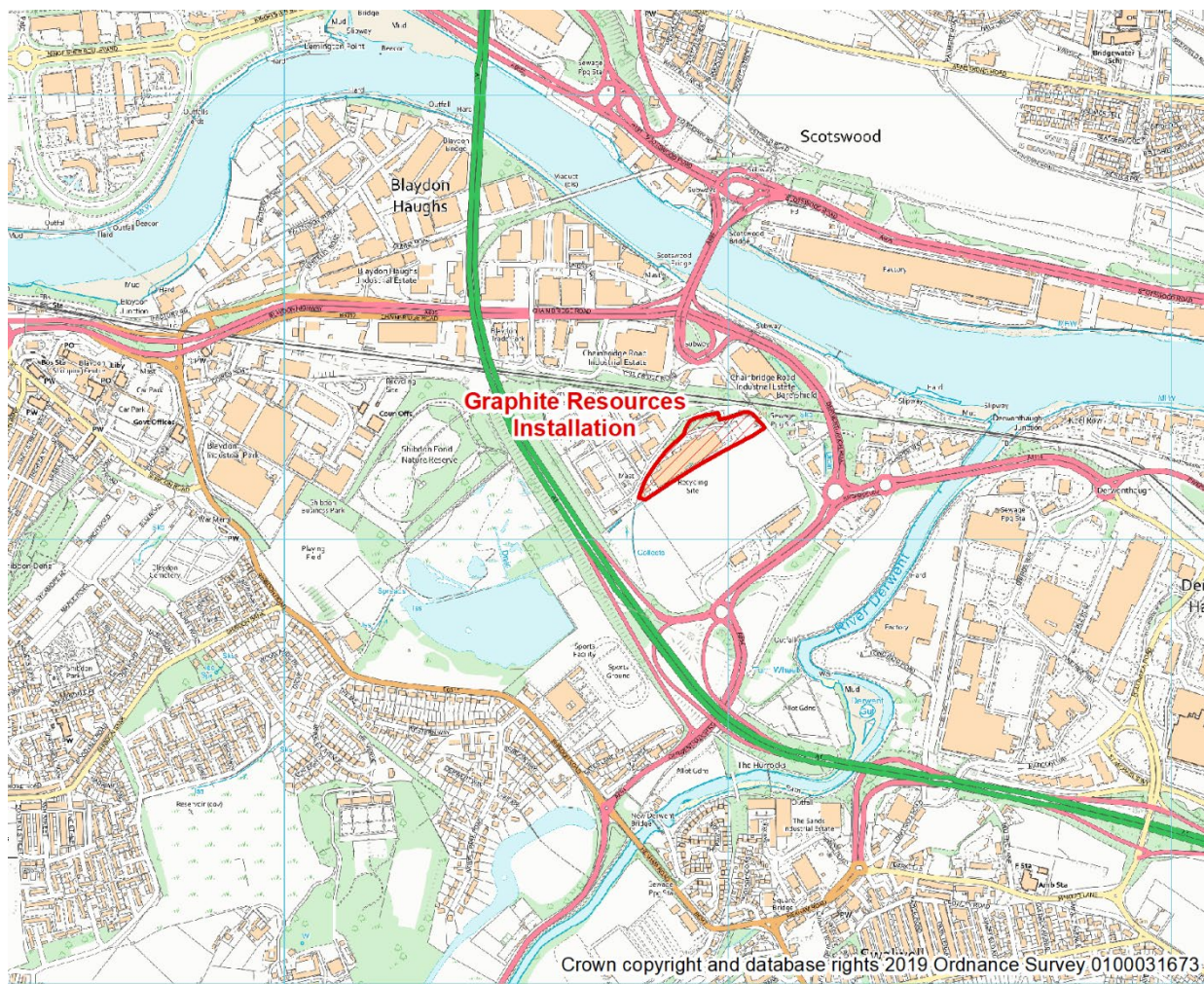
Figure 1.1 Site location

2.   LEGISLATION AND GUIDANCE

2.1. Odour Legislation and Guidance

The following legislation and guidance have been used in this assessment:

- H4: Odour Management, Environment Agency (EA), 2011;

- Odour Guidance for Local Authorities, Department for Environment, Food and Rural Affairs (Defra), 2010;

- Environmental Permitting (England and Wales) Regulations (2010); and,

- Defra Code of Practice on Odour Nuisance from Sewage Treatment Works, 2006.

2.2.   Odour Definition

Defra guidance defines odour as:

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

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

2.3.   Odour Impacts

The magnitude of odour impact depends on a number of factors and the potential for adverse impacts varies due to the subjective nature of odour perception. The FIDOR acronym is a useful reminder of the factors that can be used to help determine the degree of odour pollution:

- Frequency of detection - frequent odour incidents are more likely to result in adverse impacts;

- Intensity as perceived - intense odour incidents are more likely to result in adverse impacts;

- Duration of exposure - prolonged exposure is more likely to result in adverse impacts;

- Offensiveness - more offensive odours have a higher risk of resulting in adverse impacts; and,

- Receptor sensitivity - sensitive areas are more likely to have a lower odour tolerance.

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

The FIDOR factors can be further considered to provide the following issues with respect to the potential for an odour emission to cause adverse impacts:

- 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 (wind direction, wind speeds etc.).

- The sensitivity of receptors to the emission i.e. whether the odorous compound is more likely to cause annoyance, such as the sick or elderly, who may be more sensitive.

- The odour detection capacity of individuals to the various compound(s) in odours.

