Emissions Management Plan (EMP) for an organic chemical manufacturing plant

Purpose: Emissions Management Plan (EMP) for an organic chemical manufacturing plant to produce agarose based resin for pharmaceutical use. This supports an Environmental Permit application for a bespoke installation permit.

Operator: Purolite Ltd.

Site: Purolite Ltd. Unit C, Llantrisant Business Park, Llantrisant, Rhondda Cynon Taff, CF72 8LF

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Contents

1 Introduction

1.1 Scope

This document comprises an Emissions Management Plan (EMP), prepared by Shann Pitts Consulting Limited and Melbury Environmental Limited on behalf of the operator; Purolite Limited herein termed 'the operator'. This supports an Environmental Permit application for a bespoke installation permit, for an organic chemical manufacturing plant, to manufacture agarose based resin for pharmaceutical use at Unit C, Llantrisant Business Park, Llantrisant, Rhondda Cynon Taff, CF72 8LF herein termed 'the Site'.

This document outlines the procedures the operator will follow to control and monitor point source and fugitive emissions. This should enable the operator to not only stay within their authorised limits but also benchmark emissions data, reduce emissions and where possible prevent activities that may give rise to emissions. The EMP is based upon site-specific qualitative and quantitative environmental risk assessments presented in document SPC0055/ME17.11.23/Environmental Risk Assessment/V1/Purolite/December 17 submitted as part of the permit application, which should be read in conjunction with this document.

This EMP is designed to inform not only the permit determination process by Natural Resources Wales (NRW) but also to inform the operator on appropriate control and monitoring procedures within their ISO14001 accredited Environmental Management System (EMS).

1.2 Objectives

This EMP is designed to:

- Outline how emissions are controlled at source and what controls are in place to prevent or minimise emissions from the site;
- Outline how emissions will be monitored across the site to:
    - Ensure they do not pose risk of harm to human health or the environment, including nuisance by noise or odour;
    - Meet authorised emission limits to be set in the permit; and
    - Enable environmental performance to be benchmarked so that where possible, measurable targets and objectives can be set as part of an on-going improvement programme, via the EMS process, to further reduce or eliminate emissions.
- Outline how risks from unplanned emission incidents or accidents are minimised and if they occur how this will be managed.

2 Details of regulated facility

See Figures:

- Site location plan
- Aquifer map
- Ecological receptor plan
- Flood risk plan
- Permitted area plan
- Site layout and surfacing plan
- Site drainage plan

2.1 Site location

Address: Purolite Ltd. Unit C, Llantrisant Business Park, Llantrisant, Rhondda Cynon Taff, CF72 8LF
National Grid Reference: ST 04131 84511
Local Authority: Rhondda Cynon Taff Unitary Authority

2.2 Site description

The site is located within Llantrisant Business Park and is immediately adjacent to Purolite's existing premises. The industrial unit is currently vacant and was formally associated with the production of orange juice. The proposed site includes an industrial building, surrounding tarmac/ concrete slab access road, car park and service yard in an area of approximately 0.5 hectares (1.2 acres) with a perimeter of approximately 250m[1]. It comprises of one building 30m by 40m and 7m to the eaves, within which the entire production process takes place.

The site is located 17km north west of Cardiff. It is approximately 1.2km north north west of Llantrisant and 1.9km west of Beddau[1]. The northern and western perimeter of the site is bounded by industrial units on the Llantrisant Business Park, with the eastern perimeter being adjacent to Llantrisant Common and Pastures which is a 113 hectare (280 acre) Site of Special Scientific Interest (SSSI)[1]. A tributary of the Nant Muchudd runs adjacent to the proposed permitted boundary[1], alongside the eastern perimeter. The southern boundary rises approximately 10m above the site and is bordered by pastureland, typical of the south wales region. The region is mountainous, with the site being in an area of marshy grassland, with Llantrisant rising above as a hill town.

2.3 Environmental sensitivities

2.3.1 Human receptors

The key sensitive human receptors that have been identified within a 1km radius of the proposed site are summarised in Table 1. The prevailing wind direction at the site is westerly.

[1] Magic Map online: www.natureonthemap.naturalengland.org.uk (accessed 27.11.17)

Table 1: Summary of key human receptors within 1km radius of the site

Receptor Description	Receptor Type	Easting	Northing	Bearing	Approximate distance from site boundary (km)
Farmhouse 1	Residential	304047	185500	N	1km
Commercial residents of the Llantrisant Business Park	Commercial	N/A	N/A	Entire area 180^{O} north of the site	Up to 1km
Ynysmaerdy Terrace	Residential	303457	184466	W	0.6km
Ynysmaerdy community centre	Non-residential institution	303397	184362	WSW	0.7km
Royal mint (within Llantrisant Business Park)	Commercial/ leisure	304033	185030	NNW	0.5km
Three saints hotel/ the red mint	Hotel	303977	184731	NW	0.3km
Royal Glamorgan Hospital	Hospital	303618	184344	SW	0.5km (at nearest point)
Ansari Court	Residential	303479	184381	WSW	0.6km
Farmhouse 2	Residential	303253	184089	SW	1km
Premier Inn	Hotel	303816	183726	SSW	0.8km
Beefeater Longbow	Restaurant	303814	183657	SSW	0.9km
Farmhouse 3	Residential	303941	184105	SSW	0.4km
Farmhouse 4	Residential	303895	183895	SSW	0.6km
Farmhouse 5	Residential	303995	183651	S	0.8km
Coed Yr Esgob	Residential	304451	183768	SSE	0.8km
Llantrisant Primary School	School	304563	183853	SSE	0.7km
Farmhouse 6	Residential	304853	185169	NE	1km

Source: Magic Maps 2017[1]

To assess the impact of air and odour emissions of the proposed site on sensitive human receptors surrounding the site, Ricardo were commissioned to conduct an air quality and odour assessment (as per Appendix A)[2] to:

- Forecast pollutant concentrations against short-term and long-term environmental assessment limits (EALs) as set out in the guidance on 'Air emissions risk assessment for your environmental permit' provided by the Environment Agency and the Department for Environment and Rural Affairs; and
- Forecast odour concentrations against the applicable odour benchmarks, as per the Environment Agency's H4 Odour Management document.

The report draws on the results of emission estimations provided by the plant design consultants; Briggs of Burton PLC (Briggs) a summary of which forms Appendix B[3]. These emission estimates, provide expected emission concentrations for a number of volatile organic compounds (VOC's)

[2] Ricardo Energy and Environment (November 2016). Air Quality and Odour Impact Assessment. Report for Purolite Ltd. Reference BG/DJ/SH. Available in Appendix A.

[3] Briggs, Emission Summary Rev B, 10/11/2016. Available in Appendix B

emitted from the process. This data was used to calculate expected pollutant concentrations, and the relative odour impact, in ambient air at sensitive human receptor sites in the local area, using an atmospheric dispersion model known as ADMS v5.1, run using meteorological data representative of the location[2].

This study has shown[2]:

- Emissions of the substances assessed would not result in the exceedance of EALs in ambient air around the facility, or at any of the sensitive human receptor sites included in the model, with a stack height of 9m or 12.7m. However, by increasing the stack height to 12.7m the level of impact would be reduced by up to 16%;
- With a stack height of 9m, peak emissions exceeded the Environment Agency's odour threshold value of 3 OUE/m^3 for 'moderately offensive odours'. Whereas a stack height of 12.7m resulted in a maximum ambient concentration of 2.5OUE/m^3. The modelling assessment demonstrated that a stack height of 12.7m and velocity of release of 15m/s enabled sufficient dispersion of potentially odourous compounds such that further abatement was not required in order to minimise the impact of odour on sensitive receptors.

Based on this work, the operator will install a stack of 12.7m in height; it is not proposed to install any additional abatement.

A further quantitative environmental H1 risk assessment was undertaken by Shann Pitts Consulting and Melbury Environmental[4], which confirmed that with a stack height of 12.7m and a velocity release of 15m/s the long and short term impacts of predicted air emissions would not result in exceedances of EALs in ambient air around the facility or at any sensitive receptor sites, including at ecological receptors, which was not assessed by Ricardo. Document reference: SPC0055/ME17.11.23/Environmental Risk Assessment/V1/Purolite/December 17

2.3.2 Groundwater

The proposed site is not located in a groundwater source protection zone. The aquifer under the site is designated as 'Secondary A' and is comprised of the following 'sand and gravel' permeable layers:

- Hughes Member
- Glaciofluvial deposits

It is classed as a minor sand and gravel aquifer. Figure 2 is an aquifer map provided by NRW.

2.3.3 Surface water

A tributary of the Nant Muchudd runs adjacent to the proposed permitted boundary[1], alongside the eastern perimeter. The water quality status of the Nant Muchudd is classified as 'good' for chemical and 'good' for ecological status under the Water Framework Directive[5].

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[4] Submitted as part of the Permit Application. Doc reference: SPC0055/ME17.11.23/Environmental Risk Assessment/Purolite/December17

[5] Data obtained via e-mail correspondence between Natural Resources Wales and Shann Pitts Consulting on 08.11.17

2.3.4 Air quality management areas

The site is not within an Air Quality Management Area (AQMA)[1], with the nearest AQMA being Llamtwit Fardre which is 3.1km east and Mwyndy which 3.2km south south east, both declared due to exceedances of the objective for nitrogen dioxide (NO_2) (annual mean)[6].

2.3.5 Ecological receptors

The eastern perimeter of the site is adjacent to Llantrisant Common and Pastures which is a 113 hectare (280 acre) Site of Special Scientific Interest (SSSI) [1]. Two local fields are also protected as a SSSI under the name 'Rhos Tonyrefail' (meaning the moorland of Tonyrefail) also within 2km of the site boundary[1]. The site is not within 10km of any European Protected Habitat sites[1].

See Figure 3 for a map of ecological receptors within a 2km radius.

Table 2: List of ecological receptors within 2km of the site boundary

Receptor Description	Receptor Type	Easting	Northing	Bearing	Approximate distance from site boundary (km)
Llantrisant Common and Pastures	Site of Special Scientific Interest (SSSI)	N/A	N/A	Along eastern perimeter of site	Adjacent
Rhos Tonyrefail 1	SSSI	302106	187479	NW	0.8km
Rhos Tonyrefail 2	SSSI	302106	187497	NNW	1.7km

Source: Magic Maps 2017[1]

2.3.6 Flood risk

See Figure 4 for map showing flood risk areas in relation to the proposed site.

NRW mapping indicates a low to medium surface water risk affecting the rear service yard, originating from the watercourse on the site's eastern boundary, which is a tributary to the Nant Machudd[7]. A medium risk corresponds to an annual event probability of occurrence between 1 in 30 and 1 in 100. The design and profiling of the site to ensure if a storm event of a significant magnitude were to occur, flows would be directed around the main building affording the building adequate protection. All other external infrastructure has been raised with this risk in mind, protecting it from inundation in the most extreme of flood events. The risk of surface water floods is covered in detail in a site 'Drainage Philosophy', written by civil and structural engineers, CD Gray and Associates Ltd (see Appendix C)[8].

2.4 Permitted activities

The operator will be regulated by Natural Resources Wales (NRW) under the Environmental Permitting (England and Wales) Regulations 2016 ('the permitting regulations') under Schedule 1, Part 2, Section 4.1 Organic Chemicals, Part A(1).

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[6] Department for Environment and Rural Affairs: https://uk-air.defra.gov.uk/aqma/maps (accessed 01.12.17)
[7] Natural Resources Wales Flood Risk Map Viewer: https://naturalresources.wales/evidence-and-data/maps/long-term-flood-risk/?lang=en (accessed 01.12.17)
[8] CD Gray Associates Ltd (December 2017). Drainage Philosophy Purolite. CDGA-9021-REPO1-R4. (Appendix C).

The facility has been designed and will be operated in accordance with Best Available Techniques (BAT) to ensure emissions to air from the facility will comply with the requirements of the Industrial Emissions Directive (IED) emissions limit values[9]. A full BAT Assessment supports the permit application, document reference: SPC0055/ME17.11.23/BAT Assessment/V1/Purolite/December 17

2.5 Process description

2.5.1 Overview - non-technical summary

The proposed regulated facility is for an agarose bead production process carried out by Purolite Ltd, for use in the pharmaceutical and organic chemical sector. The new facility is located in a currently vacant warehouse, adjacent to the existing Purolite facility.

Agarose, a polysaccharide, is a highly pure form of agar that is derived from seaweed. The product can be tailored by altering the polymer chain length and using functional reagents, to convert the polysaccharide resin matrix for use as an ion exchange chromatographic resin. Agarose is the key raw input into the production process.

