National Consultancy, Locally Delivered

ODOUR MANAGEMENT PLAN
DEESIDE PACKAGING COATINGS

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REPORT PREPARED FOR: VALSPAR CORPORATION (UK) LTD

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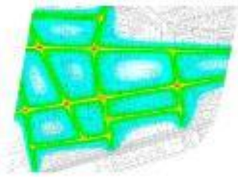

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1.0 INTRODUCTION

1.1 Background

Resource and Environmental Consultants (REC) Ltd was commissioned by Valspar Corporation (UK) Ltd to produce an Odour Management Plan (OMP) to control potential impacts associated with atmospheric emissions from the Deeside Packaging Coatings facility. This was in response to correspondence with the Environment Agency (EA), who regulate the plant under Environmental Permit reference BU7545IM.

The purpose of this OMP is to:

- Identify potential odour sources associated with the facility;
- Undertake a risk assessment to determine the most significant potential odour releases;
- Set out the procedures followed at the plant in order to prevent or minimise odour emissions; and,
- Formalise the procedures for dealing with any odour complaints.

In accordance with EA guidance H4: Odour Management , this OMP has been designed to:

- Employ appropriate methods, including monitoring and contingencies, to control and minimise odour pollution;
- Prevent unacceptable odour pollution at all times; and,
- Reduce the risk of odour releasing incidents or accidents by anticipating them and planning accordingly.

This OMP has considered sources, releases and impacts, and used these to identify opportunities for odour management.

1.2 Site Location and Context

The Deeside facility is located off Parkway, on the Deeside Industrial Park, Deeside, CH5 2NN, at National Grid Reference (NGR): 332860, 371030. Reference should be made to Figure 1 for a map of the site and surrounding area.

The installation manufactures resins and paints for coating applications. Currently the operations can be divided into two distinct activities which are undertaken in the resin plant and paint plant, respectively. These include the manufacturing processes, packaging, raw material storage, product storage and waste storage. Reference should be made to Figure 2 for a site layout plan showing the broad areas within the facility boundary.

The operation of the plant may result in odour emissions from a number of activities. These have the potential to cause adverse effects at sensitive locations within the vicinity of the site. As such, the risk of significant impact has been considered and suitable control measures to ensure effects are controlled have been formalised within this OMP.

1.3 Limitations

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

2.0 PROCESS DESCRIPTION

The Valspar manufacturing process is briefly summarised in the following Sections.

2.1 Resin Plant

Valspar produce a range of resins on a batch basis in one 12te reactor. The resin plant is operated primarily to manufacture acrylated epoxy emulsions for the adjacent paint plant, where they are converted into lacquers for the beer, beverage and food can manufacturing industries.

The reactor is also capable of producing polyester resins for in-house usage in some lacquers.

The resin plant can produce 17,500 tonnes per annum of acrylated epoxy at full capacity and is operated continuously, 24-hours per day.

Bulk raw materials and solvents are stored in a series of bunded tanks (mainly 40te capacity) located in the Tank Farm. The bulk 40te ethyl acrylate tank is located in the resin plant and vents via a scrubber system and associated emission point A3. All other tanks are freely vented to atmosphere and all have their own tanker offloading/delivery transfer pump sited outside the main bund in a smaller bunded area.

All tanks in the Tank Farm are at atmospheric pressure. Two tanks for warm epoxy storage are maintained at elevated temperatures in the region of 60-70˚C.

The resin plant consists of three weigh tanks positioned on an upper gantry:

- An epoxy weigh tank of 6,700ltrs freely vented;
- A DMEA tank of 2,500ltrs vented to the ethyl acrylate scrubber system; and,
- A monomer weigh tank of 3,700ltrs vented to the ethyl acrylate scrubber system.

Three reducing tanks (TKs) are used for the inversion step and letdown. Product from the reactor is fed into these tanks. These tanks consist of two $30m^3$ and one of $40m^3$ and are positioned on the ground floor. They are all vented through the ethyl acrylate scrubber system and associated emission point A3.

The reactor, a 12te pressure / vacuum vessel, is situated on the first floor of the building and is furnished with a fractionation column and a shell and tube condenser. Normal operating conditions vary, with temperatures up to 190˚C. Typical batch times range between 15 and 22-hours depending on the product. The reactor is nitrogen blanketed. Vapours vented from the fractionation column and condenser pass through an ethyl acrylate scrubber system and associated emission point A1.

Two filter systems for filtering the product are used on the ground floor with associated housing transfer pumps. These vent through emission point A2.

Build-up of insoluble debris on the reactor walls is removed approximately every 2 to 3-months as it interferes with temperature transfer. Pelargonic (nonanoic) acid held in bulk is pumped into the reactor and heated for 6 to 8-hours under reflux. The acid is then cooled and returned to bulk. The acid eventually becomes depleted and is replaced every 2 to 3-years.

The types of resin produced at the facility are outlined in the following Sections.

2.1.1 Acrylated Epoxy Resin

The acrylated epoxy resin process is carried out in two stages, a batch reaction followed by thinning of the resin with water in the reducing tank.

The acrylated epoxy resins are produced by initially advancing epoxy resin in the reactor. In this first stage of the production epoxy resin is charged to the reactor from bulk storage. The resin reacts additively with a phenylol alkane (bisphenol A) and acrylic monomers resulting in an epoxy resin. Styrene, carboxylate and phosphonium catalyst are also added at elevated temperature.

The reaction mixture is then diluted in a second stage by the addition of amine and hot water. This addition of hot water to the resulting resin in the reducing tank reduces the viscosity and solids concentration to the required specification.

Finished resin is filtered to either drum, intermediate bulk container (IBC) or bulk storage tanks.

2.1.2 Polyester Resin

The polyester resin production process is also carried out in two stages, a batch reaction followed by thinning with organic solvents.

The preparation of the resin is by esterification of an organic acid with a glycol and, since the reaction is reversible, water is removed as it is formed using a number of methods including high temperature, nitrogen sparge, agitation and vacuum.

Finished resin is filtered into drums.

There are no reaction by-products/wastes from these reactions other than filtration bags, which are thoroughly drained of liquor and disposed of through approved waste contractors. Drainings are returned to plant or disposed of through approved contractors.

The resin reactor is solvent washed once all product has been transferred. The technical department have completed work to enable the solvent wash to be used in subsequent batches.

2.2 Paint Plant

In the paint plant resins produced in the resin plant are used to produce a variety of different coatings.

Resins are stored in bulk storage vessels (ST1/ST2 – internal – 40te, ST3/4 – external – 80/96te) or IBCs.

Other raw materials are stored in bulk storage in the Tank Farm or in IBCs, drums or bags depending on the ingredient.

There are 17 mixing vessels in the paint plant ranging in capacity from 6 to 40te. There are 4 high-speed shear mixing tanks for dispersion and 13 blending tanks. All tanks are vented to emission point A5 without abatement. All tanks are nitrogen blanketed. The general workplace is ventilated by a Local Exhaust Ventilation (LEV) system.

There is also a small manufacturing area containing a range of pots with capacity varying between 200kg and 2,000kg for small batch sizes of various products.

Ingredients are mixed as necessary in the mixing vessels and pots to produce the required products. All processes are carried out at atmospheric pressure and at ambient temperature although heat input from high-speed mixers can raise the temperature of some batches to approximately 50˚C.

The contents of the mixing vessels/pots are then:

- Fed directly into a blend tank from where they are adjusted to specification (viscosity/solids) by adding solvent/water as necessary and then filtered and packaged; or,
- Fed from the high-speed mix vessel through a grinder/mill to reduce the particle size into a letdown tank (blending vessel) from where they are adjusted to specification (viscosity/solids) by adding solvent/water as necessary and then filtered and packaged.

The duration of individual batches varies between 0.5 and 58-hours depending on the product, the number of ingredients to be added and the number of mixing steps required.

The number of blending vessels in operation at any time is variable with typically 6 batches on the go at any one time.

The paint plant operates continuously, 24-hours per day.

3.0 METHODOLOGY

3.1 Overview

The OMP follows and addresses the various activities which have the potential to create odour. The following steps were undertaken in order to produce the OMP:

- Identification of odour sources;
- Consideration of site location, prevailing meteorology and sensitive locations potentially affected by odour emissions;
- Identification of odour mitigation measures;
- Risk assessment of potential issues and identification of control measures as necessary;
- Production of odour monitoring procedure;
- Production of complaints handling procedure; and,
- Production of OMP modification procedure.

The Risk Assessment has been undertaken in accordance with the general principles of EA document 'Horizontal Guidance Note H1: Environmental Risk Assessment for Permits' and associated annexes. This included consideration of the following:

- Receptor - what is at risk? What do I wish to protect?
- Source - what is the agent or process with potential to cause harm?
- Harm - what are the harmful consequences if things go wrong?
- Pathway - how might the receptor come into contact with the source?
- Probability of exposure - how likely is this contact?
- Consequence - how severe will the consequences be if this occurs?
- Magnitude of risk - what is the overall magnitude of the risk? and,
- Justification for magnitude - on what did I base my judgement?

Based on the Risk Assessment outcomes potential mitigation and control options were identified.

Further explanation for the key assessment areas is provided below.

3.2 Receptor

The first step was to consider how the activity could harm the environment. This involved identifying 'receptors' that may be affected and included people, property, and the natural and physical environment.

3.3 Probability of Exposure

The probability of exposure was defined based on the likelihood of exposure of the specific receptor to the identified source. This depended on several factors, such as:

- Distance between source and receptor;
- Dispersion potential of emission;
- Duration of emission; and,
- Frequency of emission.

3.4 Harm

The severity of harm from a risk depends on:

- How much a person or part of the environment is exposed; and,
- How sensitive a person or part of the environment is.

Some parts of the environment can be very sensitive. For example, serious health effects can occur if humans are exposed to certain chemicals for only short periods of time.

3.5 Magnitude of Risk

The level of risk is a combination of:

- How likely a problem is to occur; and,
- How serious the harm might be.

Risk is highest where both the likelihood of a problem is high and the potential harm is severe. Risk is lowest where a problem is unlikely to occur and the harm that might result is not serious. The magnitude of risk has been categorised as follows in the risk assessment:

- High;
- Medium;
- Low; and,
- Negligible.