- The individual perception of the odour (i.e. whether the odour is regarded as unpleasant). This is quite 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, whilst others find them less tolerable.

2.4. Odour Measurement

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

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

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

The concept of odour concentrations, as ou_E/m^3, is based on a correlation between a physiological response when odour is detected by the nose and exposure to a particular sample at a specific

concentration. The results of this assessment are expressed in terms of a single number. The odour sample assessed can be one of many individual odorous substances or a complex mixture of many substances, and so the odour unit or concentration will vary between test samples. A defined measurement standard for the odour unit is prescribed in the BS:EN standard on olfactometry using n-butanol. This gas is used to select and calibrate odour panel members.

An odour at a strength of 1 ou_E/m^3 is the concentration at which 50% of the population can detect the odour and 50% cannot within the controlled environment of an odour laboratory. As an odour becomes more concentrated, then it gradually becomes more apparent. Some guidance as to concentrations when this occurs can be derived from laboratory measurements of intensity. The following guideline values have been stated by Defra to provide some context for discussion about exposure to odours:

- 1 ou_E/m^3 is the point of detection;

- 5 ou_E/m^3 is a faint odour; and,

- 10 ou_E/m^3 is a distinct odour.

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

- 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 60ou_E/m^3 or more.

- The recognition threshold may be about 3ou_E/m^3, although it might be less for offensive substances or higher if the receptor is less familiar with the odour or distracted by other stimuli.

- An odour which fluctuates rapidly in concentration is often more noticeable than a steady odour at a low concentration.

2.5. Odour Benchmarks

There are no statutory odour annoyance criteria in the UK although the Environment Agency (the Agency) has published guidance for processes regulated under the Environmental Permitting Regulations (EPR) [1]. The guidance (H4) provides a range of benchmark levels for assessing odour annoyance depending on the

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1   H4 Odour Management, How to Comply with your Environmental Permit, Environment Agency Horizontal Guidance (March 2011)

perceived offensiveness of the process undertaken. These are all based on the 98th percentile of hourly mean concentrations modelled over a year. Expressing air quality standards as percentiles is common in the UK and has been applied to the odour offensiveness criteria as the Agency recognises that there are circumstances when it is difficult to avoid off-site odour (e.g. extreme meteorological conditions).

The Environment Agency benchmarks are as follows:

- 1.5 ou_E/m^3 for most offensive odours;
- 3.0 ou_E/m^3 for moderately offensive odours; and
- 6 ou_E/m^3 for less offensive odours.

Offensiveness of the odour takes into account the sensitivity of the receptor (e.g. residential receptors would be considered more sensitive). The Environment Agency provides examples of processes that fall within each of the offensiveness categories. For most offensive odours, these include: decaying animal or fish remains; processes involving septic effluent or sludge; and biological landfill odours. Less offensive odours include bakeries, coffee roasting, breweries etc. These criteria are not compliance limits as it would not be possible to monitor compliance with the criteria. Therefore, they may be used for assessing the acceptability of a process (where it is possible to model emissions) or for developing stack emission limits such that compliance with a criterion can be demonstrated.

There has been much debate about the most appropriate odour benchmark to be applied to industrial and other developments that may give rise to odours. Prior to publication of the H4 guidance, an assessment criterion of 5 ou_E/m^3 (as the 98th percentile of hourly values) had traditionally been applied to sewage treatment works. This was based on evidence presented at the Newbiggen-by-the-Sea public inquiry in 1993 on behalf of Northumbrian Water. The evidence was derived from a Dutch study which concluded that odour concentrations of between 5 and 10 ou_E/m^3 (as the 98th percentile of hourly values) would be acceptable and would not result in justifiable complaints. It is considered that the Dutch study referred to Dutch odour standards where one dutch odour unit is equivalent to a half European odour unit. Therefore, the Newbiggen-by-the-Sea criterion would be equivalent to 2.5 to 5 ou_E/m^3.

In 2001, UK Waster Industry Research (UKWIR) published a study on the correlation between modelled odour impacts and human response. The study was based on a review of the correlation between reported odour complaints and modelled odour impacts at nine wastewater treatment works with on-going odour complaints. The findings of the study indicated the following:

- At modelled exposure of less than 5 ou_E/m^3 (98th percentile of hourly values) complaints are relatively rare at only 3% of the total registered.
- At modelled exposures of between 5 and 10 ou_E/m^3 a significant proportion of total registered complaints occur (38% of the total).

- The majority of complaints occur in areas of modelled exposure of greater than 10 ou_E/m^3 (59% of the total).

The Chartered Institution of Water and Environmental Management (CIWEM) has published a policy position statement (PPS) relating to the control of odour [2]. The purpose of the PPS is:

'to outline the main issues relating to odours arising from industrial premises, wastewater treatment plants, sewers and pumping stations, waste management facilities and agricultural activity, taking account of legislation, regulators, the public and other stakeholders and emerging best practice, particularly in a UK context.'

The CIWEM considers the following framework is the most reliable that can be defined on the basis of limited research in the UK (all expressed as the 98th percentile of hourly means):

- > 10 ou_E/m^3 – complaints are highly likely and odour exposure at these levels represents an actionable nuisance;
- > 5 ou_E/m^3 – complaints may occur and depending on the sensitivity of the locality and nature of the odour this level may constitute a nuisance;
- <3 ou_E/m^3 – complaints are unlikely to occur and exposure below this level are unlikely to constitute significant pollution or significant detriment to amenity unless the locality is highly sensitive or the odour highly unpleasant in nature.