The new manufacturing process will produce the following varieties of agarose based products:

1. Praesto™ Pure, which is a plain agarose-based chromatography media;
2. Praesto™ SP, which is an agarose-based cation exchange resin; and
3. Praesto™ Q, which is an agarose-based strong anion exchange resin.

The final product will be in the form of spherical beads ranging from 45 µm to 90 µm stored in 20% ethanol, this is the base matrix resin sold as Praesto Pure. The final cationic or anionic charged beads are either sold directly to customers or shipped to a packaging plant for placement into columns. The products are designed for large scale biomolecule purification with Praesto™ SP and Praesto™ Q being high performance ion exchange resins optimized for large-scale purification of recombinant proteins such as monoclonal antibodies and other medium sized biomolecules.

The new plant will be batch operated and be capable of producing 100,000 litres of Praesto™ Pure agarose bead product. Praesto™ Pure can, if required, be further processed to produce either 50,000 litres of Praesto™ SP or 50,000 litres of Praesto™ Q. The initial production will be less and reach a total capacity within a three-year production ramping period. The complete production of a batch will take 21 days with 3.5 batches started per week. During initial ramp up of the production process 1 batch per week will be started.

The production process is carried out entirely within a building under highly controlled conditions. Under normal operating conditions there will only be emissions to air and emissions to sewer.

The emissions to air will comprise a variety of Volatile Organic Compounds (VOCs). Due to the batch nature of the process, emissions to air will occur in peaks over time and not continuously.

[9] How to comply with your environmental permit. Additional guidance for: Speciality Organic Chemicals Sector (EPR 4.02), Natural Resources Wales, September 2014. Available on-line: https://naturalresources.wales/media/2105/how-to-comply-with-your-environmental-permit-additional-guidance-for-speciality-organic-chemicals.pdf (accessed 04.10.17)

The primary control on VOC emissions to air is tight process control i.e. controlling emissions at source. The odour potential has been assessed and it is proposed to install a 12.7 metre stack to promote the dispersion of odourous VOCs.

Liquid waste arising from the process will either be diverted to sewer under a Trade Effluent Consent regulated by Welsh Water or if it is shown that the Trade Effluent consent limits cannot be met, will be stored in tanks on site prior to removal off site for recovery or disposal as appropriate.

There is a rear service yard behind the production building where there is a tank farm for storage of waste liquids prior to removal off site and also for storage of raw materials. There is a bund around the tanks built to CIRIA C736 (Containment Systems for the Prevention of Pollution) standards in addition to a containment strategy to manage abnormal operations i.e. spillage.

2.5.2 Process description

The process occurs over 21 days and involves a series of reaction, dilution, screening and mixing vessels. Steps range from mixing of the initial ingredients through to emulsification, dilution, washing, coupling, crosslinking, screening and allylation. It is a batch process, which cannot be operated continuously. Heating and cooling is used to help control the reaction processes. Condensers are used as part of the process control, cooling the air coming off the vessels and allowing volatile organic compounds to re-enter solution and maintain a constant composition in the process vessel.

Hazardous chemicals and processes are used in the reactions and therefore the company has undertaken detailed a hazard identification (HAZID) study and a hazard and operability study (HAZOP), to:

- Assess hazards via this quantitative risk assessment technique, to ensure the process does not pose risk of harm to personnel or equipment and to minimise health and safety risks. This covered environmental and commercial considerations, but health and safety aspects were prioritised in the chemical engineering design, although there is obviously a huge amount of cross over; and
- Optimise the reaction process ensuring it produces the least amount of wastes and emissions and uses the least amount of raw materials.

2.6 Infrastructure requirements and major plant items

Refer to Figure 6 - Site Layout and Surfacing Plan, which shows the key structures which are external to the production building.

2.6.1 The production building and major plant items

[redacted]

- [redacted]
  - [redacted]
  - [redacted]
- [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

2.6.2 Outside of the production building

The proposed site layout has been designed to ensure that infrastructure necessarily outside the building is protected from the risk of vehicle impact as far as is possible. The elements of external infrastructure from which there is a pollution risk have been detailed in the sections below.

Elements of infrastructure outside the building will be:

- **Tank Farm:** This is an above ground bunded storage area, capturing any spillages from the tanks stored within it (wall height approximately 1.2m) (developed in collaboration with CD Gray[6]). The following storage tanks are held within the tank farm:
    - **Raw materials**:
        - Bulk Industrial Methylated Spirit (IMS)
        - Bulk Toluene
        - Bulk Allyl glycidyl ether (AGE)
        - Bulk Glycidyl- trimethyl-ammonium chloride (GMAC)
    - **Wastes** (see Appendix D to understand where wastes arise during processing):
        - Waste stream A
        - Waste stream D
        - Waste stream E (2 tanks)
        - Waste stream F
- **Crash tank:** this is a secondary 'crash tank' provided below ground (underneath the tanker offloading area) to cater for emergency spillages within the building or during tanker offloading activity. It has been sized on the same principals as the tank farm bund, to CIRIA Report C736 – Containment Systems for the Prevention of Pollution, as the largest of 25% complete volume of 110% of the largest tank[6];
- **Tanker off-loading area:** is an area designed with a high-level/ ridged crown line on its outside edge, with falls created to direct run-off towards the crash tank inlet holes. This means if a spillage occurs, escaped effluent will be contained within the below ground crash tank[6];
- **Foam pumps/ water tank:** this is part of the fire prevention system, enabling a foam blanket to be sprayed over the surface of the tank farm and the crash tank simultaneously to reduce risk of fire in the event of a major spillage. Major spillages trigger an alarm system enabling the operator to manually operate the foam system from the external side of the Tank Farm Motor Control Centre (MCC);
- **Tanker farm pump house:** for pumping bulk liquids/ wastes between the tank farm and the process area;
- **Tanker Farm Motor Control Centre (MCC):** enabling the operator to monitor the tanks, which have continuous level monitoring to further reduce risk of spillages and deploy the foam cannons if required;
- **pH control facility:** used to correct the pH of effluents to sewer;

- **IBC and drum store:** this contains empty IBC's and drums. This is a covered area on an impermeable surface with sealed drainage diverted to the crash tank, preventing risk of pollution to surface waters;
- **Bin store:** this is a covered area on an impermeable surface with sealed drainage diverted to the crash tank, preventing risk of pollution to surface waters;
- **Main/ common vent stack**: this sits on top of the pipe bridge on top of the MCC and is where EP04 point source air emission is released from (see section 3.1.2);
- **Flue slab for steam generator;**
- **Nitrogen tanks (two tanks):** nitrogen is used as an inerting gas in the process. The tanks are stored on the outside of the building, on an impermeable surface and provide a contingency in the case of nitrogen generation failure.

3 Emission sources

3.1 Point source emissions to air

The locations of point source emissions to air from the manufacturing facility are shown in the Emission Point Plan (Figure 8). These are:

- Tank breather valves:
    - EP01: IMS tank vent
    - EP02: Waste tank (stream A) vent
    - EP03: Toluene tank vent
- EP04: Common (or Main) vent stack
- EP05: Hydrogen vent routing
- EP06: Epichlorohydrin tank venting
- EP07: Sewer discharge point

3.1.1 Tank breather valves

Some tanks exclusively use a tank breather valve (TBV) rather than vent to the common (or main) vent stack (EP04). This is to prevent the mixing of flammable vapours within the stack system, that could pose a health and safety risk and to prevent the vacuum pulling too much vapour (or raw material) off. Tanks that use this system are all stored outside in the tank farm and include:

- TBV from storage of raw materials:
    - Point Source: EP01 Ethanol (95% Industrial Methylated Spirit (IMS))
    - Point Source: EP03: Toluene
- TBV from storage of waste-streams:
    - Point Source: EP02: Waste stream A (includes toluene, ethanol and ethyl cellulose)

Waste stream E (two tanks) also vent to atmosphere, but this waste-stream is heavily diluted with purified water with trace amounts of ethanol, sodium hydroxide, sodium borohydride, sodium metabisulfite, sodium chloride. As it is not expected this will release an emission of any significance, it has not been marked as a 'point source'.

The tank breather valves (TBVs) will not release vapour under normal operating conditions. Losses only occur when the weather is warm enough for some liquid to evaporate and build up headspace pressure high enough to overcome the breather valve. The tanks also breathe in (usually overnight) when the pressure drops. The TBVs for tanks containing odourous compounds are connected directly to the stack to aid odour dispersion (see information below in 3.1.2). TBVs not connected to the stack are for tanks containing chemicals with a lower odour potential or a flammability risk. The loss of vapour from all tanks is controlled through tank design; tall tanks with a low surface area and appropriate pressure rating to reduce vapour loss.

The losses of VOCs from TBVs not connected to the Main Stack are not considered to be significant and have therefore not been assessed further.

3.1.2 Point source EP04: Main (Common) stack

During the process, various process vessels release vapours and these are in almost all instances diverted to the stack. The only instance where this is not the case, is during a particular reaction phase when hydrogen is generated. This occurs in six vessels (RE5A, RE5B, RE08, [RE09 being a future vessel] C10A and [C10B being a future vessel]). As hydrogen is highly flammable, it is not deemed safe to route this through the building to exit via the stack (see section 3.1.3).

Vapours are also sent to the stack where they arise from storage of wastes or raw materials that do not pose a flammability risk. The following storage tanks vent directly to the stack:

- Waste stream D
- Waste stream F
- Allyl glycidyl Ether (AGE); and
- Glycidyl-trimethyl-ammonium chloride (GMAC).

During the four years it took the operator to develop the process on an R&D and pilot scale, they were able to understand the likely emissions that would be released during the process, based on chemical engineering principles.

GMAC is an aqueous compound that will not form volatile emissions and therefore has not been considered further.

Briggs of Burton PLC quantified emissions from the process vessels and tank breather valves connected to the stack (Appendix B).

This data has been used to carry out a quantitative (H1) risk assessment through which the need for detailed dispersion modelling has been screened out. This has been detailed in SPC0055/ME17.11.23/Environmental Risk Assessment/V1/Purolite/December 17 (Appendix A).

Emissions to air from the organic chemical manufacturing plant will be regulated by NRW through an Environmental Permit issued under the permitting regulations and in accordance with the IED.

3.1.3 Point source EP05: Hydrogen venting

During the process, various process vessels release vapours and these are in almost all instances diverted to the stack. The only instance where this is not the case, is during a particular reaction phase when hydrogen is generated. This occurs in six vessels (RE5A, RE5B, RE08, [RE09 being a future vessel] C10A and [C10B being a future vessel]) for a 2 hour period for each of the processes where sodium borohydride is used. As hydrogen is highly flammable, it is not deemed safe to route this through the building to exit via the stack.

Instead the hydrogen is diverted via the shortest exit route from the building, using unobstructed pipework from the north-east face of the building (i.e. the back of the building, with the least human occupancy). It is heavily diluted with nitrogen (nitrogen being used as an inerting gas during the process) to remove/ reduce the chances of ignition.

No other vapours are expected to be generated in this phase. Whilst hydrogen is being vented, there is very little else (in terms of substances) that can be vented out as it is done in the very early stages of cross-linking. For the coupling and allylation processes, there is top pressure provided by the nitrogen and this limits the amount of evaporation (of other gasses) that can occur.

Hydrogen and nitrogen are naturally in the atmosphere and are not considered to be pollutants. This emission point has been included in the H1 risk assessment; no further assessment is required[4]. Furthermore there is no potential odour from this vent as these are odourless gases.

The hydrogen venting has been included as a point source emission due to its potential flammability.

3.1.4 Point Source EP06: Extract air from storage of epichlorohydrin

Epichlorohydrin is used a crosslinking agent and is required to be dosed into the process in a highly controlled manner. The process only requires a small amount (< 100 L) so the raw material is delivered in drums and pumped into a 100 L stainless steel vessel to ensure sufficient material is available for the duration of the process.

The storage tank is inerted with nitrogen to a set pressure. The storage tank is filled by pumping from the drum up into the tank. The pressure is balanced by a vapour return line back to the drum. This reduces the emissions from this tank.

For normal operation, the storage tank vents locally directly to atmosphere after passing through a carbon filter. The storage tank will vent low levels of nitrogen, the carbon filter is installed as a contingency to prevent epichlorohydrin emissions.

EP06 will be situated at the apex height of the main production building at a height of approximately 9 metres.