4.0 RISK ASSESSMENT

The assessment of potential risk associated with odour emissions from the facility is presented in the following Sections.

4.1 Sources

There are a number of potential odour sources at the facility. These were identified through a number of site walkovers and discussions with representatives from the engineering department. Sources were subsequently categorised into point or fugitive, dependant on their type.

Reference should be made to Figure 3 for a map of the relevant emission points.

4.1.1 Point Sources

The following potential point sources of odour emissions were identified:

- Emission point A1 - resin plant reactor scrubber;
- Emission point A2 - resin plant reactor dust filter;
- Emission point A3 - resin plant ethyl acrylate scrubber;
- Emission point A5 - paint plant vessels; and,
- Paint plant local exhaust ventilation system (LEV).

Emission point A5 serves the paint plant reaction vessels, whilst the LEV system releases fugitive emissions from the paint plant area.

Quarterly monitoring of Volatile Organic Compound (VOC) emissions from emission points A1, A2, A3 and A5 is undertaken to show compliance with the relevant Emission Limit Values (ELVs) included within the site's Environmental Permit. A summary of 2013 monitoring results is provided in Table 1.

Table 1 Monitoring Results

Emission Point	Total VOC Concentration (mg/m^3)				Ethyl Acrylate Concentration (mg/m^3)				Methyl Acrylate Concentration (mg/m^3)			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
A1	560	1,639	0	570	3.4	4.4	1.1	0.6	3.4	4.4	0.4	0.6
A2	3	4	12,703	8	3.4	4.6	3.9	0.7	3.4	4.6	3.2	0.6
A3	494	185	355	36	3.2	80.2	0.4	12.3	3.2	1.9	0.4	0.7
A5	1,304	2,039	8,329	2,911	3.5	7.4	3.8	1.0	3.5	7.4	3.8	1.0

It should be noted that concentrations less than the limit of detection have not been specifically identified.

As shown in Table 1, VOC emissions are variable from the relevant emission points, with the exception of A5, which is consistently high. The inconsistency in results would be expected due to the batch nature of the process and the various stages in the manufacturing activities. Concentrations of ethyl acrylate and methyl acrylate were generally low, though a few elevated levels were recorded, particularly for A3. The results indicate that in general, the VOC emissions consist mainly of species other than ethyl acrylate and methyl acrylate i.e. other solvents used in the process.

4.1.2 Fugitive Sources

The following potential fugitive sources of odour emissions were identified:

- Tank Farm / bulk storage tanks;
- Pelargonic acid tank;
- Facility buildings;
- Waste / empty container storage;
- Tanker fill points; and,
- Spillages.

It is noted that the Tank Farm release vents displace solvents associated with breathing losses without abatement.

Noticeable odour levels are present within the facility during the various site walkovers, particularly in the resin plant. There are a number of vents on the buildings to provide ventilation which will also allow release of any contained odourous substances.

During the site walkovers elevated odour levels were not identified in close proximity to any of the fugitive sources listed above. This is in accordance with general site observations from Valspar representatives which do not indicate a base level of odour at any specific location.

4.2 Materials

There are a number of odourous materials used on site. The most significant are summarised in Table 2.

Table 2 Materials

Material	Use	Odour Description	Odour Threshold Value (µg/m^3)
Ethyl acrylate	Resin manufacture	Hot plastic, earthy	45
Methyl acrylate	Resin manufacture	Sharp, fruity, acrid	64
Styrene	Solvent	Penetrating, rubbery, plastic	70 / 160
Toluene	Solvent	Floral, pungent, moth balls	1,000
Butanol	Solvent	-	90
2-Butanone (MEK)	Solvent	-	870

Material	Use	Odour Description	Odour Threshold Value ($\mu g/m^3$)
Xylene	Solvent	Aromatic, sweet	78
Pelargonic acid	Reactor cleaning	Rancid	20
Acrylic acid	-	Acrid	1.3
Methacrylic acid	-	Acrid	200

The materials with the lowest odour detection threshold values used on site are ethyl acrylate and methyl acrylate, as well as acrylic acid. These are also considered to be the most offensive. Subsequently efforts have traditionally focussed on controlling emissions of these substances during the manufacturing process. However, a number of solvents also have relatively low detection thresholds and distinctive odour characteristics.

4.3 Receptors

The facility is located on the Deeside industrial estate. A desk-top study was undertaken in order to identify sensitive receptor that may be affected by odour emissions from the site. These are summarised in Table 3.

Table 3 Receptors

Receptor		Receptor Type	NGR (m)		Distance from Facility Boundary (m)	Direction from Facility
			X	Y		
R1	Iceland (car park / smoking area)	Place of work	332786	371123	15	North-west
R2	Iceland (offices)	Place of work	332710	371242	150	North-west
R3	BP Garage and Shop	Commercial	332976	371084	22	North-east
R4	Road Range Mercedes	Garage	332722	370979	29	South-west
R5	Industrial unit	Place of work	332869	371180	35	North-west
R6	Henrob Joinery	Place of work	332826	370899	30	South-west
R7	SMS Precision Engineers	Place of work	332960	370915	57	South-east
R8	Industrial unit	Place of work	333015	370986	50	South-east

Reference should be made to Figure 4 for a graphical representation of sensitive receptor locations. During the site walkovers an informal smoking area for Iceland employees was noted adjacent to the south of the car park boundary. Due to the proximity of this location to the facility boundary, as well as the visual setting of the installation at this position (i.e. industrial facility with prominent tanks and other storage areas), it was included as a specific receptor within the assessment.

Although the facility is situated in a predominantly light industrial/commercial area, there are a number of receptors situated in all directions a relatively short distance from the boundary. Due to the nature of the land use there is likely to be people present at these locations during weekday and weekend time periods. The potential for receptors to be present is greatly reduced during evening and night periods.

It should be noted that the most significant potential odour emission points are situated towards the centre of the site, providing an additional buffer in excess of the distances shown in Table 3. Vegetation and planting is also provided on the north-eastern, south-eastern and south-western boundaries which acts as a visual screen and may affect emission dispersion. Although not reducing odour levels, vegetative screening has been shown to reduce perceived impacts as receptors are mentally separated from the source.

4.4 Meteorological Conditions

The potential for odour to impact at sensitive locations depends significantly on the meteorology, particularly wind direction, during emissions. In order to consider prevailing conditions at the site, review of meteorological data was undertaken. The closest observation station to the facility is Hawarden at NGR: 334586, 364102, which is approximately 7km south-east of the boundary. It is considered that conditions are likely to be reasonably similar over a distance of this magnitude and the information is a suitable source of data for an assessment of this nature.

Meteorological data used in this assessment was taken from Hawarden meteorological station over the period 1st January 2007 to 31st December 2011 (inclusive). The frequency of wind from the sixteen sectors which best describe the directions which may cause impact at the site is shown in Table 4. Reference should be made to Figure 5 for a wind rose of the meteorological data.

Table 4 Wind Frequency Data

Wind Direction (˚)	Total Frequency of Wind (%)
348.75 - 11.25	2.5
11.25 - 33.75	1.2
33.75 - 56.25	1.3
56.25 - 78.75	1.2
78.75 - 101.25	1.6
101.25 - 123.75	2.3
123.75 - 146.25	5.7
146.25 - 168.75	12.2
168.75 - 191.25	11.0
191.25 - 213.75	4.2
213.75 - 236.25	6.1

Wind Direction (˚)	Total Frequency of Wind (%)
236.25 - 258.75	7.6
258.75 - 281.25	9.8
281.25 - 303.75	7.2
303.75 - 326.25	9.2
326.25 - 348.75	6.0
Calms	10.6
Missing/Incomplete	0.3

All meteorological data used in the assessment was provided by Atmospheric Dispersion Modelling Ltd, which is an established distributor of meteorological data within the UK.

As shown in Table 4, the prevailing wind direction at the facility is from the south-east, with significant frequencies from the west and north-west. Winds from the north and east are relatively infrequent, which is indicative of conditions throughout the UK.

4.5 Control Methods

4.5.1 Point Sources

The following abatement methods are employed on site for the control of point source emissions:

- Potassium hydroxide scrubber for emission point A1 (resin plant reactor); and,
- Potassium hydroxide scrubber for emission point A3 (resin plant ethyl acetate scrubber).

The scrubbing system on emission point A1 serves the reactor vessel and weigh tanks.

The scrubbing system on emission point A3 serves the let-down tanks and ethyl acrylate bulk storage tank.

The pH and potassium hydroxide content of the scrubber reagents are tested on a weekly basis. When the relevant values fall below the stated criteria the media is replaced.

Investigations undertaken by the engineering department have identified the parts of the process which are considered to place the highest demands on the scrubber. This indicated the following actions should not be undertaken simultaneously:

- Charging of DMEA Tank (typically down after upgrade determinations for batch manufacture but variance with CM0759B and CM0564A decants);
- Charging of Monos Tank (typically during first spike);
- Solvent reflux (full solvent and midi wash); and,
- Vacuum drying of reactor.

The following improvement actions have also been undertaken following the review:

- Nitrogen pressure at TK press out reduced after 80% discharged, flow switched off. Exit pressure reduced from 8-10 psi to 3-5 psi;
- Reflux return line drained after each batch prior to press out to avoid volatilisation of contained liquid;
- Receiver tank empties on regular basis, limits risk of discharge of vapours during vacuum drying process;
- Limit time of over run of pump during manual charging of monomers (to clear line, but also risk associated displacing monomer vapour in head space);
- Time reduced to a maximum of 5-minutes when blowing back meth acrylic acid line back to tank; and,
- Time reduced to a maximum of 5-minutes when blowing back storage tanks.

The results of the engineering review are considered to have significantly improved historical conditions and reduced the potential for overloading or breakthrough of the scrubbing systems.

Abatement techniques for VOCs are not currently utilised on site.

It is noted that emission points A1, A2 and A3 discharge below eaves level. This can significantly affect dispersion of the released exhaust gases. Emission point A5 is significantly above roof level and is considered to provide good dispersion potential.