Therefore, there are a range of odour annoyance criteria that could be applied to the site as follows (all expressed as the 98th percentile of hourly values):

- 1.5 ou_E/m^3 based on the Environment Agency criterion for most offensive odours;

- 2.5 ou_E/m^3 as the lower end of the Newbiggen-by-the-Sea criterion as being acceptable and would not result in justifiable complaints;

- 3.0 ou_E/m^3 based on the Environment Agency criterion for moderately offensive odours taking into account the lack of septicity of the wastewater being treated and the waste acceptance criterion;

- 3.0 ou_E/m^3 based on the CIWEM policy position statement for complaints unlikely to occur;

- 5 ou_E/m^3 based on the UKWIR correlation between modelled concentrations and complaints documented as being rare;

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2 Control of Odour, CIWEM Policy Position Statement (September 2012)

On the basis of the material accepted at the site, it is concluded that odour sources from the five Simdean odour control units would be classified as 'moderately offensive'. Therefore, the 3.0 ou$_E$/m^3 benchmark is likely to be the most appropriate in accordance with the criteria provided in the EA's H4 guidance.

3.   ASSESSMENT METHODOLOGY

3.1. Introduction

The five Simdean odour control units may result in residual odour emissions during normal operation. Therefore, these were assessed in accordance with the following stages:

- identification of odour sources;

- identification of odour emission rates;

- dispersion modelling of odour emissions; and,

- comparison of modelling results with relevant criteria.

The following sections outline the methodology and inputs used for the odour impact assessment. There is some design information on odour emissions for the Simdean odour control units but the odour emission rate will vary depending on the nature of the gas stream being treated. Therefore, initially dispersion modelling has been undertaken using the upper odour design concentration for the Simdean units and the dispersion modelling assessment has then been used to derive an appropriate odour emission for the five odour control stacks in order to avoid off-site annoyance.

3.2.   Odour Sources

This assessment identifies that the potential odour sources are the five Simdean odour control stacks. The potential odour sources identified for the installation are summarised in Table 3.1.

Each odour control unit is designed to treat 50,000 m^3/hour of odorous air. The upper design concentration for the units is 3,000 ou_E/m^3 which results in an odour emission per odour control unit of 41,667 ou_E/s.

Table 3.1: Odour Sources Identified for the Installation			
Source		Easting	Northing
A14	Odour control stack	419859	563181
A15	Odour control stack	419855	563179
A16	Odour control stack	419851	563176
A17	Odour control stack	419849	563175
A18	Odour control stack	419843	563165

3.3. Dispersion Modelling

The Dispersion Model

The potential impact of odorous emissions from the installation has been assessed using a dispersion model to predict airborne ground level concentrations of odour emitted from the odour control units.

The operational impact of emissions has been assessed using the AERMOD dispersion model. This is one of a 'newer generation' of dispersion models which describe the atmospheric boundary layer properties. AERMOD allows for the modelling of dispersion under convective meteorological conditions using a skewed Gaussian concentration distribution. It is able to simulate the effects of terrain and building downwash simultaneously. It can also calculate concentrations for direct comparison with odour annoyance criteria (i.e. hourly means expressed as the 98th percentile). It is used extensively in the UK for assessing the air quality and odour impacts of industrial and other polluting processes.

Emission Parameters

Emission parameters associated with the operation of the odour control units are derived from data issued by the technology provider. The dispersion modelling inputs are summarised in Table 3.2.

Table 3.2: Emission Parameters for the Simdean Units (per unit)		
Parameter	Value	Unit
Volumetric flow rate (actual)	13.9	Am^3/s
Upper design emission concentration	3,000	ou_E/m^3
Upper design odour emission rate	41,667	ou_E/s
Vent diameter	1.0	m
Stack height	13	m
Temperature	Ambient	°C
Emission velocity	18.5	m/s

Initial modelling will utilise the upper design odour concentration but where the odour benchmark is exceeded at sensitive receptors then the model will be used to determine a more appropriate emission concentration for the odour control units.

Local Meteorological Data

The dispersion modelling has utilised five years (2012-2016) of hourly sequential meteorological data in order to take account of inter-annual variability and reduce the effect of any atypical conditions. Data from a meteorological station at Newcastle Airport (approximately 8 km north of the Site) has been used for the assessment, which is the most representative data currently available for the area. A surface roughness value of 0.7 m has been assumed in the processing of the meteorological data.

Wind roses for each year of meteorological data are presented in **Appendix B.**

Topography

The presence of elevated terrain can significantly affect the dispersion of pollutants by increasing turbulence and reducing the distance between the plume centre line and the ground level.

Information relating to the topography of the area surrounding the proposed facility has been used in the dispersion modelling to assess the impact of terrain features on the dispersion of emissions.

Building Downwash / Entrainment

The presence of buildings close to emission sources can significantly affect the dispersion of pollutants by leading to a phenomenon called downwash. This occurs when a building distorts the wind flow, creating zones of increased turbulence. Increased turbulence causes the plume to come to ground earlier than otherwise would be the case and result in higher ground level concentrations closer to the stack.

Downwash effects are only significant where building heights are greater than 30 to 40% of the emission release height. The downwash structures also need to be sufficiently close for their influence to be significant. All potential downwash structures have been included in the model and comprise the following:

- Upper building section with a mean height of 14.6 m (polygon shape); and
- Lower building section with a mean height of 10.5 m (polygon shape).

Sensitive Receptors

Details of the discrete sensitive receptors selected for the assessment of odour impacts are presented in Table 3.3 and the locations illustrated in Figure 3.1.