3.1.5 Extract air from powder handling rooms

Operational procedures minimise losses of any powder (see section 7.2.2). The extracted air from this room is released directly to atmosphere after being filtered by two filters (the second one installed as a back-up if the primary one fails – an alarm system sounds in this occurrence). This extracted air is vented through the side of the building. It is not expected it will contain any emissions, other than warmed air.

3.2 Fugitive emissions

3.2.1 Air emissions

3.2.1.1 Losses from leaking pipes or other equipment

The process has been designed carefully to minimise these losses and this was formalised through a HAZID and HAZOP assessment. All vacuums are designed for the load and a preventative maintenance plan will be in place to ensure all equipment is well maintained and tested. The content and frequency of checks will be derived from: frequency of use considerations; criticality of equipment; and manufacturer's recommendations. Furthermore, before every single transfer a vacuum test is conducted, which pulls on every bit of equipment and holds for a set amount of time. If the pressure drops, this suggests a leak or failure and an alarm is raised via the SCADA system. Vapour detection systems also enable the SCADA system to pick up any abnormalities.

3.2.1.2 Vapour losses from tanker loading/ unloading

This is expected to be nil as the tanker off-loading/ loading procedures are in place to prevent this. There is a closed loop system and vapour return to ensure no vapour is released during this process.

3.2.2 Odour

All of the reactor vessels, apart from those from which only hydrogen is released, are connected to the stack via condensers which use a heat exchanger to cool the air coming off the vessels and allow volatile organic compounds to re-enter solution.

In addition, the tank breather valves (TBVs) of several of the bulk chemical and waste storage tanks are connected to the stack:

- Glycidyltri-methyl-ammonium chloride (GMAC) storage tank;
- Allyl glycidyl ether (AGE) (which is stored with nitrogen (stored under for quality);
- Waste Stream D GMAC waste; and
- Waste Stream F AGE waste.

In the design phase, it was deemed that not all of the storage tanks should have tank breather valves connected to the stack as there was a concern that being connected to the vent stack would create a slight negative pressure on the top of the tank leading to increased loading on the vent stack from a draw off of material. However, the tanks containing the most potentially odourous compounds have their tank breather valves connected to the stack.

The potential for odour impact from the stack has been assessed via an Air Quality and Odour Impact Assessment written by Ricardo Energy & Environment, which forms Appendix A of this document. Predicted levels were found to be within published odour nuisance thresholds.

The stack will be of an appropriate height (12.7m) to ensure dispersion of any residual odourous compounds.

TBVs not connected to the stack are for tanks containing chemicals with a lower odour potential. The loss of vapour from all tanks is controlled through tank design; tall tanks with low surface area and appropriate pressure rating to reduce vapour loss.

Tank breather valves will not open under normal operating conditions. Losses are minimal with venting only occurring when the weather is warm enough for some liquid to evaporate and build up headspace pressure high enough to overcome the breather valve.

There is no odour potential from the hydrogen and nitrogen vents as these are odourless gases.

When liquid raw material tanks are being filled and waste tanks are being emptied for off-site disposal, there is a closed loop system for road tanker filling and emptying to ensure vapour return (except for GMAC). This system was introduced into site design to reduce vapour loss and to minimise odour emissions.

3.2.3 Dust and particulate matter

The potential for fugitive release of dust/ particulate matter associated with the production site is considered to be negligible.

The proposed manufacturing process will be carried out within a building under highly controlled conditions. Ancillary activities outside the building will not be a source of dust or particulates.

Vehicles moving in and out of the site for deliveries and collections will move over concreted / tarmacked areas.

3.2.4 Noise

The chemical manufacturing process will be carried out within the building; air compressors are within the building. The compressor room is designed for high noise levels and will be suitably insulated for sound. Operators will wear suitable PPE (ear protection). The building is constructed of steel sheets with a Rockwool core giving a good level of sound insulation.

The air-handling unit is located outside the building but is not anticipated to be a source of noise.

Noise from vehicle movements will be minimal, as it is not anticipated that there will be any more than four tanker movements per week.

3.3 Visual impact – plumes

No point source emissions will generate a visible plume.

3.4 Emissions to controlled water

There are no point source emissions to controlled waters arising from the process.

3.5 Emissions to sewer (EP07)

This is marked on the Emission Point Plan (Figure 8) as emission point 'EP07'. These emissions have been fully quantified during the project development stage and will be regulated through the conditions of a Trade Effluent Consent issued by DCWW (Welsh Water). The draft Trade Effluent Consent forms Appendix G.

Trade effluent will arise from:

- Qualifying production wastes known as 'waste-stream E';
- Qualifying effluents arsing in the crash tank; and
- Qualifying effluent arising in the tank farm.

Effluents that do not comply with the agreed limits as per the Trade Effluent consent will be held in tanks in tanks in the above ground bund (the tank farm), before off-site removal by an authorised waste contractor.

CD Gray[8] were commissioned to investigate foul water discharges in their drainage philosophy which forms Appendix C.

3.6 Emissions to land

There are no point source emissions to land arising from the process.

3.7 Waste inventory

Waste that will be produced by the proposed facility has been considered in line with Best Available Techniques and the waste hierarchy and are summarised in Table 3: Waste Inventory below.

Table 3: Waste Inventory

In-house waste stream identification term	Description	European Waste Code (EWC)	Code Description	Entry Type	Form	Forecast of annual tonnage	Application of Waste Hierarchy Principles
		07	WASTES FROM ORGANIC CHEMICAL PROCESSES				
		07 01	wastes from the manufacture, formulation, supply and use of basic organic chemicals				
Waste stream A	Ethanol and toluene	07 01 04	other organic solvents, washing liquids and mother liquids	Absolute hazardous	Liquid	992	This waste will go for recovery via physiochemical treatment (via distillation). Ideally the solvent will be sold back to the Operator as a raw material input, although it is unlikely the purity will be high enough. In this instance it will be sold on by the waste contractor for use at other sites;
Waste stream C	Cross linking process liquid	07 01 01	aqueous washing liquids and mother liquids	Absolute hazardous	Liquid	395	This has been routed for physiochemical treatment, although the waste contractor would like to see more representative samples closer to the time. If not suitable for recovery, it will be disposal of via incineration. Recovery via incineration would not be possible due its low calorific value. For the purposes of OPRA it has been assumed this will go for disposal as a worst case.

In-house waste stream identification term	Description	European Waste Code (EWC)	Code Description	Entry Type	Form	Forecast of annual tonnage	Application of Waste Hierarchy Principles
Waste stream D	Glycidyltri-methyl-ammonium chloride (GMAC) waste	07 01 01	aqueous washing liquids and mother liquids	Absolute hazardous	Liquid	457	This has been routed for physiochemical treatment, although the waste contractor would like to see more representative samples closer to the time. If not suitable for recovery, it will be disposal of via incineration. Recovery via incineration would not be possible due its low calorific value. For the purposes of OPRA it has been assumed this will go for disposal as a worst case.
Waste stream F	Allyl glycidyl ether waste	07 01 01	aqueous washing liquids and mother liquids	Absolute hazardous	Liquid	270	The only available option for this waste is disposal via incineration. Due to its low calorific value, it cannot be recovered via incineration.

4 Overarching controls

4.1 Environmental management system

The Operator has in place an Environmental Management System (EMS) certified to ISO 14001:2015. The EMS supports the business to meet and exceed environmental regulatory requirements and well as make day-to-day operations more sustainable. It commits the operator to maintaining and continually improving environmental performance. The EMS is further underpinned by an environmental policy, which outlines a companywide commitment to ensure all products are developed in ways that:

- minimise any adverse environmental impacts;
- reduce use of energy, water, raw materials, wastes and emissions; and
- ensures through active engagement with the customer base, products are used wisely to further minimise their environmental impact.

As part of the wider EMS, the EMP has been developed to detail the procedures that will be followed in order to minimise and control the risks to the environment due to emissions from the site.

This EMP is a live document that will be reviewed and amended as necessary throughout the life of the operational site.

4.2 Training and competence

The operator will train relevant site personnel on the correct operational procedures for the safe and efficient running of the plant. This will include operational control procedures, process controls, health and safety procedures, environmental control procedures, daily routine checks, making safe procedures including how to put the plant into a controlled 'hold' or shut down as well as emergency procedures.

The training will be documented with major topics recorded using Q-Pulse (a QMS software solution to help ensure regulatory compliance across environmental, quality, compliance safety and operational risk management sides of the business). Refresher training or updates will be delivered when changes occur, managed via Q-Pulse. Toolbox talks will also provide additional training on specific topics for each of the areas above.

The operator has operations worldwide and as a result can draw upon the expertise of many people for troubleshooting or improving process efficiency through bespoke training packages. In addition, the site will be located next to the companies R&D centre of excellence, where the entire process was developed from lab scale to pilot plant trials before being taken to full scale.

During operational hours the site will be supervised by at least one member of staff who is suitably trained and conversant with the requirements of the EMS, the operating techniques, the conditions of the environmental permit, site maintenance including inspections, the operators internal health and safety procedures (certified to Occupational Health and Safety Standard OHSAS 18001: 2007), the internal Major Accident Prevention Policy (MAPP) document and emergency action plans.

4.3 Maintenance

The Operator will have in place a full preventative inspection and maintenance programme for the facility. This will set out a preventative maintenance and inspection programme for the site infrastructure, process vessels, process monitoring equipment and all other associated equipment.

Qualified engineers will inspect, service and repair any diagnosed faults with the equipment. All machinery will be maintained according to the manufacturer's or supplier's recommendations including routine shut-down periods for service and calibration.

A record will be kept and retained of all inspection and maintenance tasks carried out.

The maintenance programme will ensure that the potential for abnormal operating conditions or unplanned or uncontrolled emissions due to breakdowns or plant/ equipment failure is minimised as far as possible.

4.4 Site security

The site will eventually be manned 24/7 when at full production. Initially the site will only operate for 4 days a week. Whole plant shutdown will occur on two occasions per year - in the run up to summer and over Christmas. The summer shutdown will be slightly longer (expected 2-3 weeks).

The site is secured on its perimeter by a fence. There is a gate at the site entrance, which is locked when the site is not occupied. There are also two gates at each side of the building, when the building is open to prevent unauthorized access to the rear of the building. Trucks and deliveries ring through to the control room by intercom.

The building itself will have access control from all external entrances. Only authorised personnel will have access.

CCTV cover both sides of the access road and over the tank farm and offloading area, with the site having an intruder alarm that is monitored by a security firm. Manned security guards will not be on-site.

4.5 Record keeping

The Operator will maintain records of all monitoring carried out under this EMP,, details of maintenance of plant, the results of calibration tests performed on plant/ equipment, surveys and any assessment or evaluation made on the basis of such data.

All records shall be legible, made as soon as reasonably practicable; both the original and any amended records are maintained; be retained, unless otherwise agreed with NRW, for a period of at least 6 years from the date when the record was made or until permit surrender where there is record of off-site environmental effects. Reporting

The requirements for the reporting of monitoring undertaken at the site, will be set out within the permit and the EMS updated accordingly.

In the event that a complaint is received, the investigation of the complaint and subsequent report to NRW will be undertaken by the Operator without delay.

4.6 Notifications

In the event that the operation gives rise to an incident or accident that has the potential to impact significantly on the environment, the Operator will immediately: inform NRW; take the necessary steps to limit the environmental consequence and, thereafter, steps to further prevent future occurrences.

In the event that a permit condition is breached the Operator will: inform NRW and take action to restore compliance as soon as possible; or immediately suspend the operation or relevant activity where there is a danger to human health and/or the potential for significant adverse environmental impact.

5 Regulatory controls

5.1 Planning permission

On the 26th May 2016, Rhondda Cynon Taff County Council granted full planning permission for the development (application number 16/0255/10). The Planning Permission forms Appendix E.

5.2 Environmental permit conditions

The operation will also be subject to the conditions of an Environmental Permit regulated by Natural Resources Wales under the Environmental Permitting Regulations 2016 and in line with the requirements of the EU Industrial Emissions Directive.

5.3 Duty of Care

Any waste leaving the facility is subject to controls under Duty of Care legislation (Environment Protection Act 1990, Section 34), which is also regulated by NRW.

5.4 Health and safety

The operation is subject to Health and Safety regulations that apply to workplaces and industry. The proposed operation falls under the threshold for regulation under the Control of Major Accident Hazards (COMAH) Regulations[Error! Bookmark not defined.]. However, it has been deemed appropriate by the perator to adopt a Major Accident Prevention Policy (MAPP), a requirement for establishments that fall under the COMAH Regulations.