4.5.2 Fugitive Sources

The following abatement methods are employed on site for the control of fugitive emissions:

- Ethyl acrylate is received in tankers and transferred into the bulk storage tank via a non-drip connection;
- The ethyl acrylate storage tank is served by a scrubbing system to losses during storage;
- Finished product is slowly bottom filled into tankers over a period of 3 to 4-hours to minimise releases;
- Accidental spills are kept to a minimum through a combination of operator training and procedures which control the handling of materials onsite;
- All operators are required to place lids on containers where solvents are stored (raw materials, finished product and waste) when not in use;
- Drums and IBCs of liquid waste are securely fastened to prevent fugitive emissions during storage;
- Seaweed based product is used for floor cleaning instead of solvent based materials; and,
- At the design stage the number of required valves and flanges are considered so that a conscious effort is made to keep these to the absolute minimum for the required purpose.

4.6 Risk Assessment

The assessment of potential risk of odour impact is shown in Table 5.

Table 5 Risk Assessment

Data and information				Control Measures	Judgement			
Receptor	**Source**	**Harm**	**Pathway**		**Probability of exposure**	**Consequence**	**Magnitude of risk**	**Justification for magnitude**
What is at risk? What do I wish to protect?	**What is the agent or process with potential to cause harm?**	**What are the harmful consequences if things go wrong?**	**How might the receptor come into contact with the source?**		**How likely is this contact?**	**How severe will the consequences be if this occurs?**	**What is the overall magnitude of the risk?**	**On what did I base my judgement?**
Receptors as outlined in Table 3	Ethyl acrylate and methyl acrylate emissions from point sources	Loss of amenity/ nuisance Complaints Low odour threshold value for substance means even small amounts may cause impacts	Airborne emissions	Scrubbing systems on A1 and A2 Process controls to avoid overloading scrubbers Design of process to avoid fugitive releases	Prevailing wind direction from the south-east which would cause most frequent impacts at R1 Receptors often present at R1 due to nature of land use A number of receptors are located in close proximity to the boundary Contact may be likely if emissions are significant and not dispersed effectively	Dependant on concentration at receptor May range from no impact through to complaint	**Medium**	Proximity of receptors, prevailing wind direction, odour threshold value and complaints history Further investigation of risk is recommended

Data and information				Control Measures	Judgement			
Receptor	**Source**	**Harm**	**Pathway**		**Probability of exposure**	**Consequence**	**Magnitude of risk**	**Justification for magnitude**
What is at risk? What do I wish to protect?	**What is the agent or process with potential to cause harm?**	**What are the harmful consequences if things go wrong?**	**How might the receptor come into contact with the source?**		**How likely is this contact?**	**How severe will the consequences be if this occurs?**	**What is the overall magnitude of the risk?**	**On what did I base my judgement?**
Receptors as outlined in Table 3	Solvent emissions from point sources	Loss of amenity/ nuisance Complaints Low odour threshold value for some substances means even small amounts may cause impacts	Airborne emissions	Scrubbing systems on A1 and A2, though not specific to solvent emissions Process controls to avoid overloading scrubbers Design of process to avoid fugitive releases	Prevailing wind direction from the south-east which would cause most frequent impacts at R1 Receptors often present at R1 due to nature of land use A number of receptors are located in close proximity to the boundary Contact may be likely if emissions are significant and not dispersed effectively	Dependant on concentration at receptor May range from no impact through to complaint	**Medium**	Proximity of receptors, prevailing wind direction, odour threshold value and complaints history Further investigation of risk is recommended

Data and information				Control Measures	Judgement			
Receptor	**Source**	**Harm**	**Pathway**		**Probability of exposure**	**Consequence**	**Magnitude of risk**	**Justification for magnitude**
What is at risk? What do I wish to protect?	**What is the agent or process with potential to cause harm?**	**What are the harmful consequences if things go wrong?**	**How might the receptor come into contact with the source?**		**How likely is this contact?**	**How severe will the consequences be if this occurs?**	**What is the overall magnitude of the risk?**	**On what did I base my judgement?**
Receptors as outlined in Table 3	Solvent emissions from Tank Farm	Loss of amenity/ nuisance Complaints Low odour threshold value for some substances means even small amounts may cause impacts	Airborne emissions	None	Prevailing wind direction from the south-east which would cause most frequent impacts at R1 Receptors often present at R1 due to nature of land use A number of receptors are located in close proximity to the boundary Emissions are likely to be low as are only related to breathing losses	Dependant on concentration at receptor May range from no impact through to complaint	**Low**	Proximity of receptors, prevailing wind direction and source magnitude

Data and information				Control Measures	Judgement			
Receptor	**Source**	**Harm**	**Pathway**		**Probability of exposure**	**Consequence**	**Magnitude of risk**	**Justification for magnitude**
What is at risk? What do I wish to protect?	**What is the agent or process with potential to cause harm?**	**What are the harmful consequences if things go wrong?**	**How might the receptor come into contact with the source?**		**How likely is this contact?**	**How severe will the consequences be if this occurs?**	**What is the overall magnitude of the risk?**	**On what did I base my judgement?**
Receptors as outlined in Table 3	Fugitive emissions from facility buildings	Loss of amenity/ nuisance Complaints Low odour threshold value for some substances means even small amounts may cause impacts	Airborne emissions	Automatic roller shutter doors in warehouse Limited number of potential release points i.e. windows and doors	Prevailing wind direction from the south-east which would cause most frequent impacts at R1 Receptors often present at R1 due to nature of land use Emissions are likely to be low as natural ventilation rates are limited and although odour levels are noticeable within buildings, they are not overpowering	Dependant on concentration at receptor May range from no impact through to complaint	**Low**	Proximity of receptors, prevailing wind direction and source magnitude Odours not detected close to facility buildings with highest internal levels

Data and information				Control Measures	Judgement			
Receptor	**Source**	**Harm**	**Pathway**		**Probability of exposure**	**Consequence**	**Magnitude of risk**	**Justification for magnitude**
What is at risk? What do I wish to protect?	**What is the agent or process with potential to cause harm?**	**What are the harmful consequences if things go wrong?**	**How might the receptor come into contact with the source?**		**How likely is this contact?**	**How severe will the consequences be if this occurs?**	**What is the overall magnitude of the risk?**	**On what did I base my judgement?**
Receptors as outlined in Table 3	Pelargonic acid tank	Loss of amenity/ nuisance Complaints Low odour threshold value and offensiveness means even small amounts may cause impacts	Airborne emissions	None	Prevailing wind direction from the south-east which would cause most frequent impacts at R1 Receptors often present at R1 due to nature of land use Material only used every few months during reactor cleaning Tank losses are not likely to be significant due to high boiling point (254˚C)	Dependant on concentration at receptor May range from no impact through to complaint	**Low**	Proximity of receptors, prevailing wind direction, frequency of emission and source magnitude

Data and information				Control Measures	Judgement			
Receptor	**Source**	**Harm**	**Pathway**		**Probability of exposure**	**Consequence**	**Magnitude of risk**	**Justification for magnitude**
What is at risk? What do I wish to protect?	**What is the agent or process with potential to cause harm?**	**What are the harmful consequences if things go wrong?**	**How might the receptor come into contact with the source?**		**How likely is this contact?**	**How severe will the consequences be if this occurs?**	**What is the overall magnitude of the risk?**	**On what did I base my judgement?**
Receptors as outlined in Table 3	Fugitive emissions during material delivery	Loss of amenity/ nuisance Complaints	Airborne emissions Low odour threshold value and offensiveness means even small amounts may cause impacts	Appropriate coupling Back filling of delivery tankers with displaced air Staff training Use of drip trays Immediate cleaning of any spills	Prevailing wind direction from the south-east which would cause most frequent impacts at R1 Receptors often present at R1 due to nature of land use Losses are unlikely to be significant due to back filling techniques	Dependant on concentration at receptor May range from no impact through to complaint	**Negligible**	Proximity of receptors, prevailing wind direction, control measures and source magnitude

4.7 Discussion

4.7.1 Risk Assessment Summary

As indicated in Table 5, the most significant risks are considered to be associated with point source emissions from the plant. The findings of the risk assessment correspond with observations during the site walkover. These include:

- Locations of recorded odour. These were away from obvious sources and most likely linked to dispersion from elevated releases;
- Very low/negligible levels of odour in close proximity to the storage areas. Noticeable levels would be expected if these were a major emission point; and,
- Locations of complaints. These have come from outside the site boundary and again indicate elevated releases with subsequent plume dispersion.

Further investigation of potential impacts associated with point source emissions through dispersion modelling has therefore been undertaken. Reference should be made to Appendix II for full details of the relevant methodology.

4.7.2 Dispersion Modelling Results

Figures 6 to 12 show predicted odour levels as a result of ethyl acrylate, methyl acrylate and VOC as xylene emissions from the facility. Concentrations greater than $1ou_E/m^3$ indicate odours may be detectable at that location. However, an odour at a strength of $1ou_E/m^3$ is in reality so weak that it would not normally be detected outside the controlled environment of an odour laboratory by the majority of people (that is individuals with odour sensitivity in the "normal" range - approximately 96% of the population[1]). 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[2] to provide some context for discussion about exposure to odours:

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

As shown in Figure 6, there are no locations beyond the facility boundary with predicted odour concentrations as a result of ethyl acrylate emissions greater than $1ou_E/m^3$. As such, the modelling results indicate emissions of this species should not be detectable at off-site locations.

As shown in Figure 7, there are no locations beyond the facility boundary with predicted odour concentrations as a result of methyl acrylate emissions greater than $1ou_E/m^3$. As such, the modelling results indicate emissions of this species should not be detectable at off-site locations.

As shown in Figure 8, the maximum odour concentration beyond the facility boundary is approximately $4ou_E/m^3$. This indicates odour as a result of xylene emissions may be detectable at

1 Code of Practice on Odour Nuisance from Sewage Treatment Works, DEFRA, 2006.
2 Odour Guidance for Local Authorities, DEFRA, 2010.

off-site locations during some meteorological conditions. Figures 9 to 11 show odour concentrations from the individual emission points. These indicate that A2 is the only emission point that causes odour concentrations over 1ou_E/m^3 at off-site locations when considered in isolation. The modelling is based on the worst-case monitoring results for 2013. These include the Q3 value for A2 which is significantly than other surveys. The second most significant emission point is A5, which recorded consistently high VOC concentrations during all monitoring exercises.

Based on the dispersion modelling results, emissions of ethyl acrylate and methyl acrylate are considered unlikely to cause significant odour impacts beyond the site boundary. Emissions of VOCs have been identified as the most significant issue, with releases from A2 of most importance.