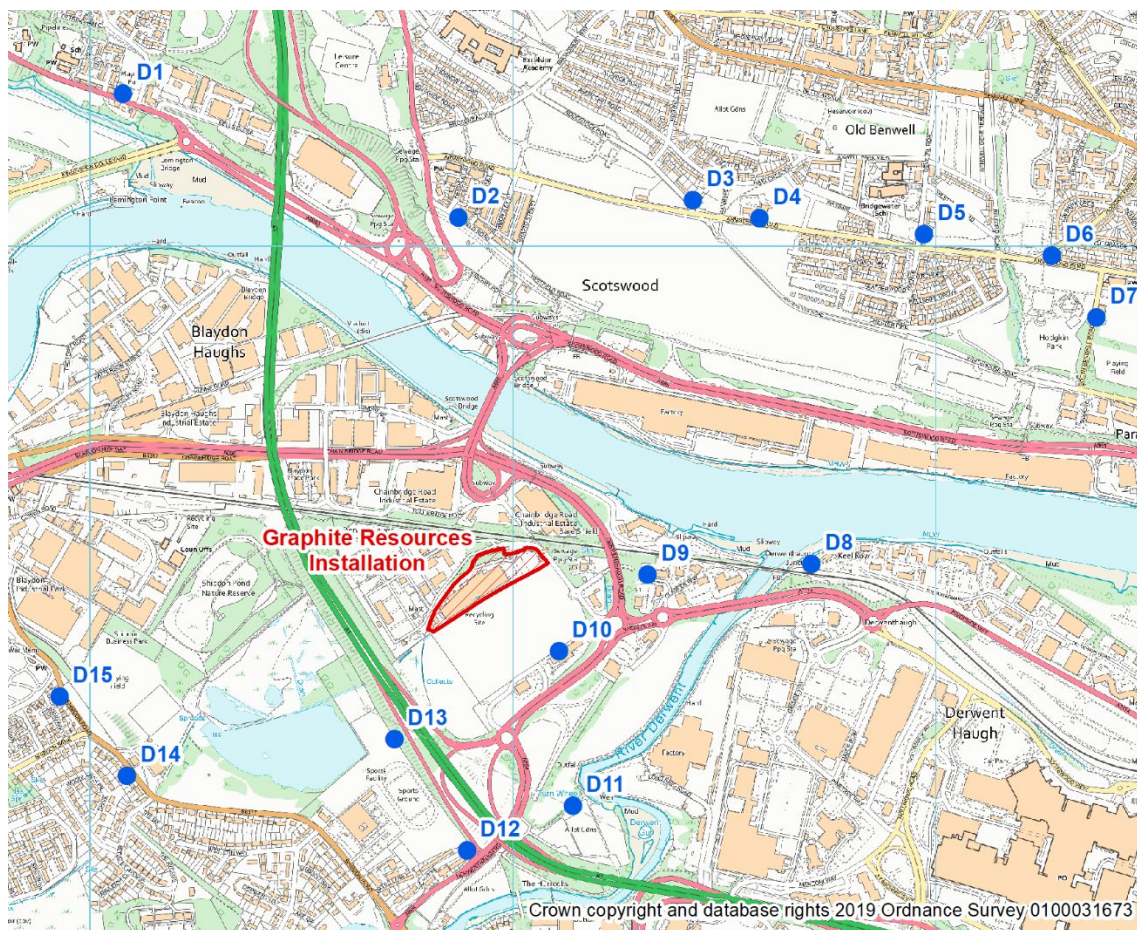| Table 3.3: Odour Impact Receptors				
ID	Receptor	Type	Easting	Northing
D1	Scotswood Road	Residential	419078	564360
D2	Whitfield Road	Residential	419871	564068
D3	Woodstock Road	Residential	420427	564108
D4	Surgery/Day Nursery	Business	420584	564066
D5	Delaval Road	Residential	420973	564029
D6	Hodgekin Park Road	Residential	421275	563978
D7	South Benwell Road	Residential	421381	563831
D8	Keel Row	Business	420707	563249
D9	Travelodge	Hotel	420319	563224
D10	Premier Inn	Hotel	420110	563042
D11	Allotments	Leisure	420142	562677
D12	The Copse	Residential	419892	562572
D13	Leisure Centre	Leisure	419721	562834
D14	Shibdon Road	Residential	419088	562747
D15	Shibdon Park	Residential	418928	562935

Figure 3.1: Sensitive Receptor Locations

Pollutant concentrations have been predicted at both discrete receptor locations and over a 4 km by 4 km Cartesian grid of 25 m resolution. These are used to provide contour plots of odour concentration for the on-site sources.

Modelling Uncertainty

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

- model uncertainty - due to model limitations;

- data uncertainty - due to errors in input data, including emission estimates, land use characteristics and meteorology; and

- variability - randomness of measurements used.

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

- Choice of model - AERMOD is a commonly used atmospheric dispersion model and results have been verified through a number of studies to ensure predictions are as accurate as possible.

- Meteorological data - modelling was undertaken using 5-years of annual meteorological data sets from the most appropriate observing station to the facility to take account of local conditions. In addition, for each receptor the maximum for the five years is presented.

- Plant operating conditions - plant operating conditions were provided by the technology provider. As such, these are considered to be representative of operating conditions.

- Emission rates – odour emission rates were calculated taking into account worst-case assumptions.

- Receptor locations - a Cartesian Grid was included in the model in order to calculate maximum predicted concentrations throughout the assessment extents. Receptor points were also included at sensitive locations to provide additional consideration of these areas.