The MAPP document is similar in approach to a health and safety policy document, but with two important additions: it deals specifically with major accident hazards; and it includes measures to protect the environment[11]. The operator's MAPP will include: their policy setting out the aims and principles of action concerning the prevention of major accidents; and a description of their safety management system for achieving these aims.

The operator has a safety management system in place, accredited to Occupational Health and Safety Standard OHSAS 18001: 2007. There is a target based system in place for Health and Safety performance with yearly management health and safety meetings held to ensure targets for a safe working environment have been met and new targets set for the following year. Monthly health and safety team meetings are held to ensure delivery of these targets and to prevent accidents wherever possible.

[11] Health and Safety Executive (HSE), 2013. Control of Major Accident Hazards, understanding COMAH – a guide for new entrants (pdf) Available from < http://www.hse.gov.uk/comah/guidance/understanding-comah-new-entrants.pdf > (accessed 15.11.17)

6 Physical control measures

6.1 Building specifications

To prevent any process activities from polluting land, water or air, all process activities will be carried out inside the building. See section 2.6 for full details on this. Infrastructure elements that are outside of the building, from which a pollution risk could occur, as well as the controls to limit this, are also covered by section 2.6 of this document.

6.2 Drainage

CD Gray were commissioned as civil and structural consulting engineers to design the physical aspects of drainage provision across the site, with Briggs of Burton PLC responsible for any plant or electrical equipment held within these civil works. The full CD Gray report is included in Appendix C and should be looked at in conjunction with Figure 7 - Site Drainage Plan. This project was conducted in consultation with NRW and DCWW (Welsh Water) [12] and covers:

- **Existing drainage network for foul water** and its suitability for reuse by the Operator and where necessary what modifications would be required prior to start-up;
- **Existing drainage network for surface water** and its suitability for reuse by the Operator and where necessary what modifications would be required prior to start-up;
- **Management of foul water** including:
  - **Discharges from domestic flows**;
  - **Trade Effluent management released in line with a Trade Effluent (TE) consent** which would arise from:
    - Discharge of waste-stream E – which is stored within the above ground holding tanks in the tank farm and automatically tested for pH and TOC prior to direct release to the below ground drainage network, provided it is in line with the TE consent; and
    - Any discharges from the crash tank/ tank farm, which need to be pumped out, provided it is in line with the TE consent.
- **Management of surface water/ run-off**, ensuring external areas designated as 'high-risk' (such as the bin area and IBC storage area) remain undercover to reduce risk of contamination to the surface water system;
- **Management of spillages/ containment events** arising from spillages within the tank farm and the crash tank. Spillages originating from the tanker off-loading area, the production building or as an overflow from the tank farm are directed to the crash tank. Both the tank farm and crash tank are designed in accordance with CIRIA Report C736 (containment systems for the prevention of pollution), with appropriate allowances made for rainfall/ storm events within the containment capacity;
- **Construction of the tanker off-loading area** and advice on the tanker off-loading procedures to ensure any potential spillages are contained; and

[12] CD Gray and Purolite met with Mark McLoughlin, an Environment Officer at NRW and Heather Pepper, a Trade Effluent Officer at DCWW (Welsh Water) on 21/04/16 and 12/05/16 where design principals were agreed.

- **Surface water flood risk**, ensuring if a storm event of a significant magnitude were to occur, flows would be directed around the main building affording the building adequate protection. All other external infrastructure has been raised with this risk in mind, protecting it from inundation in the most extreme of flood events.

7 Process controls

7.1 Overview

A key control over emissions is the limits of the design of the process; the infrastructure has been designed to produce a maximum of 100 tonnes (litres) of product per year.

The process was designed over four years, from R&D scale, through to a pilot plant. Briggs of Burton PLC (Briggs) were commissioned to develop the overall detailed design of the process in collaboration with Purolite:

- **Basis of Design, Block Flow Diagrams, Process Flow Diagrams and site layout drawings;**
- **Piping and Instrumentation Diagrams (P&ID)** as listed in Appendix F. These diagrams show the interconnection of process equipment and the instrumentation used to control the process, including valves, control inputs and outputs (i.e. sensors and final element interlocks), drains, flanges, sampling lines, reducers and increasers. This instrumentation feeds into the overall supervisory system (PLC and SCADA system);
- **User Requirement Specification (URS)** which broadly defines the project scope and intended method of automated operation for the proposed site; and
- **Functional Design Specification (FDS)**, which brings the entire process together in detail, defining how the objectives outlined in the URS will be implemented within the automation system.

Briggs and the operator have subsequently conducted a HAZOP study on all the physical and operational controls in place on all plant systems and equipment. All P & ID diagrams have been systematically reviewed during this process and up-dated where needed, to ensure the plant is well controlled to minimise the risk of health and safety and environmental incidents. This feeds into the final USR and FDS for the plant. Each 'node' that was assessed during the HAZOP (i.e. a specific portion of the process) is listed in Appendix H.

These internal documents are confidential as they contain the recipe for the process and therefore cannot be shared in full with NRW during the permit determination period, as they are commercially sensitive. This section instead draws from these documents, providing an overview of the key process controls in place across the plant to prevent emissions, without disclosing confidential information regarding process design.

7.2 System process control

7.2.1 Industrial control system - SCADA

The process is entirely recipe driven, making this a highly controllable process. The Operator can only carry out the next process step, when the previous series of actions (most automated) have been through the correct sequence. The operator interfaces with all of equipment through the Supervisory Control and Data Acquisition (SCADA) control system, which is a type of industrial control system, designed to automatically supervise the plant. This uses multiple means to interface with the plant including computers, networked data communications, programme logic controllers (PLCs) and proportional integral derivative controllers (PIDs). Unless an operator has supervisory access, the operator cannot simply over-ride the SCADA system and add in or remove process steps.

For process vessels (by way of example), the SCADA monitors and displays information on the temperature, pressure, agitation speed, flow and time. These are all displayed and set to predetermined ranges. Alarms will sound if the parameter is out of range or has been exceeded. There are literally hundreds of control loops (i.e. a fundamental building block of the SCADA system) across the plant. These are marked on the internal P & IDs (see Appendix F for full list of P&IDs) and covered by the URS and FDS. The HAZOP has systematically reviewed these controls to ensure they provide adequate health and safety protection, prevent emission breakthroughs and where these occur minimise risk of harm to human health and the environment.

7.2.2 Controls during processing

The process is designed to produce a high purity product, rather than focus on high yields as such a high level of accuracy and control is exerted. It is designed to prevent run-away-reactions, through controls that maintain temperatures, pressures and inerting gases within the required range. A summary of the main controls during processing include[13]:

- **Ensuring vessels are clean prior to start-up and before transferring materials to the next process vessel.** Strict cleaning and nitrogen purging (where necessary) is required for each vessel or between phases of the process. The process cannot move on until the operator has followed a strict cleaning sequence and confirmed via the human machine interface (HMI) on the SCADA that cleaning processes are complete.
- **Vessels are purged (where required) with nitrogen prior to transfer to the next vessel** using a vacuum system. Nitrogen is specifically used in reaction vessels where it is needed for blanketing;
- **Powders are added via hoppers and these must be in place securely prior to start-up**. Safety interlocks verifies a hopper is in place. The process cannot start until the hopper is secure;
- **Purified water is flushed to drain for 30 seconds prior to use**, to ensure water is of a purified standard before addition to the vessel. This is added using fast fill, followed by slow fill to achieve the exact input accuracy. Nitrogen is used to purge the purified water supply line;
- **Agitators need to be running prior to the addition of powders.** The operator re-confirms via the HMI that the hopper is securely in place. Powder cannot be added until the water addition phase/ raw material input phase is complete. The operator confirms powder has been added via the main control panel and is promoted to check the hopper is empty, cross-checking the container's empty weight back in the dispensary. Mixing via agitators is set to pre-determined ranges;
- **Heating begins automatically once the correct sequence of actions has been followed**. If heating is not achieved an alarm will sound. If heating exceeds a threshold an alarm will sound and put the reactor into a controlled 'hold' (the agitators will keep running);
- **Watchdog timers are used to monitor the time and target temperatures** across a whole variety of sequences and alarms once exceeded.

[13] Briggs of Burton PLC (July 2017). User Requirement Specification Issue D for Agarose Manufacturing Facility, Llantrisant Wales. MG1939.

- **Viscosity meters are used to determine when the mixture meets the specified viscosity**. Alarms alert the operator if there are any process issues. Watchdog timers are used to monitor the time taken to reach the viscosity and alarms when exceeded;
- **Recirculation loops are back-flushed with hot water and purged with nitrogen** to ensure an empty line between batches. The operator cannot start new batches without a clean recirculation line;
- **Chilled water is used to decrease the temperature of the vessels** with agitator speeds reduced automatically. Watchdog timers are used to ensure the vessel has reached the required temperature in the required time and alarms if not completed on time;
- **Transfer to ensuing reactors is initiated by the operator** who opens the bottom outlet valve via a software sequence. Verification of transfer is completed by the operator via a sight glass on the transfer line. Transfer can only occur if heat up, viscosity and cooling/ heating cycles haven fallen within the recipe parameters. If this has not been achieved, the operator will over-ride the transfer and move to a different reactor. The other reactor must be verified as ready (clean). During transfer the headspace will be backfilled with nitrogen to maintain the correct top pressure;
- **Failed batches can be diverted manually to an IBC**, once they are cooled to a safe temperature for handling. Transfer is confirmed via the HMI. Failed batches can be re-worked into the product or removed off site by authorised waste contractors;
- **Condensers are used to maintain the water: raw material ratio specified by the recipe** as well as cool the air coming off the vessels and allow volatile organic compounds to re-enter solution. Condensers are connected to the main/ common stack, Point Source EP04;
- **Hardwired interlocks are in place, to function independently of the software via an independent relay system**. For example a high level inlet stream would be isolated if high vessel level is detected (closing or preventing the purified water/ hot water valve from opening);
- **Software interlocks include by way of example**:
  - High temperature – heating is stopped if high vessel temperature is detected;
  - High pressure – pressurised gases connected to the vessel are isolated if high pressure is detected or the bursting disc ruptures;
  - Cleaning of recirculation loops can only be performed when the vessel is isolated. Flush and drain valves can only be opened if/when both vessel isolation valves have been confirmed as closed.

- **Sampling is used to determine the desired particle size has been reached** so cooling phases can begin. Cooling can only begin when the operator has confirmed the correct particle size on the local control panel;
- **Specific cleaning/ purging methods are in place for each vessel** and the next phase cannot begin until the operator has confirmed the cleaning phase has completed. Much of this is automated once promoted by the operator; and
- **For settling phases of the process, the operator visually checks that the product has settled** via a vertical site glass.

The process controls are designed to maximise the success of each batch and ensure emission limits remain within authorised limits as defined by the permit. They are also there to prevent any health and safety incidents, ensuring the right fail safe mechanisms are in place should any equipment fail.

7.3 Utility controls

7.3.1 Nitrogen blanketing

Nitrogen is used across the plant for creating an inert atmosphere in some cases to purge reactors to prevent the formation of flammable atmospheres. It is used in cases where hydrogen will be present from reactors, specifically where sodium borohydride is used. It is also used when ethyl cellulose is being mixed into toluene and is the only solvent present. It is used when IMS is being added to reactors above its flashpoint. It is also added to the headspace of the AGE storage tank as AGE is oxidised by air[13].

To ensure adequate supply of nitrogen, nitrogen pressure and oxygen content are constantly monitored, with alarms on low nitrogen pressure or high oxygen. There is a buffer vessel as part of the nitrogen generation package, to allow sufficient nitrogen gas to be supplied to ensure nitrogen blankets are maintained during operation. For any one sodium borohydride reaction for example, there is a pair of buffer tanks included in the system to allow for a full charge of nitrogen[13].

The operator will be able to identify loss of nitrogen in a sequence step, if the pressure in a vessel fails to increase. Flow monitors will be located on key vessels (such as hydrogen producing vessels) to ensure loss of nitrogen is quickly identified. All downstream equipment has over pressure protection to prevent overpressure protection scenarios during use of nitrogen. The process area will have oxygen detection and a high degree of ventilation. Operators will have personal oxygen monitors in high-risk areas to identify if localised asphyxiating atmospheres are forming. All nitrogen distribution pipework will be located indoors, to prevent the freezing of valves, fittings, relief valves etc. during cold weather[13].

As part of the standard operating procedures, nitrogen purges and their quality will be monitored at regular intervals. Pressure monitoring during purge cycles, will be conducted by watchdog timers[13].