It should be noted that the dispersion modelling assessment has been undertaken based on a number of assumptions. These can be summarised as follows:

- Emissions are constantly at the maximum recorded during the four emissions monitoring exercises undertaken in 2013;
- VOC emissions consist only of the speciated compounds detailed in the Environmental Permit Application for the facility; and,
- The composition of VOC emissions from all stacks is the same as those detailed in the Environmental Permit Application for the facility.

The exact results should therefore be viewed with caution. However, due to the worst-case nature of the assessment, it is considered the following conclusions can be drawn:

- Emissions of ethyl acrylate and methyl acrylate are unlikely to cause odour impacts and the abatement systems in place for these substances are considered appropriate; and,
- Emissions of VOCs may cause odour impacts during certain meteorological conditions.

4.7.3 Further Works

There are not currently any VOC abatement systems at the facility. The following further works should be considered in order to refine the dispersion modelling and ensure any control measures are effective and provide a level of improvement commensurate with costs:

- VOC monitoring to provide speciated emission profiles for each release point;
- VOC monitoring to define concentrations at different stages of the process to determine changes in release over time;
- Further investigation of emissions from A2 due to the significant variation in monitoring results; and,
- Boundary monitoring over short survey periods to quantify concentrations of various VOCs on site. This could be used with the results of the dispersion modelling assessment to identify which solvents cause odour impacts.

Following completion of the above works and any other measures deemed suitable to reduce VOC emissions it is proposed to revise the dispersion modelling assessment and update the OMP.

5.0 MONITORING

In order to ensure significant odour impacts do not occur as a result of normal operations periodic odour monitoring will be undertaken in accordance with the following methodology.

5.1 Procedure

Sniff testing is a common form of odour monitoring that can be undertaken for relatively low cost with little formal training. While a number of factors need to be taken into account in order to minimise inconsistencies, it can provide good evidence of odour conditions in the vicinity of industrial facilities.

Sniff testing will be undertaken around the facility boundary on a daily basis. This will allow any issues to be quickly identified and will also provide an evidence base of odour emissions for verification of complaints etc.

A sniff test consists of the assessor standing at the monitoring position for a specific period of time and recording any odour experienced at the survey location during this time. Notes on odour frequency, intensity, duration and offensiveness are recorded, as well as the prevailing meteorological conditions. The test is then repeated at a number of monitoring points around the site to determine the extent of odour impact. The results can be analysed in association with operating conditions during the survey in order to consider the most significant odour sources, how these may affect sensitive receptors around the facility and help inform any necessary mitigation.

Ambient sniff testing will be undertaken by the General Manager on a daily basis to determine odour impacts in the vicinity of the site. A walk around the site perimeter will be undertaken and the following parameters scored:

- Odour detectability / intensity;
- Odour extent and persistence;
- Odour offensiveness; and,
- Meteorological conditions.

Categories for the recording of odour intensity and extent are summarised in Table 6.

Table 6 Odour Scoring System

Category	Intensity Description	Extent and Persistence Description
1	No detectable odour	Local & transient (only detected during brief periods when wind drops or blows)
2	Faint odour (barely detectable, need to stand still and inhale facing into the wind)	Transient as above, but detected for approximately 50% of survey period
3	Moderate odour (odour easily detected while breathing normally)	Persistent, detected for approximately 75% of survey period
4	Strong odour	Persistent and pervasive, detected for approximately 90% of survey period

Category	Intensity Description	Extent and Persistence Description
5	Very strong odour (possibly causing nausea)	Persistent and widespread, detected for entire survey period

The offensiveness of any odour will be recorded in accordance with the categories shown in Table 7.

Table 7 Odour Offensiveness Scoring System

Category	Offensiveness Description
1	Potentially offensive
2	Moderately offensive
3	Very offensive

Meteorological conditions during the survey, including wind speed and direction, cloud cover, temperature and precipitation will be noted, as well as assessor name, process conditions, any deliveries received and any specific material being treated at the facility.

The surveys will be undertaken by the same individual as far as practicable to minimise errors when comparing results. Consideration will also be provided to the sensitivity of the assessor, with anyone with a poor sense of smell excluded from monitoring. The person undertaking the assessment will avoid strong food or drinks, including coffee, for at least half an hour before undertaking the survey. Strongly scented toiletries will be avoided. Colds, sinusitis or sore throat can affect the sense of smell. Planned assessments will be re-scheduled if possible or undertaken by someone else, otherwise the fact will be clearly stated on the reporting form.

5.2 Reporting

One survey will be undertaken per day and the results logged using the form provided in Appendix II. It is noted that the assessor may suffer from olfactory fatigue due to constant exposure to odour from the facility. However, it is considered that the information gathered during the survey may still be used to provide an indication of odour impacts within the vicinity of the site.

5.3 Remedial Actions

Should significant impacts be noted then the odour source will be investigated and suitable measures put in place to ensure emissions do not cause adverse effects at any sensitive locations in the vicinity of the site. These may include changes to operational procedures, cessation of activities during designated winds or other appropriate actions deemed necessary by the General Manager.

Any remedial measures will be recorded using the form provided in Appendix III.

It should be noted that the term 'significant' is subjective and will take account of the frequency, duration and offensiveness of the odour as perceived, as well as the sensitivity of the receptor location and the specific activities being undertaken on site during the survey.

6.0 ODOUR COMPLAINT PROCEDURE

Any received odour complaints will be dealt with by the General Manager in the first instance. The complaints procedure will be followed, responding to the event within 24-hours and investigating the incident to determine the nature of the complaint. Where such an investigation identifies an odour issue, remedial action will promptly be implemented. The exact measures will be determined based on the odour source and likelihood of incident reoccurrence.

If a complaint is made, the form included at Appendix III of this OMP will be completed and this will be available for inspection by the appropriate regulator.

Information will normally be collected by visiting the complainant, although in some cases, contact may be made by telephone. After details of the complaint have been compiled, the cause(s) will be investigated, with reference to:

- The activities taking place on the plant during the incident;
- The timing of the complaint and whether weekday, weekend etc;
- The prevailing meteorological conditions;
- Likely reasons for the complaint will be added to the form and the complainant will be contacted as appropriate; and,
- The feasibility of making changes to the activities responsible for the complaint will be considered.

If changes are made, Improvement Programmes will be recorded in the format shown in Appendix III and the OMP will be amended accordingly.

7.0 RECORD KEEPING

7.1 Odour Diary

All sniff testing results and associated reporting forms will be filed within an Odour Diary. This will form a permanent record of odour issues associated with the site and can be used should investigation of complaints or other concerns be necessary. Details of any received complaints and associated remedial actions will also be archived. The Odour Diary will be kept on-site at all times and will be available for inspection by the relevant regulator.

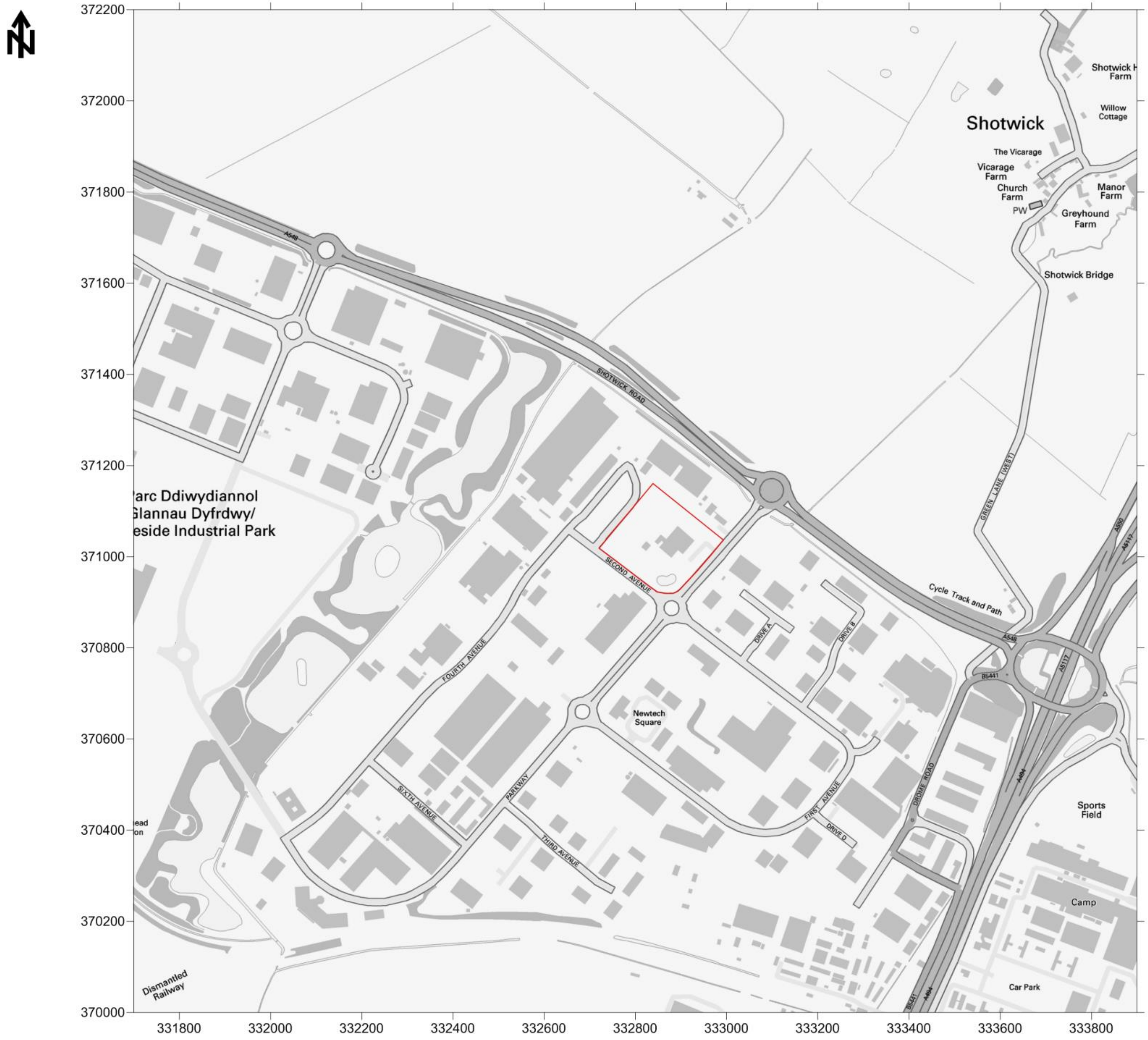
7.2 Odour Plan Review Procedure

The OMP shall be reviewed at least every three years or as soon as practicable after a complaint (whichever is the earlier) and changes recorded in the format shown in Appendix III.