- 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 odour concentrations.

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

4. ASSESSMENT OF ODOUR IMPACT

4.1. Introduction

Predicted ground level concentrations of odour as the maximum off-site and at sensitive receptors has been provided. For each receptor, these are the maximum predicted for the five years of meteorological data and represent worst-case conditions.

4.2. Upper Design Concentration

Predicted ground level odour concentrations as the 98th percentile of hourly means for the units is presented in Table 4.1.

Table 4.1: Predicted Odour Concentration as the 98th Percentile of Hourly Means – Upper Design Concentration			
ID	Receptor	Type	Odour (ou_E/m^3)
Maximum predicted			55.9
D1	Scotswood Road	Residential	0.6
D2	Whitfield Road	Residential	2.5
D3	Woodstock Road	Residential	1.3
D4	Surgery/Day Nursery	Business	1.2
D5	Delaval Road	Residential	0.9
D6	Hodgekin Park Road	Residential	0.8
D7	South Benwell Road	Residential	0.8
D8	Keel Row	Business	2.2
D9	Travelodge	Hotel	6.2
D10	Premier Inn	Hotel	9.3
D11	Allotments	Leisure	2.9
D12	The Copse	Residential	2.3
D13	Leisure Centre	Leisure	3.2
D14	Shibdon Road	Residential	0.7
D15	Shibdon Park	Residential	0.7

Maximum predicted concentrations occur at the boundary of the site at 55.9 ou_E/m^3 as the 98th percentile of hourly means. However, the site is quite remote from sensitive receptor locations and there would be

no exposure at this location. At sensitive receptor locations, highest concentrations occur for the two hotel receptors (D9 and D10) where the highest concentration is 9.3 ou_E/m^3 a factor of around three above the odour benchmark of 3.0 ou_E/m^3. However, at all residential properties, the predicted odour concentration is less than the odour benchmark with highest residential exposure at 2.5 ou_E/m^3 (D2). Therefore, it is concluded that the odour control unit emissions may give rise to off-site odour at some receptors but not at residential receptors.

4.3. Derived Odour Emission Concentration

To achieve 3.0 ou_E/m^3 at sensitive receptors, the emission concentration for all units would need to be reduced to 968 ou_E/m^3 (i.e. 3,000*3/9.3). Predicted ground level odour concentrations as the 98th percentile of hourly means for this proposed odour emission level is presented in Table 4.2.

Table 4.2: Predicted Odour Concentration as the 98th Percentile of Hourly Means – Proposed Odour Emission Concentration			
ID	Receptor	Type	Odour (ou_E/m^3)
Maximum predicted			18.0
D1	Scotswood Road	Residential	0.2
D2	Whitfield Road	Residential	0.8
D3	Woodstock Road	Residential	0.4
D4	Surgery/Day Nursery	Business	0.4
D5	Delaval Road	Residential	0.3
D6	Hodgekin Park Road	Residential	0.2
D7	South Benwell Road	Residential	0.3
D8	Keel Row	Business	0.7
D9	Travelodge	Hotel	2.0
D10	Premier Inn	Hotel	3.0
D11	Allotments	Leisure	0.9
D12	The Copse	Residential	0.7
D13	Leisure Centre	Leisure	1.0
D14	Shibdon Road	Residential	0.2
D15	Shibdon Park	Residential	0.2

Maximum predicted concentrations are 18.0 ou_E/m^3 as the 98th percentile of hourly means and at sensitive receptors predicted odour concentrations are 3.0 ou_E/m^3 or less. At residential receptors, the highest exposure is 0.8 ou_E/m^3, well below the odour benchmark. At D10 (Premier Inn), predicted concentrations are at the odour benchmark level but this is for the worst-case meteorological year and assumes the units operate continuously. For the five years of meteorological data, predicted concentrations at this receptor vary between 1.9 and 3.0 ou_E/m^3 with a mean of 2.4 ou_E/m^3 as the 98th percentile of hourly means.