7.3.2 Compressed air

Oil free compressed air is required for instrumentation and sterile air requirements on site (e.g. required for oxidation as part of the Praesto™ SP process). Compressed air is also supplied to the nitrogen generation package and air distribution main ring[13].

Air pressure is monitored and trended, with alarms on low air pressure. Air production occurs inside the building, preventing any freezing of the distribution system in cold weather. Over-pressure protection is available. To prevent nuisance by noise, the compressor room is designed for high noise levels and will be suitably insulated for sound. Operators will wear suitable PPE (ear protection).[13]

7.3.3 Chillers

Cooling water is required on-site for:

- Cooling reactors;
- Supplying condensers on vessels that are hot or contain volatiles;
- The vacuum pump seal;

- Water coolers that supply the temperature control units;
- The heating, ventilation and air condition (HVAC) system; and
- The purified water heat exchanger.

The chilled water supply is to be provided at 7°C, which negates the need for glycol in the circuit. This is a closed system, with water flow only required for top up. During detailed design, external weather conditions have been taken into account. Chilled water supply and return temperature, flow and pressure will be constantly monitored. Critical operations will be stopped or not initiated unless chilled water supply has been proved[13].

7.3.4 Temperature control units

During reactions, TCU's are used to maintain reactor temperature, much more accurately than steam or water cooling/ heating. This in itself is a critical part of the process control, for example ensuring materials such as GMAC do not solidify in the reactor and cause an emission breach. TCU's are equipped with alarms if there are any losses of hot water or heating capability. Operators are trained if a material such as GMAC solidifies enabling the GMAC tank to be emptied if required. Valve position monitoring and flow monitoring is in place to prevent loss of hot water to TCU's – the system is a closed system, so if the flow is disrupted, the end user will be able to identify this loss. Flange guards will be fitted and steam pipework lagged, to prevent release of hot steam, injuring personnel. Operators will have the correct PPE and be trained for hot surface work. Insulation and guarding will be in place where required[13].

7.3.5 Water purification

This is required due to the purity of products the operator is manufacturing. It is not part of the critical control process from an emission point of view. The process does have a 10,000ltr buffer tank to provide some supply if required. Flow and level monitoring downstream of the purified water system is installed[13].

7.4 Controls related to handling of raw materials

7.4.1 Raw material storage controls

All reactive chemicals are stored as per the manufacturer and supplier recommendations. This includes, the container type, their proximity to other reactive chemicals, flammability, the need for storage under a steady gas stream where necessary and environmental considerations. Table 4 below outlines where raw materials are stored, a description of their use, maximum tonnage stored on site and tonnages per year of each raw material used in production. Material safety data sheets for each of the raw materials is included in Appendix I.

[redacted]

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
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Specific consideration has been given to storage of bulk raw materials and wastes that pose a spillage risk, hence the construction of a bunded tank farm. This external tank holding area was designed by civil and design engineering consultants, CD Gray in consultation with NRW and DCWW (Welsh water)[12] with the full report included in Appendix C. It has also been systematically reviewed by the HAZOP. The following provides an overview of the main controls on the tank farm[8]:

- Storage tanks themselves are fully sealed and subject to frequent visual checks, which will form part of the site EMS. All tanks have continuous level monitoring;
- The tank farm bund is equipped with flammable vapour detectors (% LEL) that will alarm and notify personnel if a spillage occurs. This is in addition to operational management procedures which are in place to visually monitor the tanks and tank farm;
- In the event of vessel rupture within the tank farm, liquid will be held within the above ground bund (wall height approximately 1.2m);
- The bund has been designed in accordance with CIRIA report C736 – containment systems for the prevention of pollution, with appropriate allowances for rainfall/ storm events in the containment capacity (see calculations in CD Gray report);
- The bund has been water tested prior to commissioning;

- Surface water, contaminated water or stagnant water collected within this bunded area is tested and pumped out periodically. It is either disposed to sewer, in line with the trade effluent discharge consent or removed off-site by authorised waste contractors if outside acceptable limits; and
- Foam cannons are in place to cover the bunded tank farm area and crash tank simultaneously in a foam blanket if required to prevent the risk of fire or escape of chemicals/ vapours into the environment.

7.4.2 Handling/ arrival on-site of raw materials

All powders arrive on site in sealed containers. These are weighed in the dispensary, added to a mobile hopper, transported to the reaction areas and discharged to reactors via a vacuum delivery system. The 'addition' quantity is controlled by the main SCADA control system. Watchdog timers are in place to ensure there are no issues with transfer. Any powders that have additional health and safety risks (such as sodium borohydride) are placed in closed containers, where no escape to atmosphere is possible during movement, weighing or transfer.

In addition to powder handling, there are several liquid chemicals that are delivered in smaller quantities and stored inside the warehouse or flammable store as appropriate inside the building (see Table 4). IBC's are moved to the reaction areas, linked to the vessels, with 'additions' controlled by the SCADA system. Alarms sound when the IBC reaches a low level. Changeover is manual and controlled by standard operating procedures. Only one container at a time can be called in from the processing facility.

Flammable materials, such as epichlorohydrin, are metered into the process at a flow rate dictated by the process recipe. Prior to fill, vessels are purged with nitrogen. Only one container at a time can be called in from the processing facility.

Bulk liquids arrive on site in tankers and are unloaded in the tanker off-loading area, designed by CD Gray (see Appendix C, Drainage Philosophy & Site Layout and Surfacing Plan, Figure 6). This is located directly above the crash tank (see section 2.6.2 and CD Gray report) enabling any spillage from tankers to be contained within the below ground crash tank. The tanker off-load area has been designed with a high level/ ridged crown line on its outside edge with falls created to direct run-off within this area towards the crash tank inlet holes. The containment volume of the crash-tank caters for deliveries with a maximum load of 28,000 litres. Ordinarily, the penstock within the crash tank's receiving chamber will direct run-off to the surface water network. Operational management procedures are in place to ensure this penstock valve is closed before tanker off-loading, to ensure if spillages occur during this process, they are diverted into the crash tank.

Further operational management procedures are in place to ensure no spillages occur during the filling/ emptying of tankers. This is all done under a closed loop vapour return system, to prevent releases during this process.

The HAZOP has systematically assessed the process and operational controls in place during the handling of all raw materials across the site, including their transfer into process vessels/ reactors, to ensure this can be done safely without an emission break-through.

7.4.3 Venting of storage tanks/ storage areas

The following raw materials vent directly to the main/ common stack (Point Source Emission EP04) during storage to ensure proper dispersal of any emissions and prevention of nuisance by odour:

- Allyl glycidyl Ether (AGE); and
- Glycidyl-trimethyl-ammonium chloride (GMAC).

Please refer to section 3.1.2 to see how this emission has been thoroughly assessed for safe release via Point Source EP04.

Under normal operating conditions these tanks will not release vapours (as this would result in a large amount of raw material loss). The loss of vapour from all tanks is controlled through tank design; tall tanks with a low surface area and appropriate pressure rating to reduce vapour loss.

Some storage tanks exclusively use a tank breather valve (TBV) rather than vent to the stack. This is to prevent the mixing of flammable vapours within the main/ common stack system, that could pose a health and safety risk. It also prevents the vacuum system, connected to the main/ common stack, from pulling too much vapour/ raw material off. Tanks that use this system are all stored outside in the tank farm and include:

- Point Source: EP01: Ethanol (95% Industrial Methylated Spirit (IMS))
- Point Source: EP03: Toluene

The tank breather valves (TBVs) will not release vapour under normal operating conditions. Losses only occur when the weather is warm enough for some liquids to evaporate and build up headspace pressure high enough to overcome the breather valve. The tanks also breathe in (usually overnight) when the pressure drops. The loss of vapour from all tanks is controlled through tank design; tall tanks with a low surface area and appropriate pressure rating to reduce vapour loss.

Vapours from the storage of epichlorohydrin (a highly flammable liquid) are released directly to air following filtration via a carbon filter (point source EP06). This is released from the side of the building and vented to a high level. This is very low volume material with a maximum working capacity of 100 litres. This will only vent infrequently due to a closed loop system that is used during emptying/ filling of the container drum. Only one drum is connected at a time.

Powders are delivered in assorted container types that are sealed before use. The powder handling systems in the dispensary have extraction to remove any dust from this area and this goes through a double filter before being released to atmosphere. Any issue with the extraction system sends an alarm via the SCADA system to enable the operator to rectify the issue. Because this release is only expected to contain warmed air, it is not considered to be a ‘Point Source’ emission.

7.5 Waste management

To understand how wastes are generated by the processes please refer to Appendix D.

7.5.1 Waste storage controls

Table 5 outlines the characteristics of each of the main process wastes, their storage locations and maximum volumes stored on-site at any one time.

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Specific consideration has been given to storage of bulk raw materials and wastes that pose a spillage risk, hence the construction of a bunded tank farm. This external tank holding area was designed by civil and design engineering consultants, CD Gray in consultation with NRW and DCWW (Welsh water) with the full report included in Appendix C. It has also been systematically reviewed by the HAZOP. The following provides an overview of the controls on the tank farm:

- Storage tanks themselves are fully sealed and subject to frequent visual checks, which form part of the site EMS. All tanks have continuous level monitoring;
- The tank farm bund is equipped with flammable vapour detectors (% LEL) that will alarm and notify personnel if a spillage occurs. This is in addition to operational management procedures which are in place to visually monitor the tanks and tank farm;
- In the event of vessel rupture within the tank farm, liquid will be held within the above ground bund (wall height approximately 1.2m);

- The bund has been designed in accordance with CIRIA report C736 – containment systems for the prevention of pollution, with appropriate allowances for rainfall/ storm events in the containment capacity (see calculations in CD Gray report);
- The bund has been water tested prior to commissioning;
- Surface water, contaminated water or stagnant water collected within this bunded area is tested and pumped out periodically. It is either disposed to sewer, in line with the trade effluent discharge consent or removed off-site by authorised waste contractors if outside acceptable limits; and
- Foam cannons are in place to cover the bunded tanks farm area and crash tank simultaneously in a foam blanket if required to prevent the risk of fire or escape of chemicals/ vapours into the environment.

Waste-stream C contains sodium sulphate at levels that pose a risk of it crashing out if the temperature is too low, which means it is not appropriate to store on the tank farm. This liquid is pumped into an IBC with trace heating and followed by purified water as a flush to minimise sulphate blockage risk. Breaks are available to rod if required.

A small number of other wastes (other than domestic office wastes) are generated on-site including, storage containers, IBC's, drums and some packaging originally containing raw materials. These are held in the external bin store, protected by walls from vehicle impact. This store is undercover and on an impermeable surface with drainage leading directly into the crash tank.

7.5.2 Movement of wastes off-site

All wastes are transported off-site by authorised waste contractors and treated as per the best environmental option, in line with the waste hierarchy. Waste-stream E is discharged to sewer in line with a DCWW (Welsh Water) Trade Effluent consent (see Draft TE Consent in Appendix G and section 8.2).

Wastes removed from site are pumped into tankers in the 'tanker off-loading area', designed by CD Gray (see Figure 6 - Site layout and surfacing plan & Appendix C -Drainage Philosophy). This is located directly above the crash tank (see section 2.6.2) enabling any spillage from tankers to be contained within the below ground crash tank. The tanker off-load area has been designed with a high level/ ridged crown line on its outside edge with falls created to direct run-off within this area towards the crash tank inlet holes. The containment volume of the crash-tank caters for deliveries with a maximum load of 28,000 litres. Ordinarily, the penstock within the crash tank's receiving chamber will direct run-off to the surface water network. Operational management procedures are in place to ensure this penstock valve is closed before tanker off-loading, to ensure if spillages occur during this process, they are diverted into the crash tank.

Further operational management procedures are in place to ensure no spillages occur during the filling/ emptying of tankers. This is all done under a closed loop vapour return system, to prevent releases during this process.

Wastes are all moved through the production building to their storage locations via vacuum filtration. Liquid removal and transfer systems are provided by three separate vacuum sets. There will be a dedicated vacuum system for waste stream A and waste stream C and a combined vacuum system for waste stream D, E and F. This is to allow proper waste segregation and enable recovery of the solvent in the waste stream by the waste contractors.

All vacuums are designed for the load and a preventative maintenance plan will be in place to ensure all equipment is well maintained and tested. The content and frequency of checks will be derived from: frequency of use considerations; criticality of equipment; and manufacturer's recommendations. Furthermore, before every single transfer a vacuum test is conducted, which pulls on every bit of equipment and holds for a set amount of time. If the pressure drops, this suggests a leak or failure and an alarm is raised via the SCADA system.