8.0 ABBREVIATIONS

EA	Environment Agency
ELV	Emission Limit Value
IBC	Intermediate bulk container
LEV	Local Exhaust Ventilation
NGR	National Grid Reference
TK	Tank
OMP	Odour Management Plan
REC	Resource and Environmental Consultants
VOC	Volatile Organic Compound

APPENDIX I FIGURES



Legend

Site Boundary

Title

Figure 1

Site Location Plan

Project

Odour Management Plan

Deeside Packaging Coatings

Project Number

34055

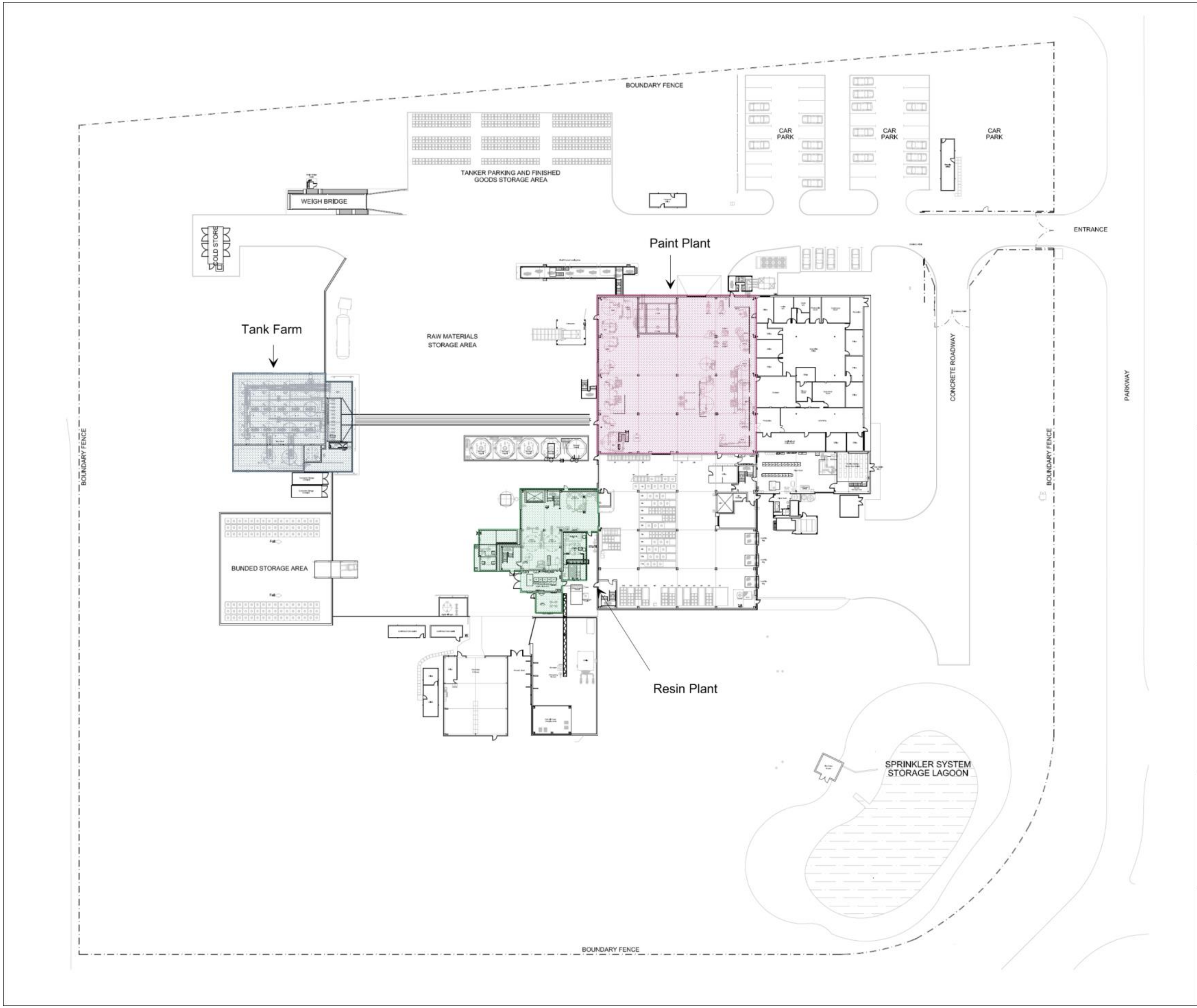
Client

Valspar Corporation (UK) Ltd

REC
Resource & Environmental Consultants Ltd

Resource and Environmental Consultants Ltd
Osprey House, Broadway, Manchester M50 2UE

Tel – 0161 868 1300 Fax – 0161 868 1301
www.recltd.co.uk



Legend

Title

Figure 2
Site Layout Plan

Project

Odour Management Plan
Deeside Packaging Coatings

Project Number

34055

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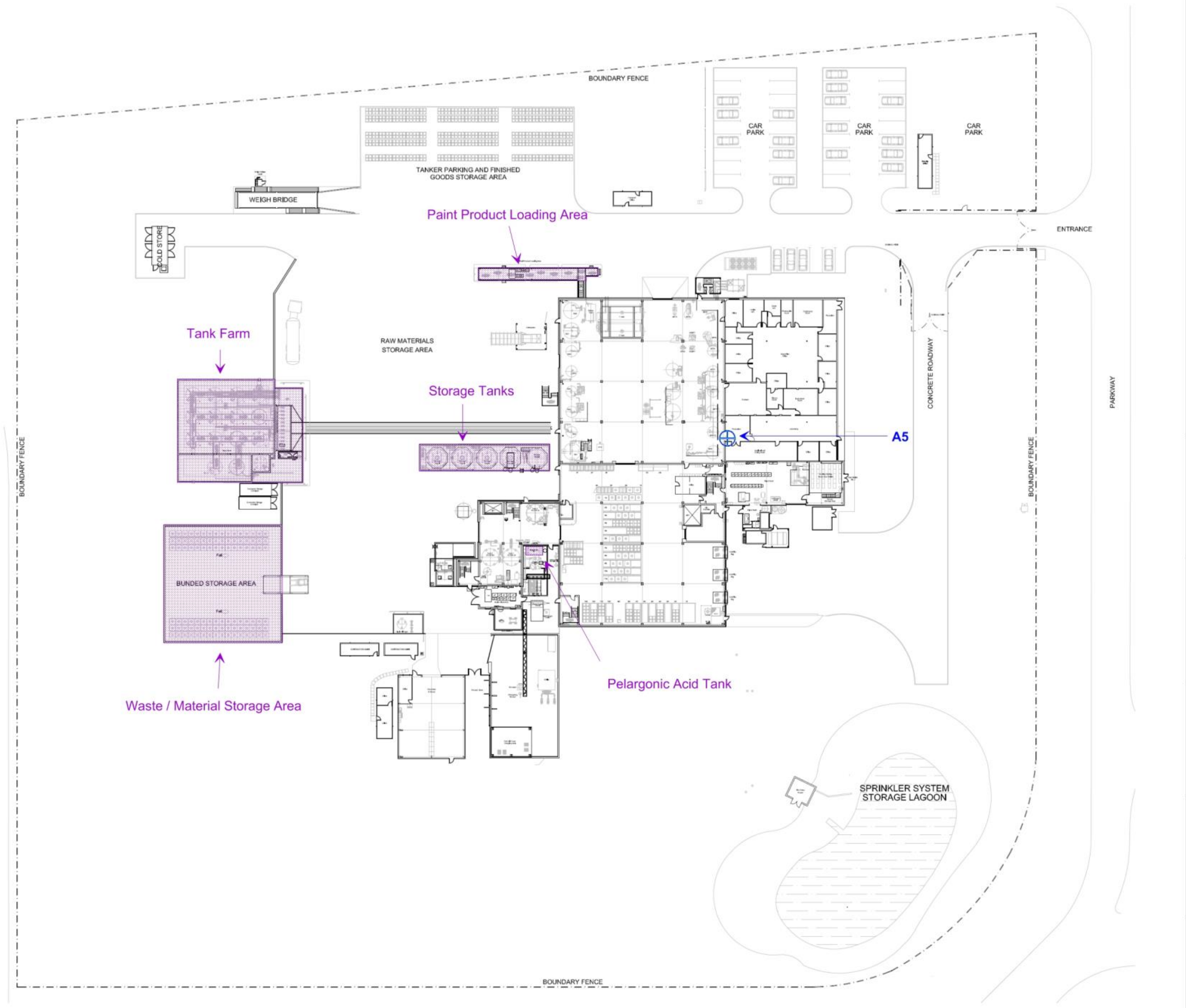