A contour plot of the 98th percentile of hourly means for the odour control unit emissions is presented in Figure 4.1. Results are presented for the 2016 meteorological year which gives rise to the highest off-site concentration and highest sensitive receptor concentration. The 1.5, 3.0 and 6.0 ou_E/m^3 contours are highlighted in red.
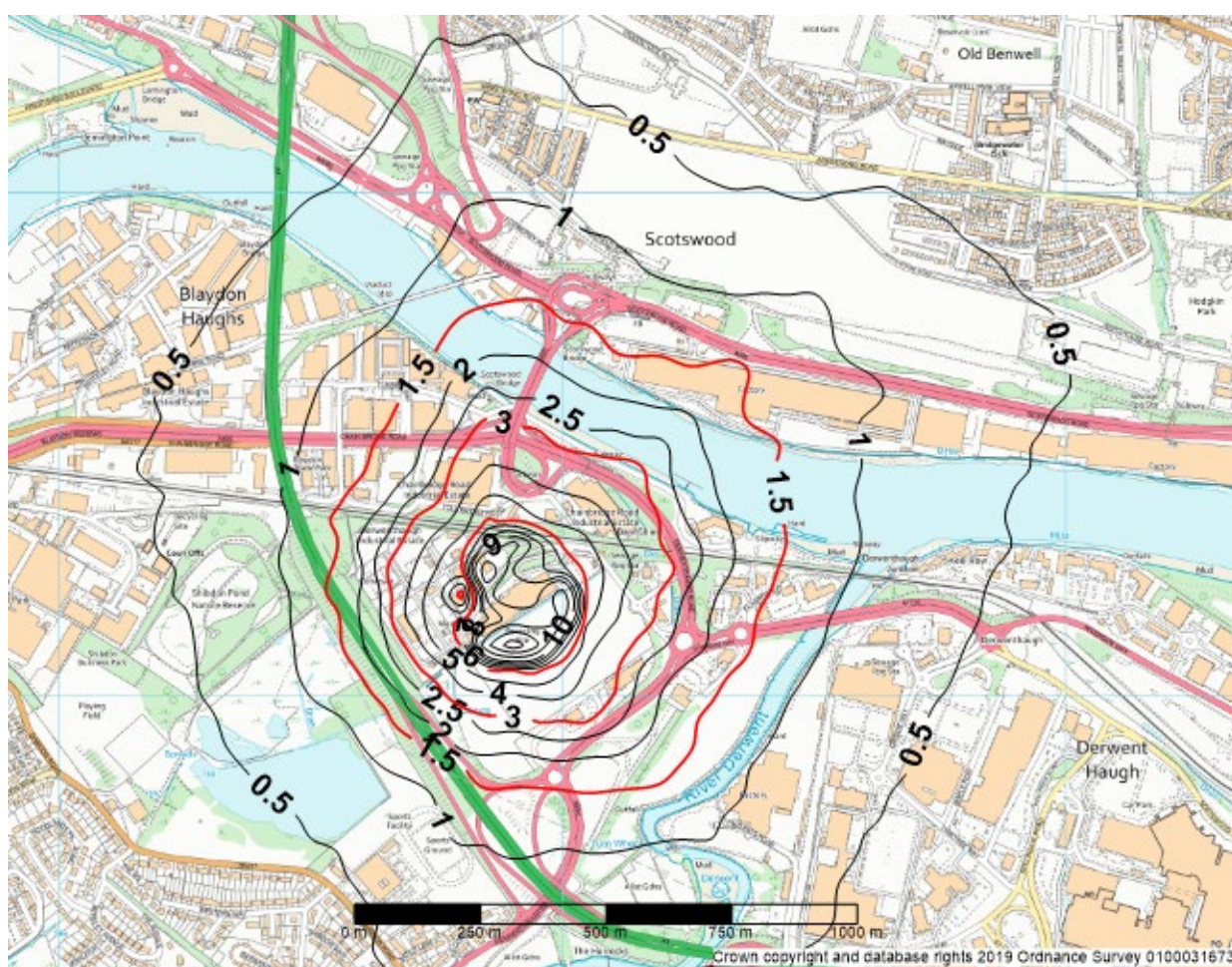

Figure 4.1: 99.8th Percentile of Hourly Mean Odour Concentrations for the Proposed Odour Emission Level (ou_E/m^3)

5. CONCLUSIONS

An Odour Impact Assessment has been provided to support a permit variation application for a waste treatment facility located at the Derwenthaugh Industrial Estate in Blaydon, Gateshead to the southwest of Newcastle Upon Tyne. The site is currently permitted EPR/KB3939RR to process 320,000 tonnes per annum of non-hazardous waste. The permit is for the treatment of waste though autoclaves along with two pyrolysis units, four gas engines and a Materials Recycling Facility (MRF). The assessment is to support the permit variation application for the installation. The permit variation is to change the type and quantity of waste treated and the application is for 100,000 tonnes per annum of clinical and other wastes for sterilisation through the autoclaves, two pyrolysis units, nine associated gas engines and a drier.

Odour emissions from the five Simdean odour control units have the potential to cause impacts at sensitive receptors. An Odour Impact Assessment was therefore undertaken to consider effects in the vicinity of the proposed facility and to derive an odour emission level for the odour control units.

On the basis of the combined emissions from the five odour control units, an emission concentration for these of 1,000 ou_E/m^3 is recommended (rounded up from 968 ou_E/m^3). This would result in predicted odour concentrations at or below the odour benchmark of 3.0 ou_E/m^3 at all sensitive receptors and at residential receptors less than 0.8 ou_E/m^3 as the 98th percentile of hourly means.

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Appendix A – Air Quality and Odour Terminology

Term	Definition
Accuracy	A measure of how well a set of data fits the true value.
Air quality objective	Policy target generally expressed as a maximum ambient concentration to be achieved, either without exception or with a permitted number of exceedances within a specific timescale (see also air quality standard).
Air quality standard	The concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. The standards are based on the assessment of the effects of each pollutant on human health including the effects on sensitive sub groups (see also air quality objective).
Ambient air	Outdoor air in the troposphere, excluding workplace air.
Annual mean	The average (mean) of the concentrations measured for each pollutant for one year. Usually this is for a calendar year, but some species are reported for the period April to March, known as a pollution year. This period avoids splitting winter season between 2 years, which is useful for pollutants that have higher concentrations during the winter months.
AQMA	Air Quality Management Area.
Defra	Department for Environment, Food and Rural Affairs.
Exceedance	A period of time where the concentrations of a pollutant is greater than, or equal to, the appropriate air quality standard.
Fugitive emissions	Emissions arising from the passage of vehicles that do not arise from the exhaust system.
LAQM	Local Air Quality Management.
NO	Nitrogen monoxide, a.k.a. nitric oxide.
NO_2	Nitrogen dioxide.
NO_x	Nitrogen oxides.
O_3	Ozone.
ou_E/m^3	European odour concentration
Percentile	The percentage of results below a given value.
PM_{10}	Particulate matter with an aerodynamic diameter of less than 10 micrometres.
ppb parts per billion	The concentration of a pollutant in the air in terms of volume ratio. A concentration of 1 ppb means that for every billion (10^9) units of air, there is one unit of pollutant present.
ppm parts per million	The concentration of a pollutant in the air in terms of volume ratio. A concentration of 1 ppm means that for every billion (10^6) units of air, there is one unit of pollutant present.
Ratification (Monitoring)	Involves a critical review of all information relating to a data set, in order to amend or reject the data. When the data have been ratified they represent the final data to be used (see also validation).
$\mu g/m^3$ micrograms per cubic metre	A measure of concentration in terms of mass per unit volume. A concentration of 1ug/m3 means that one cubic metre of air contains one microgram (millionth of a gram) of pollutant.
UKAS	United Kingdom Accreditation Service.
Uncertainty	A measure, associated with the result of a measurement, which characterizes the range of values within which the true value is expected to lie. Uncertainty is usually expressed as the range within which the true value is expected to lie with a 95% probability, where standard statistical and other procedures have been used to evaluate this figure. Uncertainty is more clearly defined than the closely related parameter 'accuracy', and has replaced it on recent European legislation.
USA	Updating and Screening Assessment.