7.5.3 Venting of vapours released from wastes

The following wastes have vents that connect directly to the main/ common stack (which is an overall Point Source Emission reference EP04) to ensure proper dispersal of any emissions and prevention of nuisance by odour:

- Waste stream D; and
- Waste stream F.

Please refer to section 3.1.2 to see how this emission has been thoroughly assessed for safe release via EP04.

The following wastes have tank breather valves (TBVs) that vent directly to atmosphere:

- Waste stream A (Point Source: EP02) (includes toluene, ethanol and ethyl cellulose); and
- Waste stream E (two tanks) (containing mostly purified water with trace amounts of ethanol, sodium hydroxide, sodium borohydride, sodium metabisulfite, sodium chloride)

The TBVs will not release vapour under normal operating conditions. Losses only occur when the weather is warm enough for some liquid to evaporate and build up headspace pressure high enough to overcome the breather valve. The tanks also breathe in (usually overnight) when the pressure drops. The loss of vapour from all tanks is controlled through tank design; tall tanks with a low surface area and appropriate pressure rating to reduce vapour loss.

As waste-stream E is heavily diluted with purified water (it is disposed to sewer under a Trade Effluent consent) it is not expected this will release an emission so it has not been marked as a 'point source' emission.

8 Emission Control

8.1 Point source emissions to air

Point source emissions to air from the site are marked on the Emission Point Plan (Figure 8). They arise from:

- Tank breather valves:
    - EP01: IMS Tank vent;
    - EP02: Waste Tank A vent;
    - EP03: Toluene Tank vent;
- EP04: Common (or Main) Vent Stack;
- EP05: Hydrogen Vent Routing; and
- EP06: Epichlorohydrin tank venting.

Further details on the specific controls on point source emissions to air are summarised in Table 6.

Table 6: Point source emission to air – summary of controls

Point Source EP01, EP02 and EP03 – Tank Breather Valves (TBVs)
These emissions are released directly to air to prevent the mixing of flammable vapours within the main/common stack system. TBVs are only used for chemicals with a lower odour potential. TBVs will not release vapour under normal operating conditions. Losses only occur when the weather is warm enough for some liquid to evaporate and build up headspace pressure high enough to overcome the breather valve. The tanks also breathe in (usually overnight) when the pressure drops. To prevent or minimise the impact of emissions from TBVs: • Materials are stored as per the manufacturer's recommendations. All tanks with TBVs are stored outside in the tank farm; • The loss of vapour from all tanks is controlled through tank design; tall tanks with a low surface area and appropriate pressure rating to reduce vapour loss; • Standard operating procedures are in place to prevent escape of emissions during tanker loading/ unloading. Further operational management procedures are in place to ensure no spillages occur during the filling/ emptying of tankers. This is all done under a closed loop vapour return system, to prevent releases during this process.
Point Source EP04 – Common (or Main) Stack
These are captured from a number of chemical storage tank vents (GMAC and AGE) and process steps and vented via a single elevated stack (12.7m) at a required discharge velocity (15m/s). These emissions have been fully characterised by Briggs PLC (Appendix B) and detailed air dispersion modelling has been conducted by Ricardo (Appendix A) to ensure these can be released to atmosphere without posing risk of harm to human health or the environment or posing an odour risk. A quantitative risk assessment using the H1 tool supports the air dispersion modelling report[4]. To prevent or minimise the impact of emissions from Point Source EP04: • Emissions from process vessels are controlled by: ○ Rigorous process controls to ensure only the emissions expected will be released from the process vessels under normal operating conditions (see Chapter 7);

- Process controls, overseen by the SCADA system, prevent breaches of GMAC and AGE during transfer to processing vessels;
- Condensers, to some degree, which are there to enable good process control. If a condenser fails (for example because the chilled water circulation system fails), the plant will go into a controlled 'hold state', with operations remaining limited until the process is safe to start again. At worst, town's water will be flowed through the condensers at ambient rather than chilled temperature;

- Emissions released from storage of AGE and GMAC are controlled by:
  - Ensuring these are stored as per the manufacturers recommendations (AGE is stored under a nitrogen blanket and GMAC within a particular temperature range, controlled by an external heat exchanger).
  - Ensuring these tanks are stored in the bunded tank farm in the unlikely event of tank rupture. A foam cannon fire suppression system is activated if required to blanket the tank farm and crash tank simultaneously in a foam blanket, to prevent escape of contaminants into the environment and reduce fire risk;
  - Tank design; tall tanks with a low surface area and appropriate pressure rating to reduce vapour loss;
  - Standard Operating Procedures and EMS procedures ensure storage tanks themselves are fully sealed and subject to frequent visual checks. All tanks have continuous level monitoring. The distribution pumps for all bulk tanks will trip an alarm if there is low pressure in the tanks;
  - Tanker loading/ unloading. Operational management procedures are in place to ensure no spillages occur during the filling/ emptying of tankers. This is all done under a closed loop vapour return system, to prevent releases to air during this process.
  - Designing the tanker off-load area with a high level/ ridged crown line on its outside edge with falls created to direct run-off within this area towards the crash tank inlet holes. The containment volume of the crash-tank caters for tanker deliveries with a maximum load of 28,000 litres. Ordinarily, the penstock within the crash tank's receiving chamber will direct run-off to the surface water network. Operational management procedures are in place to ensure this penstock valve is closed before tanker off-loading, to ensure if spillages occur during this process, they are diverted into the crash tank;
- The common/ main vent stack itself will be controlled by ensuring:
  - A minimum vapour speed of 15m/s is maintained at all times to correctly disperse air emissions from EP04 and prevent odour issues. There is an air bleed control valve upstream of the vent fan inlet seal pot, drawing in on low process vent flow. The aim being to maintain the vent stack at the required exit velocity;
  - A flowmeter is fitted to the vent stack to monitor exit velocity. An alarm sounds if <15m/s
  - The stack has two standby fans to ensure emissions can still be released at the required velocity even if one fan fails. If a fan does fail, the SCADA system puts the plant into a controlled hold, alerting the operator to the issue so it can be rectified, during which time the velocity speed will still be maintained by the standby fan.

Point Source EP05 - Hydrogen vent routing

During the cross-linking, coupling and allylation processes hydrogen is generated. No other vapours will be generated during these phases as it is either done in the early stages of cross-linking, when there is little else (in terms of substance) that can be released. Or during coupling and allylation processes, there is top pressure provided by nitrogen, which limits the amount of evaporation (of other gasses) that can occur. Hydrogen generation occurs in six vessels (RE5A, RE5B, RE08, [RE09 being a future vessel] C10A and [C10B being a future vessel]). As hydrogen is highly flammable, it is not deemed safe to route this through the building to exit via the stack. Hydrogen is not considered to be an environmental pollutant, although is listed as a Point Source emission due to its flammability. There is no potential odour from this vent as these are odourless gases.

The main controls in place to minimise the impact of this emission include:

- Rigorous process controls as covered by the internal P&ID Drawings, USR and FDS and systematically reviewed by the HAZOP, to ensure only the emissions expected will be released from the process vessels under normal operating conditions (see Chapter 7);
- Designing the site layout to ensure hydrogen can be diverted via the shortest exit route from the north-east face of the building, using unobstructed pipework (i.e. from the back of the building, with the least human occupancy);
- Prevention of excess hydrogen generation during reactions by:
    - Using sodium borohydride granules (rather than powders) to limit the rate of hydrogen formation;
    - Where possible, limiting rates of agitation, to prevent excess hydrogen generation.
- Purging all pipework, ancillary equipment and vessel headspace with nitrogen before and after hydrogen generation, to prevent risk of equipment damage and health and safety incidents if a source of ignition is found. Nitrogen blanketing is used throughout the hydrogen generating reactions. The efficacy of these purge cycles have been reviewed during the HAZOP;
- Ensuring via the SCADA system and standard operating procedures, that during reaction phases that release the highest level of hydrogen (during the sodium borohydride reaction), a full back-up buffer tank containing nitrogen is connected and available for any one sodium borohydride reaction; and
- Ensuring at the point of release to atmosphere, hydrogen is heavily diluted with nitrogen.

Point Source EP06 - Epichlorohydrin tank venting

Epichlorohydrin (EPCH) is a highly flammable liquid, so it was deemed safer to discharge any vapours released during storage, directly to air following filtration via a carbon filter. It is released from the side of the building and vented to a high level. This is very low volume material with a maximum working capacity of 100 litres. This will only vent infrequently due to a closed loop system that is used during emptying/ filling of the container drum. Only one drum is connected at a time.

The main controls in place to minimise the impact of this emission from this vent are that:

- The emission from storage of EPCH runs over a carbon filtration system, which has been selected by Briggs of Burton PLC and will be designed for the load. The Operator is currently seeking clarification on this;
- Venting only occurs when a drum is connected to a processing vessel, with only one connected at any one time (the drum remains in the flammable store at all times);
- Sealed drums arrive on-site and are moved into the flammable store;
- All drums have a coupling connection, preventing the operator ever needing to open the drum for a connection. The dosing vessel connection coupling will be made before a transfer can be initiated;
- All drums will be inspected at the point of delivery;
- The operator will have the correct PPE as identified in COSHH assessment to handle the drums;
- Leaking drums will not be used for the process;
- Dry break couplings will be used so if no coupling is made, no spillage of EPCH will go to the local area;
- All connection pipework will be double skinned. All flexible hosing is routinely inspected;
- The flammable store is a bunded area and will only store ethanol IBC’s and up to 12 EPCH drums;

• All flanges will have flange guard to protect against leaks; • Purging and nitrogen blanketing will be used when material is transferred to the dosing vessel. There is a vapour return line from the dosing vessel to the drum, which minimises the egress of this emission to EP05. • The flammable store will have oxygen detection, vapour monitoring and a high degree of ventilation. Operators will have personal oxygen monitors.

8.2 Point source emission to sewer

There is one point source emission to sewer as marked on Emission Point Plan, reference EP07. The controls in place are outlined in Table 7. This emission is released to sewer under a Trade Effluent consent issued by Welsh Water and arises from:

- Qualifying production wastes known as 'waste-stream E';
- Qualifying effluents arsing in the crash tank; and
- Qualifying effluents arising in the tank farm.

Table 7: Point Source Emission to Sewer – Summary of Controls

Point Source EP07 – Sewer Emission
The key controls in place to ensure the sewer emission falls within the agreed Trade Effluent consent limits are as follows: For waste stream E: • A two-tank system is used, enabling one tank at a time to be filled from an effluent buffer tank from the main process building. This operates between a mid-level and low-level probe. The two tanks operate as a duty standby system, with one tank recirculating and pH correcting whilst preparing to drain, whilst the other is receiving from the main building; • Once one tank is filled (45,000L) it is recirculated for 30 minutes, and the pH and TOC checked automatically; • If the pH is <9, the acid pump turns on for 2 minutes. The tank is recirculated for 15 minutes and re-checked; • If pH is >5, the caustic pump is turned on and pumped for 2 minutes. The tank is recirculated for 15 minutes and re-checked; • Total Organic Carbon (TOC) measurements are automated by a Metrohm unit; • Once the pH falls between 5.5 and 8.5 for 10 minutes and the TOC has been determined as within limits by the operator, the vessel is ready for discharge, using gravity flow to drain; • Maximum consented flow is 10.8m^3/hr, so flow is controlled to be 90% of this value during normal operation; • Flow monitoring, via a metering device, will be in place to verify the volume communicated to the public sewerage network is correct; • Once the vessel is empty, there is no automatic clean. The vessel is ready to be the standby vessel once the other vessel is full again. • If the effluent is outside of the Trade Effluent consent limits, it will be removed off-site by an authorised waste contractor and recovered as per the best environmental option with regards to the waste hierarchy. Effluent arising from the crash tank or tank farm: • Can be pumped into holding tanks in the tank farm. For example surface water run-off collected in the bunded areas may be able to meet Trade Effluent limits;

- The tanker off-load area only discharges surface water run-off to the crash tank during tanker off-loading activities. Ordinarily, the penstock within the crash tank's receiving chamber will direct run-off to the surface water network (if no tanker is in the bay). Operational management procedures are in place to ensure this penstock valve is closed before tanker off-loading, to ensure if spillages occur during this process, they are diverted into the crash tank;
- The holding tank for effluents arising from the crash tank or tank farm, will follow the same procedure as above (for waste stream E) in terms of dosing, recirculating, mixing and testing and will only be communicated to the foul network if within consent limits;
- If the effluent is outside of the Trade Effluent consent limits, it will be removed off-site by an authorised waste contractor and recovered as per the best environmental option with regards to the waste hierarchy.