Legend

Point Source

Fugitive Source

Title

Figure 3
Emission Points

Project

Odour Management Plan
Deeside Packaging Coatings

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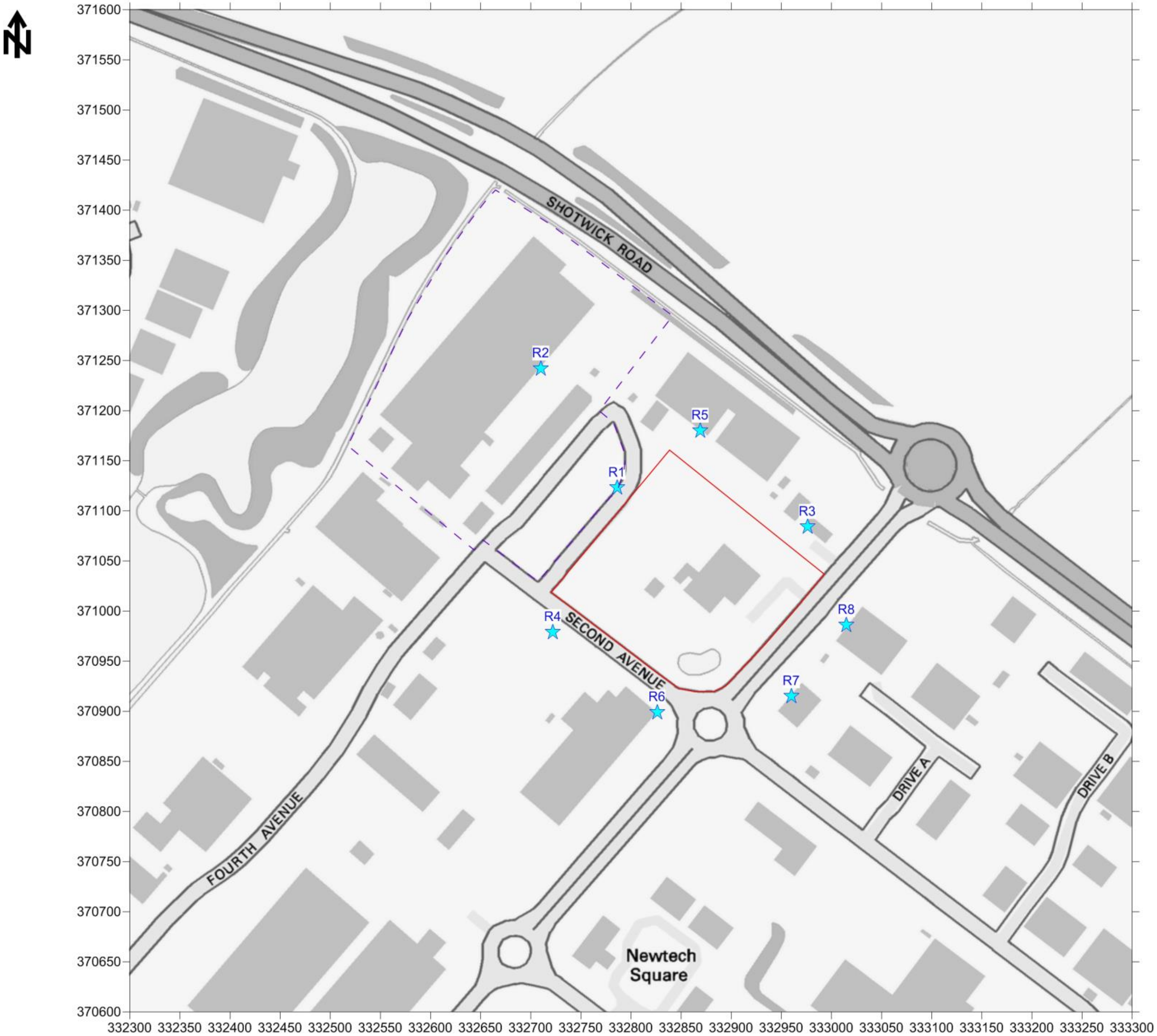

Legend

Site Boundary

Receptor Location

Approximate Iceland Boundary

Title

Figure 4

Sensitive Receptor Locations

Project

Odour Management Plan

Deeside Packaging Coatings

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Legend

Site Boundary

WIND SPEED (m/s)

- >= 11.1
- 8.8 - 11.1
- 5.7 - 8.8
- 3.6 - 5.7
- 2.1 - 3.6
- 0.5 - 2.1

Calms: 10.63%

Title

Figure 5
Wind Rose of Prevailing Conditions at Site

Project

Odour Management Plan
Deeside Packaging Coatings

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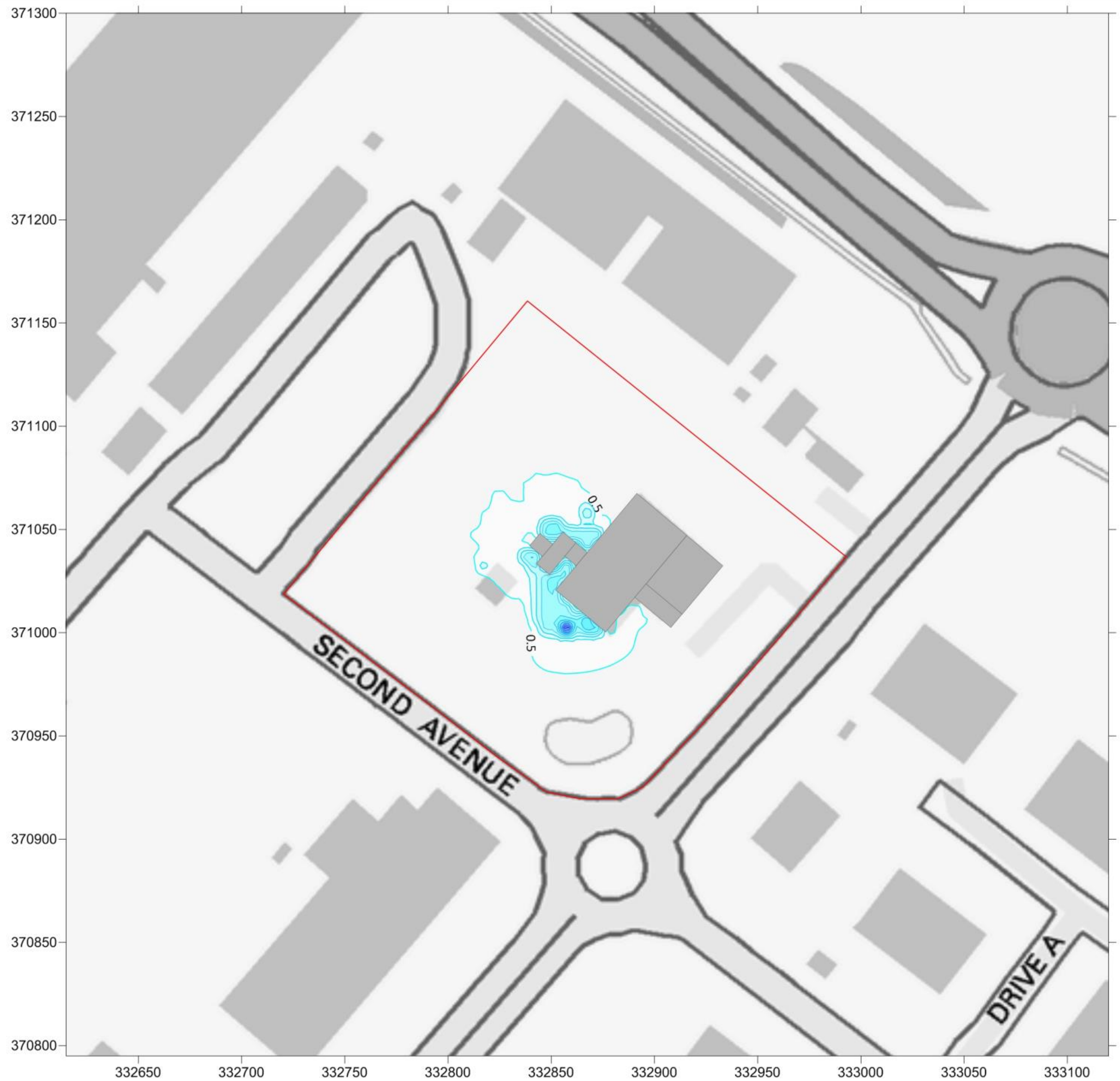

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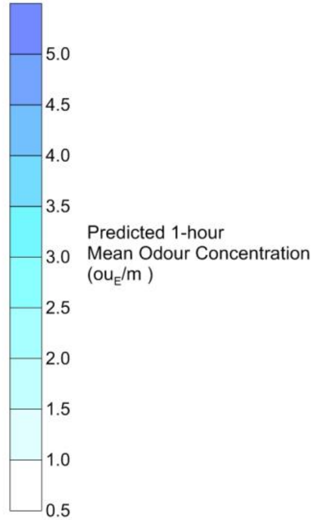

Title

Figure 6
Predicted 1-hour Mean Odour Concentration (ouE/m)
Ethyl Acrylate

Project

Odour Management Plan
Deeside Packaging Coatings

Project Number

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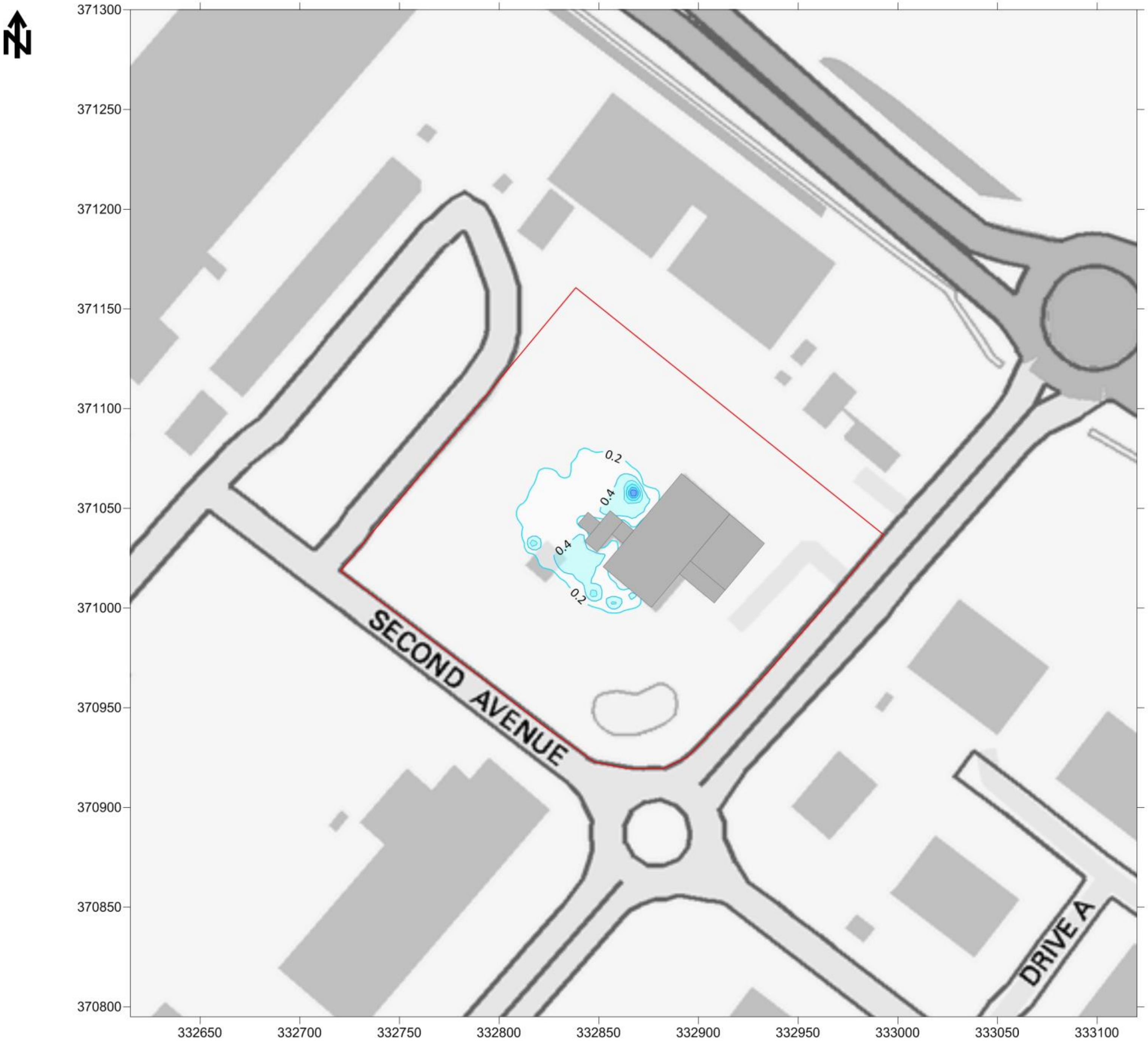