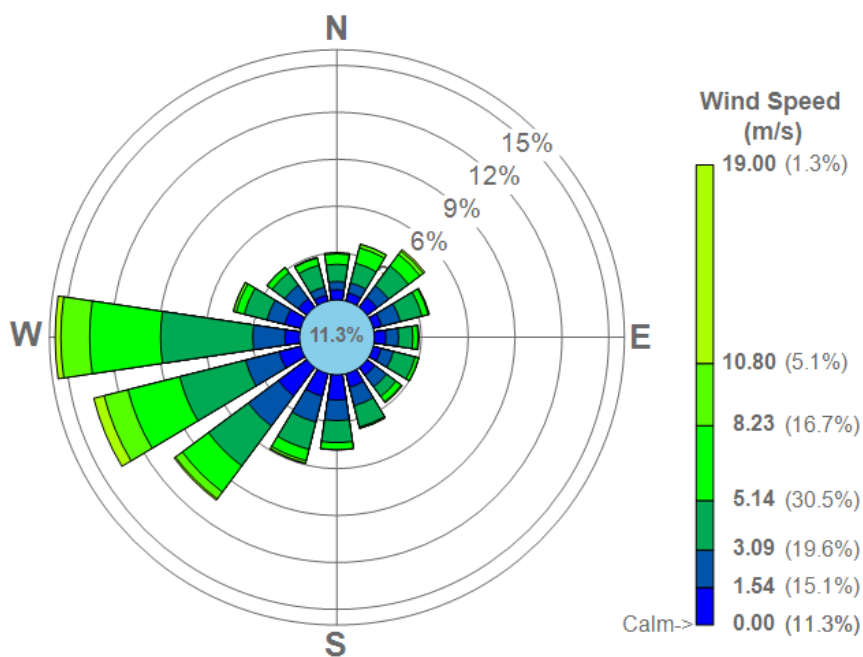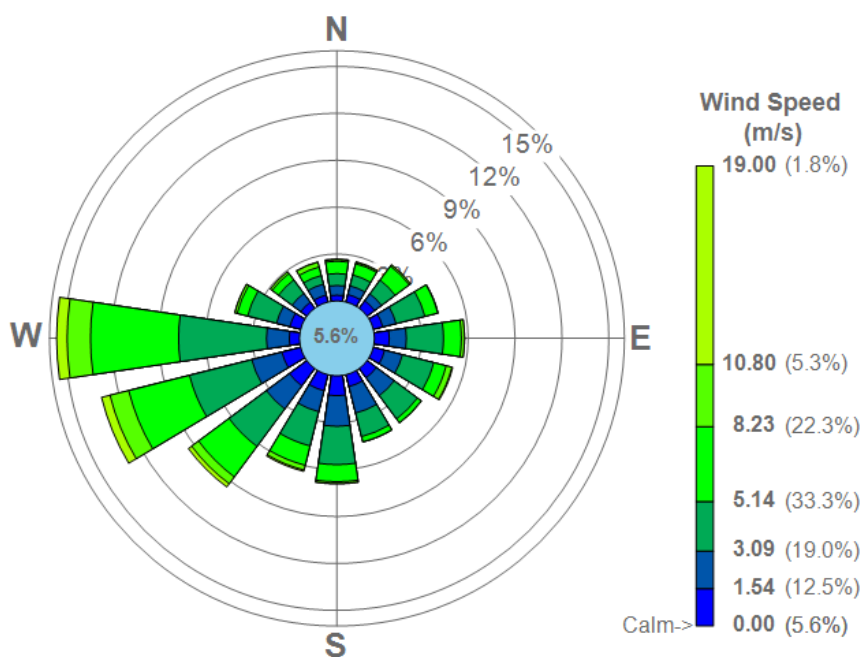| Term	Definition
Validation (modelling)	Refers to the general comparison of modelled results against monitoring data carried out by model developers.
Validation (monitoring)	Screening monitoring data by visual examination to check for spurious and unusual measurements (see also ratification).
Verification (modelling)	Comparison of modelled results versus any local monitoring data at relevant locations.