8.3 Odour control

Odour is primarily controlled through plant design as described in section 3.2.2.

The condensers on the outlets of the reactor vessels enable a reduction in loss of volatile organic compounds, hence a reduction in product loss as well as a reduction in odour potential. The condensers operate via a chilled water system and a heat exchanger. When processes are running which use condensers as a control, the temperature is continuously monitored to ensure maximum efficacy of the condensers.

Operational procedures and training on the use of the vapour return system will form part of the Environment Management System and Standard Operating Procedures.

Daily checks for odour will be carried out in accordance with operational procedures.

If odour is an amenity issue then an Odour Management Plan will be developed in consultation with Natural Resources Wales.

8.4 Noise impact control

Noise is primarily controlled through plant design as described in 3.2.4. All equipment is inside the building and any external equipment is not a high source of noise.

There is a preventative maintenance programme for all equipment.

Daily checks for noise will be carried out in accordance with operational procedures.

If noise is an amenity issue then a noise and vibration management plan will be developed in consultation with Natural Resources Wales.

9 Monitoring emissions to air

9.1 Benchmarks & estimated data

The Operator must meet emission benchmarks in order to comply with their permit. The relevant emission benchmark values for emissions to air from Annex 1 of the NRW Best Available Technique[14] document (herein referred to as the 'Organic Chemical Sector BAT') in Annex 1, are shown in Table 8 below:

Table 8: Emission to air benchmarks

Released substance	Benchmark Value (mg/Nm^3)
Benzene	5
VOC Total Class A (*)	20
VOC Total Class B (*) (expressed as carbon)	75

**Releases of VOCs should be individually identified, where possible. The VOC concentration levels generally apply where the following total mass release rates are exceeded:*

- *Total Class A 100g/h (expressed as individual VOCs)*
- *Total Class B 5 tonnes/yr or 2kg/h, whichever is the lower (expressed as carbon)*

Note, however, that releases below these mass emission rates may not be trivial, and so may still require controls and the setting of appropriate emission limit values.

As shown in Table 9 below, the VOCs that will be released to air have been categorised in accordance with published guidance on the Categorisation of Volatile Organic Compounds[15]. In this guidance, Annex F provides a Proposed Categorised List of VOCs with medium risk and low risk corresponding to Class A and Class B VOCs respectively. Ethanol as Industrial Methylated Spirits (IMS) is not specifically listed however; it is assumed it fits into Class B as it is a combination of ethanol and methanol, which are both classified as low risk or Class B.

The estimated mass emissions have been taken from the Briggs of Burton PLC Emission Summary, which forms Appendix B of this document. The concentrations were calculated from Briggs Emission Data taking in account flow rates. These calculations form Appendix J.

Note that emission calculations from which this data has been taken did not account for the condensers and therefore give the worst possible emission case under normal operations.

[14] How to comply with your environmental permit, Additional guidance for Speciality Organic Chemicals Sector (EPR 4.02), Natural Resources Wales, Version 2, September 2014

[15] The Categorisation of Volatile Organic Compounds, DOE Report No: DoE/HMIP/RP/95/009, Recreated June 1999

Table 9: Categorisation of VOC's, estimated mass emissions & concentrations

Volatile Organic Compound	ID	Class of VOC	Estimated Emissions in kg/yr	Estimated peak emission (hourly) kg/hr	Concentration(mg/m^3)
Acetic acid	1	B	5.81	7.21×10^{-4}	1.7
Allyl glycidyl ether (AGE)	2	Highly harmful	118.39	1.47×10^{-2}	34.7
Epichlorohydrin	3	Highly harmful	7.11	8.82×10^{-4}	2.1
Ethanol	4	B	131.93	1.64×10^{-2}	38.7
Ethanol as IMS	5	B	579.28	7.18×10^{-2}	169.3
Methanol as IMS	6	B	49.81	6.18×10^{-3}	14.6
Toluene	7	B	225.93	2.80×10^{-2}	66

9.2 Assessment of Class B VOCs

In accordance with Annex 1 of the Organic Chemical Sector BAT[14], Class B VOC Emission Benchmark Levels (Table 8) generally apply when the total mass emission rate of 5 tonnes/yr or 2kg/h, whichever is lower, is exceeded.

As shown in Table 9, neither of the total mass emission rates thresholds (annual or hourly) have been exceeded for Class B VOCs. Therefore the Benchmark Value of VOC Total Class B of 75mg/Nm^3 does not apply.

9.3 Assessment of highly harmful VOCs

For AGE and epichlorohydrin which are classified as highly harmful, there are no emission benchmark values listed in the Organic Chemical Sector BAT document[14]. For this reason the limit for benzene has been used as a conservative comparator. Benzene is classified as a Category 1A carcinogen[16]. Epichlorohydrin is a Category 1B carcinogen[17] and AGE is a Category 2 carcinogen[18]. The use of benzene is therefore a conservative comparator for epichlorohydrin and AGE.

Epichlorohydrin is a precursor to allyl glycidyl ether (AGE). Epichlorohydrin reacts in a condensation reaction and the product is subsequently treated with bases to produce AGE.

The estimated concentration of epichlorohydrin is 2mg/m^3, which falls below the benchmark value of 5mg/m^3 for benzene.

The estimated concentration of AGE is 23mg/m^3, which is above the benchmark value of 5mg/m^3 for benzene.

[16] https://echa.europa.eu/information-on-chemicals/cl-inventory-database/-/discli/details/127390 Accessed 11th December 2017
[17] https://echa.europa.eu/information-on-chemicals/cl-inventory-database/-/discli/details/107704 Accessed 11th December 2017
[18] https://echa.europa.eu/information-on-chemicals/cl-inventory-database/-/discli/details/112431 Accessed 11th December 2017

9.4 Emissions to air monitoring proposal

9.4.1 Overview

If following the permit application assessment by NRW determines that emissions to air monitoring is required then, due to the small scale and batch nature of the Purolite process, the most appropriate monitoring of emissions to air, would be through periodic testing at critical stages in the batch.

Emission profile data has been developed, showing the predicted time and quantity of emissions over a 25-day period. This data shows the emissions from a whole batch, which takes 21 days and also the other batches started within that time; a new batch will be started 3.5 times a week. This data and accompanying graphs forms Appendix K.

Any required monitoring will be carried out with reference to Environment Agency Technical Guidance Note M16, Monitoring volatile organic compounds in stack gas emissions[19] and Technical Guidance Note M1, Sampling requirements for stack emission monitoring[20].

9.4.2 Class B VOCs

It is not proposed to carry out emissions to air monitoring for Class B VOCs. As shown in Sections 9.1 and 9.2 Emission Benchmark Values do not apply.

9.4.3 Highly harmful VOCs

9.4.3.3 Allyl glycidyl ether (AGE)

The estimated emission data for AGE shows that there will be 3.5 hours per batch where there is an emission of AGE as shown in Table 10 below.

Table 10: **Predicted emissions of AGE in a batch**

Duration (hrs)	AGE (kg/h)
0.5	0.018
1.0	0.036
1.0	0.002
1.0	0.002

Briggs of Burton PLC have assumed that little to no AGE is emitted during heating due to 280 mbar nitrogen top pressure and no additional amounts displacing air volume in the vessel.

In terms of annual operations (48 weeks, 24 hrs a day = 8,064 hrs / 167 batches per year) the duration of emissions equates to 585 hrs. There will be an emission of AGE approximately 7.25% of operational time. The predicted emission times coincide with processes occurring in Reactor RE08.

[19] Environment Agency Technical Guidance Note M16, Monitoring volatile organic compounds in stack gas emissions, LIT_6920, Environment Agency, Version 5, November 2016

[20] Technical Guidance Note M1, Sampling requirements for stack emission monitoring , Environment Agency, Version 8, August 2017, LIT_4736

Therefore using the emission benchmark value for benzene, as a conservative comparator, the emission benchmark value is predicted to be exceeded up to 5 fold. This exceedance will occur approximately 7.25% of the time.

Within a 21 day batch there is no release of AGE until day 12. As 3.5 batches are started per week, once the manufacturing process is operational there may be up to 10 batches in progress at any one time.

If the permit application assessment by NRW determines that emissions to air monitoring is required then, based on the batch and process times above, it is proposed that a three-day monitoring window will be long enough to capture actual emission levels of AGE. If deemed appropriate, it would be feasible to carry out individual monitoring for AGE using an appropriate methodology such as sorbent tubes with gas chromatography analysis in line with Technical Guidance Note M16[19].

9.4.3.4 *Epichlorohydrin*

An assessment of epichlorohydrin emissions has been included as this is the only other VOC that is categorised as highly harmful. The estimated emission data for epichlorohydrin shows that the duration of any emission event is longer than for AGE but the mass is substantially less as shown in Table 11 below:

Table 11: Predicted emissions of epichlorohydrin in a batch

Duration (hrs)	Epichlorohydrin (kg/h)
6.0	0.000333
0.5	0.000247
1.0	0.018
1.0	0.00127
6.0	0.000333
0.5	0.000255
1.0	0.018
1.0	0.00127

Contrary to the Briggs data in Appendix B the emission events represented in the two rows highlighted in yellow in Table 11 (tank fill time) are actually no longer likely to occur. This emission value was associated with filling the epichlorohydrin tank (100 L working volume) before dosing it to the process. There is now a system similar to that used in the tank farm: the drum is emptied by a pump and pumped into this small tank. The air/vapour that is displaced is then returned back to the drum.

Discounting the 1 hr tank fill time, in terms of annual operations (48 weeks, 24 hrs a day = 8064 hrs / 167 batches per year) the total duration of emissions over a year equates to 2,505 hrs. This is approximately 31% of operational hours.

The above detail on epichlorohydrin has been included for completeness. However, it is not proposed to carry out individual monitoring of epichlorohydrin released from the main stack as the predicted emissions fall below the conservative comparator benchmark emission value for benzene as described in Section 9.3.

10 Monitoring of emissions to sewer

As per the draft consent letter as per Appendix G, DCWW (Welsh Water) have granted permission for Trade Effluent to be communicated into the public sewer provided:

- The maximum volume of trade effluent does not exceed 100 cubic metres per day at a flow rate of no more than 3 litres/ second. Flow monitoring will be recorded via a metering device, downstream of the underground storage tank to verify the volume communicated to the public sewerage network is correct. This will enable daily flow meter readings to provide cumulative volumes for compliance and charging purposes;
- All effluents are tested for pH and Total Organic Carbon (TOC) prior to discharge to ensure compliance with the consent limits. Both Total Organic Carbon (TOC) and pH will be tested automatically as part of process control. It will only be released to sewer if it falls within the agreed limits;
- The consent limits are:
  - Settled Chemical Oxygen Demand load of 100 kilograms per day;
  - Total Suspended Solids limit of 100 milligrams per litre;
  - Ammonia (as N) 10 milligrams per litre;
  - Ethanol load of 10 kilograms per day;
  - Toluene 1.0 milligram per litre; and
  - Total Sulphate 1800 milligrams per litre.

Section 8.2 outlines how the sewer emissions will be tested to be in line with the Trade Effluent consent.

11 Emissions control during abnormal events

The process controls are designed to maximise the success of each batch and ensure emission limits remain within authorised limits as defined by the permit. They are also there to prevent any health and safety incidents, ensuring the right fail safe mechanisms are in place should any equipment fail. However, the Operator has planned for the worst, to ensure during an abnormal event, environmental and human health protection remain at the forefront of plant design.

This section specifically outlines measures to control emissions to air during maintenance and emergency situations that may either affect the ability of the site to operate effectively or result in exceedances of the permitted emission limits.

It sets out the ways in which the Operator will invoke an action plan for abnormal event scenarios (including emergencies, maintenance, breakdowns, etc.).

Table 12 provides a summary of the foreseeable situations that may compromise the Operator's ability to prevent and/or minimise releases from the process and the actions to be taken to minimise the impact.

Where planned or emergency maintenance of the facility equipment has to be carried out the Operator will contact the EA to notify them of the event. The Operator shall provide details of the event, details of actions being taken to resolve the issue and likely timescale to rectify.