Legend

1.2
1.0
0.8
0.6
0.4
0.2

Predicted 1-hour Mean Odour Concentration (ou_E/m)

Title

Figure 7
Predicted 1-hour Mean Odour Concentration (ouE/m)
Methyl Acrylate

Project

Odour Management Plan
Deeside Packaging Coatings

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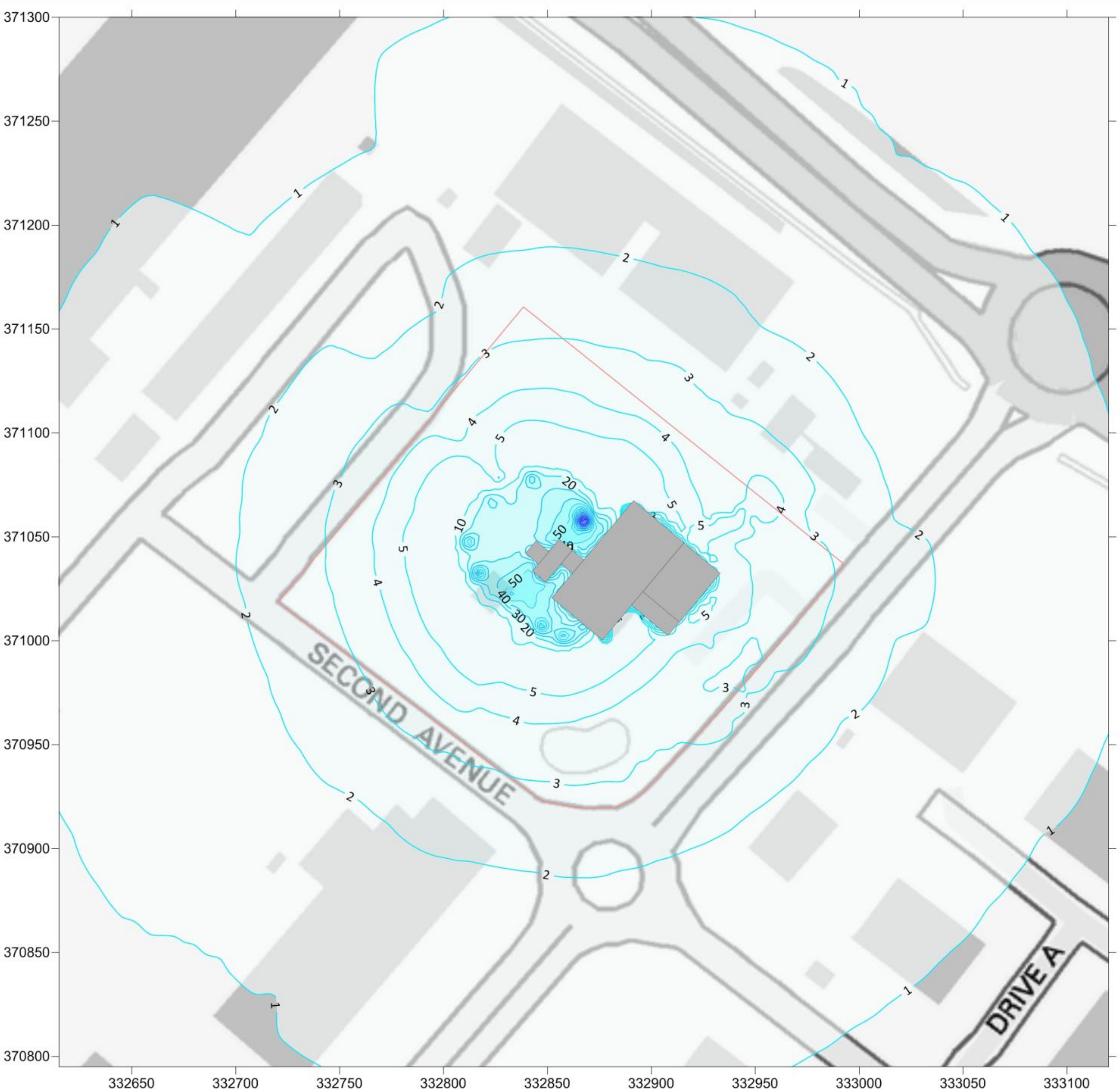

Legend

140
130
120
110
100
90
80
70
60
50
40
30
20
10
5
4
3
2
1

Predicted 1-hour Mean Odour Concentration (ou_E/m)

Title

Figure 8
Predicted 1-hour Mean Odour Concentration (ouE/m)
Xylene - All Sources

Project

Odour Management Plan
Deeside Packaging Coatings

Project Number

34055

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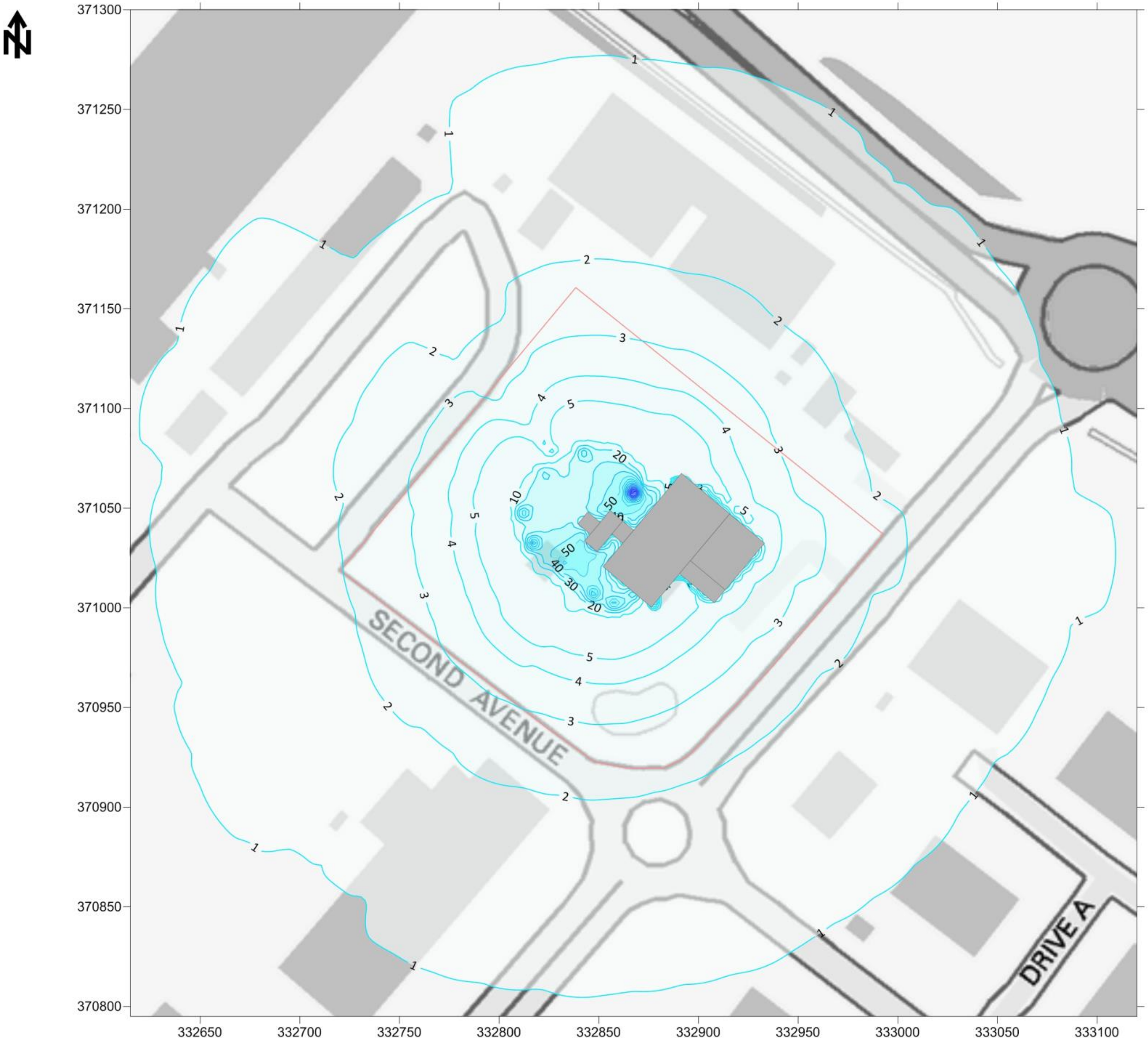

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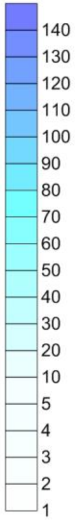