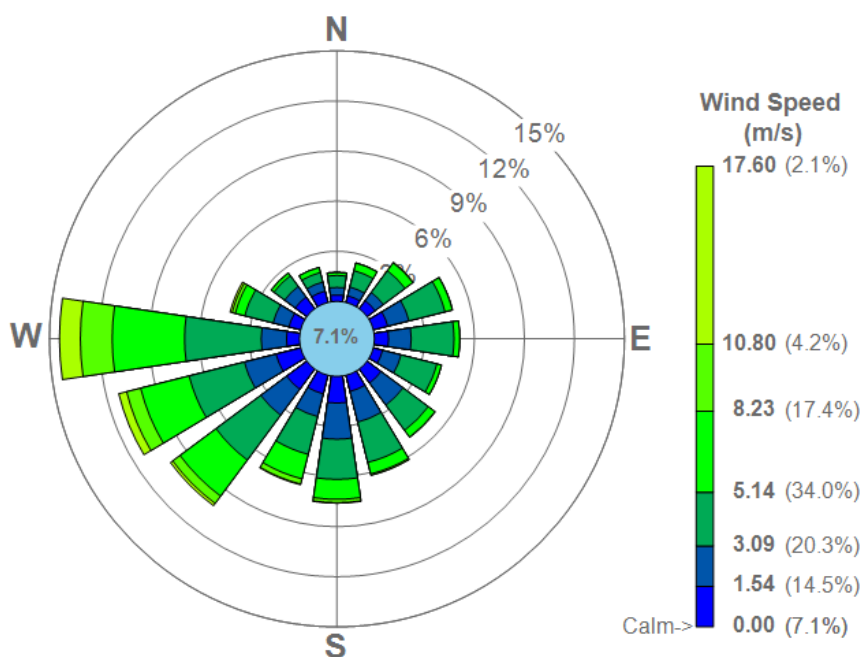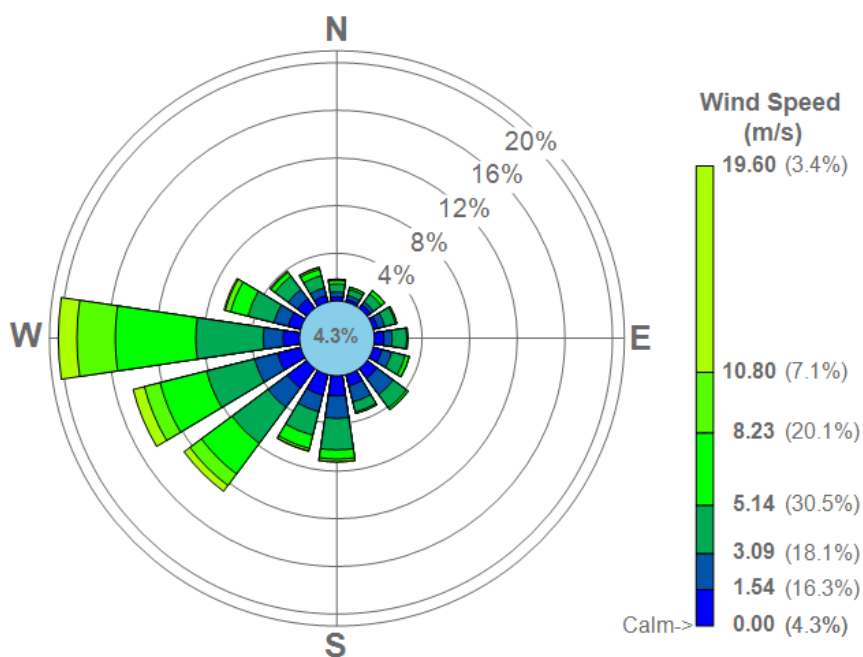## Appendix B – Wind Roses

Figure B1: 2012
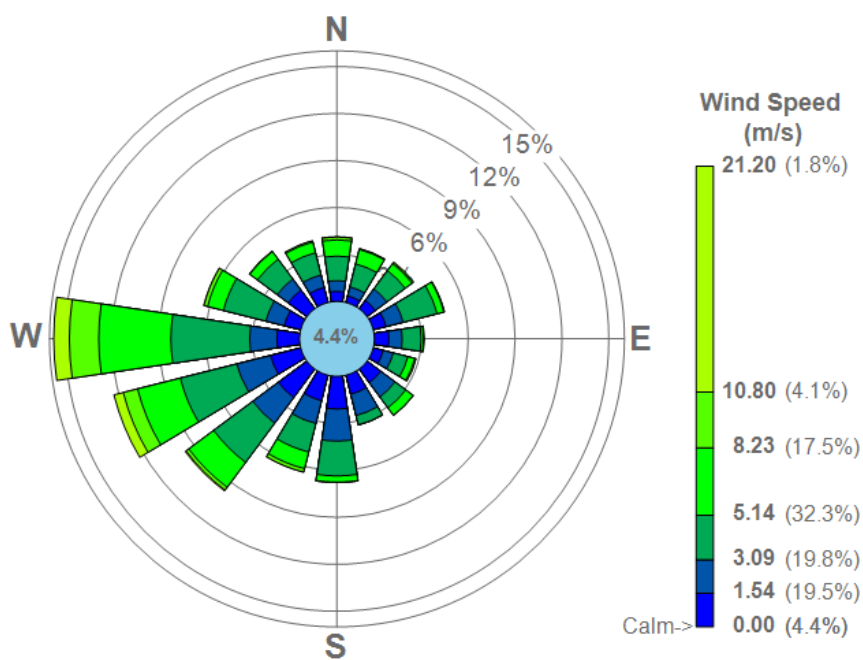

Figure B2: 2013

Figure B3: 2014

Figure B4: 2015

Figure B5: 2016