Title

Figure 9
Predicted 1-hour Mean Odour Concentration (ouE/m)
Xylene - A2

Project

Odour Management Plan
Deeside Packaging Coatings

Project Number

34055

Client

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Legend

0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1

Predicted 1-hour Mean Odour Concentration (ou_E/m)

Title

Figure 10
Predicted 1-hour Mean Odour Concentration (ouE/m)
Xylene - A3

Project

Odour Management Plan
Deeside Packaging Coatings

Project Number

34055

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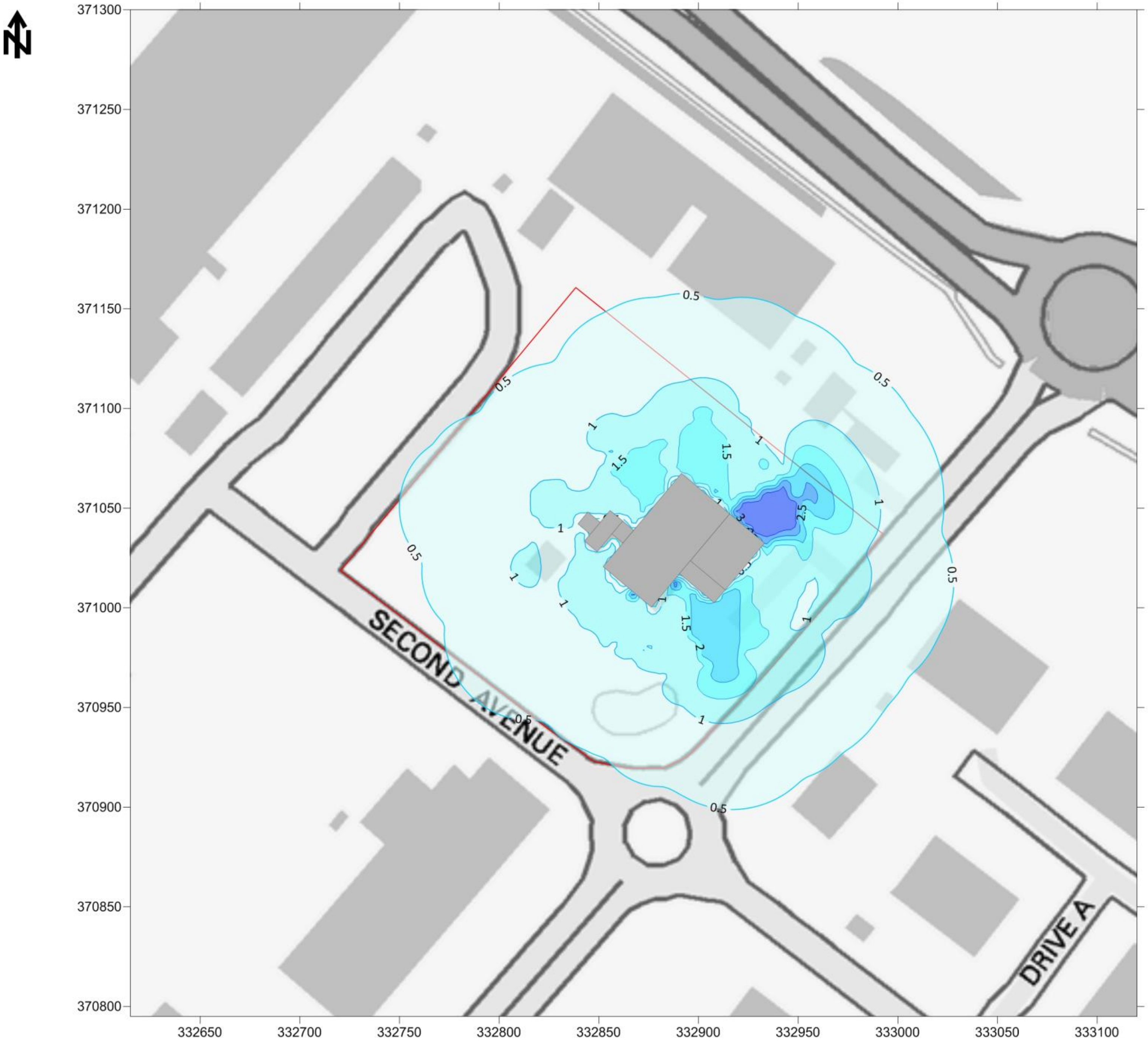

Legend

3.0
2.5
2.0
1.5
1.0
0.5

Predicted 1-hour Mean Odour Concentration (ou_E/m)

Title

Figure 11
Predicted 1-hour Mean Odour Concentration (ouE/m)
Xylene - A5

Project

Odour Management Plan
Deeside Packaging Coatings

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APPENDIX II DISPERSION MODELLING

DISPERSION MODELLING

Dispersion modelling was undertaken in order to provide further assessment of potential odour impacts associated with emissions from the various point sources at the facility.

Dispersion modelling was undertaken using ADMS 5 (v5.0.0), which is developed by Cambridge Environmental Research Consultants (CERC) Ltd. ADMS 5 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.

Modelling Scenarios

The scenarios considered in the modelling assessment are summarised in Table AII.1.

Table AII.1 Dispersion Modelling Scenarios

Parameter	Modelled As	
	Short Term	Long Term
VOCs	1-hour mean	-

Odour Sources

Potential odour sources are detailed in the main report text. These are summarised in Table AII.2. Process conditions were derived through review of the 2013 quarterly stack emissions monitoring undertaken by REC.

Table AII.2 Sources

Condition	Unit	A1	A2	A3	A5
Stack location	NGR	332855.3, 371035.5	332852.9, 371032.6	332861.8, 371029.2	332902.2, 371030.5
Stack diameter	m	0.36	0.20	0.20	0.46
Stack height	m	9.0	6.0	9.0	10.0
Flue gas efflux velocity	m/s	0.001	4.85	3.25	0.82
Exhaust gas flow rate	Nm^3/hr	439	518	347	465
Temperature	˚C	15	16	17	17

Emission point A1 discharges horizontally. As such, an efflux velocity of 0.001m/s was utilised to represent the restricted dispersion potential of any releases.

Emissions

Emission rates were determined from the 2013 quarterly stack emissions monitoring undertaken by REC. The quantity of each species emitted during each exercise was determined and the maximum identified for use in the assessment. These are summarised in Table AII.3.

Table AII.3 Emission Rates

Species	Emission Rate (g/s)			
	A1	A2	A3	A5
VOC[(a)]	0.000000	2.293597	0.034218	0.992539
Ethyl Acrylate[(b)]	0.000574	0.000671	0.006995	0.001018
Methyl Acrylate[(b)]	0.000574	0.000671	0.000166	0.001018

NOTE: (a) Obtained from quarter 3 monitoring results
(b) Obtained from quarter 2 monitoring results

VOC emissions were speciated based on emissions monitoring results included within the Environmental Permit Application for the facility. These are summarised in Table AII.4.

Table AII.4 VOC Composition by Species

Species	Odour Threshold Value (µg/m^3)	Concentration Detected (mg/m^3)	Concentration Detected as Carbon (mg/m^3)	Proportion of VOC Emission (%)
Toluene	1,000	213.9	1,497.3	16.0
Xylene	78	668.5	5,348.0	57.3
MEK	870	534.8	2,139.2	22.9
N-butanol	90	22.0	88.0	0.9
Styrene	70	32.1	256.8	2.8

As shown in Table AII.4, xylene represented 57.3% of the total VOC emission and has the second lowest odour threshold value. The most significant potential for impacts was therefore associated with this species. This was considered throughout the report where necessary.

Assessment Extents

Ambient concentrations were predicted over the area NGR: 332615, 370795 to 333120, 371300. One Cartesian grid with a resolution of 5.05m was used within the model to provide data suitable for plotting within the Surfer software package.

Terrain Data

Inclusion of terrain data is recommended within the ADMS 5 user guide[3] if the gradient within a modelling area varies by more than 10% (1 in 10). Assessment of changes in elevation throughout the modelling extents using Google Earth indicated the assessment area was generally flat. As such, terrain data was not included within the model.

Meteorological Data

Meteorological data used in this assessment was taken from Hawarden meteorological station over the period 1st January 2010 to 31st December 2010 (inclusive). Hawarden meteorological station is located at NGR: 334586, 364102, which is approximately 7km south-east of the proposed development. DEFRA guidance LAQM.TG(09)[4] recommends meteorological stations within 30km of an assessment area as being suitable for detailed modelling.

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

3 ADMS 5 User Guide, CERC, 2013.
4 Local Air Quality Management Technical Guidance LAQM.TG(09), Department for Environment, Food and Rural Affairs, 2009.

APPENDIX III REPORTING FORMS

REPORTING FORM: ODOUR 1 - AMBIENT SNIFF TESTING

NOTE: This form should be used for recording results from ambient sniff testing surveys. All fields should be completed in full.

Reporting of odour level on (date): ....

Table 1 Ambient Sniff Testing Monitoring Results

Survey Location	Time of Survey	Odour Intensity (1- 5)	Odour Persistence (1- 5)	Odour Offensiveness (1- 3)	Meteorological Conditions	Notes

Monitoring undertaken by: ....

....

Observations from monitoring team during testing: ....

....

Details of any required amendments to Odour Management Plan or site operation: ....

....

Signed:.. Date: ....

(authorised to sign as representative of Valspar Corporation (UK) Ltd)

REPORTING FORM: ODOUR 2 - COMPLAINT REPORTING FORM
NOTE: This form should be used for recording odour complaints. All fields should be completed in full.

Reporting of odour complaint on (date): ....

Name, telephone number and address of complainant: ....

....

Details of complaint: ....

....

Date, time and duration of odour: ....

Description of odour: ....

Meteorological conditions during incident: ....

Potential sources or activities that could give rise to odour during incident: ....

....

Operating conditions at time of incident: ....

....

Date and time of complaint follow up call: ....

Action taken: ....

Details of any required amendments to Odour Management Plan or site operation: ....

....

Signed: .... Date: ....

(authorised to sign as representative of Valspar Corporation (UK) Ltd)

REPORTING FORM: ODOUR 3 - ODOUR MANAGEMENT PLAN AMENDMENT FORM

NOTE: This form should be used for recording details of any amendments to the Odour Management Plan. All fields should be completed in full.

Date of Review	Detail of Amendment	Signature