Table 12: Emission control during abnormal events

Contingency event	Measures to prevent/ reduce likelihood of event	Contingency
Failure of Plant and / or Process Equipment		
Failure of nitrogen blanketing system	To ensure adequate supply of nitrogen, nitrogen pressure and oxygen content are constantly monitored, with alarms on low nitrogen pressure or high oxygen. Flow monitors will be located on key vessels (such as hydrogen producing vessels) to ensure loss of nitrogen is quickly identified. All downstream equipment has over pressure protection to prevent overpressure protection scenarios during use of nitrogen. The process area will have oxygen detection and a high degree of ventilation As part of the standard operating procedures, nitrogen purges and their quality will be monitored at regular intervals. Pressure monitoring during purge cycles, will be conducted by watchdog timers. All nitrogen distribution pipework will be located indoors, to prevent the freezing of valves, fittings, relief valves etc. during cold weather.	There are two nitrogen storage tanks located outside the building, which contain sufficient quantities of nitrogen to inert any reactions that may be going on at any one time.
Failure of compressed air system	Air pressure is monitored and trended, with alarms on low air pressure. Air production occurs inside the building, preventing any freezing of the distribution system in cold weather. Over-pressure protection is available.	There is some limited compressed air storage. The compressor is actually made up of two compressors (P&ID 706) so downtime is reduced as the chance of both failing is very slim. In the case of air failure, all valves across the plant will fail safe (closed, open or "as is") to give the safest option. For example, a chemical addition valve will likely fail closed; the quench tank valves will fail "as is" to ensure the quench tanks can still be operated if needed. Vent routing will fail open.
Failure of chilled water circulation	Chilled water supply and return temperature, flow and pressure will be constantly monitored.	If the condensers fail (chilled water circulation), the plant will go into a controlled 'hold state', with operations being limited until the process is safe to start again. At worst, mains water can be flowed through the condensers at ambient rather than chilled temperature.
Failure of temperature control system	Temperature Control Units are equipped with alarms if there are any losses of chilled/ hot water or cooling/ heating capability.	If this system fails, the plant will go into a controlled 'hold state', with operations being limited until the process is safe to start again.
Failure of water purification system.	Flow and level monitoring downstream of the purified water system is installed.	This system is not deemed to be critical to the environmental management of the process. Although, there is a 10,000ltr buffer tank to provide some supply if required.

Contingency event	Measures to prevent/ reduce likelihood of event	Contingency
Failure of main stack fan	The stack has two fans to ensure air emissions from the main/common stack can still be released at the required velocity even if one fan fails, with the aim being to maintain a minimum vapour speed of 15m/s at all times. There is an air bleed control valve upstream of the vent fan inlet seal pot, drawing in on low process vent flow. A flowmeter is fitted to the vent stack to monitor exit velocity. An alarm sounds if <15m/s and the SCADA system puts the plant into a controlled hold, alerting the operator to the issue so it can be rectified, during which time the velocity speed will still be maintained by the standby fan.	If one fan fails, the Operator is alerted via the SCADA and the plant put into a controlled 'hold' whilst the other fan is reinstated.
Accidental Spillage		
Spillage of liquid in tank farm	The tanks stored within the tank farm are fit for purpose and subject to frequent visual checks, which form part of the site EMS. All tanks have continuous level monitoring. The bund is equipped with flammable vapour detectors (% Lower Explosive Limit) that will alarm and notify personnel if a spillage occurs. In the event of vessel rupture within the tank farm, liquid will be held within the above ground bund (wall height approximately 1.2m). The bund has been water tested prior to commissioning. Operational management procedures will be in place to manage the tank farm.	The tank farm bund system has been designed in accordance with CIRIA report C736 – containment systems for the prevention of pollution, with appropriate allowances for rainfall events in the containment capacity. As an additional health and safety precaution, foam cannons are in place to cover the bunded area and crash tank simultaneously in a foam blanket if required to prevent the risk of fire or escape of chemicals/ vapours into the environment.[21]
Spillage during loading or off-loading tanker	All road tanker filling and emptying is done under a closed loop vapour return system, to prevent vapour, odour releases and spillages during this process. Operational management procedures will be in place to manage this activity. The tanker off-loading area is located directly above the crash tank enabling any spillages from tankers to be contained within the below ground crash tank.	The tanker off-load area has been designed with a high level/ ridged crown line on its outside edge with falls created to direct run-off within this area towards the crash tank inlet holes. The containment volume of the crash-tank caters for deliveries with a maximum load of 28,000 litres. As an additional health and safety precaution, foam cannons are in place to cover the bunded area and crash tank simultaneously in a foam blanket if required to prevent the risk of fire or escape of chemicals/ vapours into the environment.[21]
Spillage of powder in powder room	Powders are stored in suitable packaging. There is extraction provided to prevent dust formation. Spillages are reduced through good housekeeping. Minimal movement of large bulk bags is required. Smaller packs of higher value raw material inherently limit quantity of spill.	Dispensary extraction system has sufficient power to be used as a vacuum system to clean up powders. Powders are not to be swept up (due to static risks) or washed away (due to potential reactions and then moisture in the environment).

[21] CD Gray Associates Ltd (December 2017). Drainage Philosophy Purolite. CDGA-9021-REPO1-R4. (Appendix C).

Contingency event	Measures to prevent/ reduce likelihood of event	Contingency
Spillage of flammable liquid in store	Floor drains drain to crash tank. Epi drum is sat on a bund that is fitted with level detection to alarm the operator. If the connected IBC/drum registers as empty there is a warning on the control system.	Flush drains with water to remove flammable liquid from building. All operators are trained in spillage procedures.
Spillage inside production area	Floor drains drain to crash tank. All pipework is fully welded with exception of flanges to valves and vessels (leak potential is reduced across plant on longer pipe runs from tank farm/warehouse.)	This drains to the crash tank (see above).
Fire		
Chemical fire	The risk of deliberate or accidental combustion of chemicals is low due to the foam cannon system, which will be deployed in the instant of detection of any spillage in the crash tank or in the outside tank bund, which will smother the spillage and extinguish the ignition source. This is in addition to other fire prevention methods including site security. All powder transfer systems are earth bonded and the earthing system continually tested. This is to ensure the build-up of static charge does not occur (which could act as a source of ignition leading to an explosion).	The crash tank and / or bund will contain foam used to suppress any fire.
Fire leading to high pressure in tanks and spillage	The storage tanks in the tank farm as well as process vessels are all fitted with pressure relief. The process vessels within the building production area have pressure relief valves and/or bursting discs with pipework sized to route the pressure relief vents to the external of the building. Pressure relief valves and /or bursting discs will only be triggered with significant pressure increases caused by scenarios such as external fires that cause the contents to boil and vaporise.	A foam cannon fire suppression system automatically covers the crash tank and tank farm in a foam blanket in the event of a major spillage;
Explosion		
Explosion relating to process vessels or raw material storage	The process is highly controlled, to minimise the risk of this occurring. Process vessels with explosion risk are operated with an inert atmosphere. Vessels are pressure rated to contain any explosion and vent to a safe location. Ignition sources are forbidden on site. All electrical equipment is ATEX rated appropriate for the solvent and zone according to the Hazardous Area Classification.	Equipment and control room areas have been designed to cope with explosions or pressure bursts - in this unlikely event, the HAZOP team identified possible locations of process explosions leading to pressure bursts, namely vessel RE02, RE05A/B, RE08 and CR10A. Briggs of Burton PLC have designed and incorporated higher-pressure ratings for these vessels (8barG) to contain explosions within the vessels.
Surface water flooding		
Surface water flood external yard	Drainage infrastructure suitably designed to cope with expected rainfall events.	Infrastructure has been designed such that if the yard flooded, key infrastructure would not be impacted.
Mains electricity failure		
Resulting in a possible loss of air supply to the plant	All valves are designed to fail in their fail-safe state. Valve status monitoring determines if values are in the correct position, with pressure alarms on the air supply system.	The plant is designed to shut down in a safe state in this occurrence.

Contingency event	Measures to prevent/ reduce likelihood of event	Contingency
Resulting in a possible loss of electrical power supply to the plant.	No back-up power arrangements in place.	The plant is designed to shut down in a safe state in this occurrence.

Figures

Figure 1 - Site location plan – Drawing ref SPC0055/ME17.11.23/Site Location Plan/V1/Purolite

Figure 2 - Aquifer map (provided by Natural Resources Wales)

Figure 3 - Ecological receptor plan – Drawing ref SPC0055/ME17.11.23/Ecological Receptors/V1/Purolite

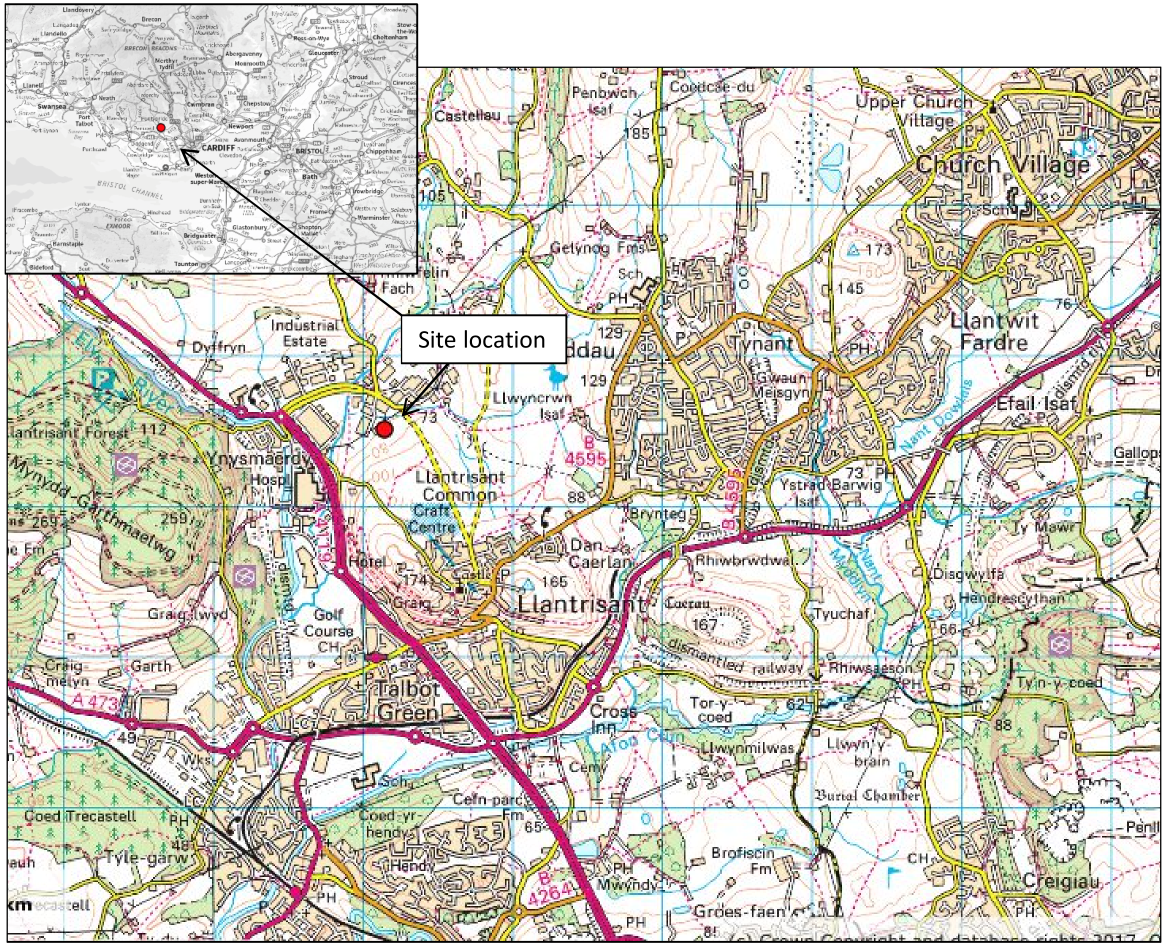
Figure 4 - Flood risk plan – Drawing ref SPC0055/ME17.11.23/Flood Risk Plan/V1/Purolite

Figure 5 - Permitted area plan

Figure 6 - Site layout and surfacing plan – CDGA-9021-301-P1-SITE LAYOUT SURFACING PLAN

Figure 7 - Site drainage plan - CDGA-9021-300-P1-SITE DRAINAGE PLAN

Figure 8 - Emission point plan- MG1939-OGA-010_1_A Emission Point Plan



Project: Purolite, Unit C, Llantrisant Business Park, Llantrisant, Rhondda Cynon Taff, CF72 8LF

Title: Site Location Plan

Reference number: SPC0055/ME17.11.23/Site Location Plan/V1/Purolite

Date: December 2017

Produced by: Amy Wolff, Melbury Environmental Limited

Cyfoeth Naturiol Cymru
Natural Resources Wales

Legend

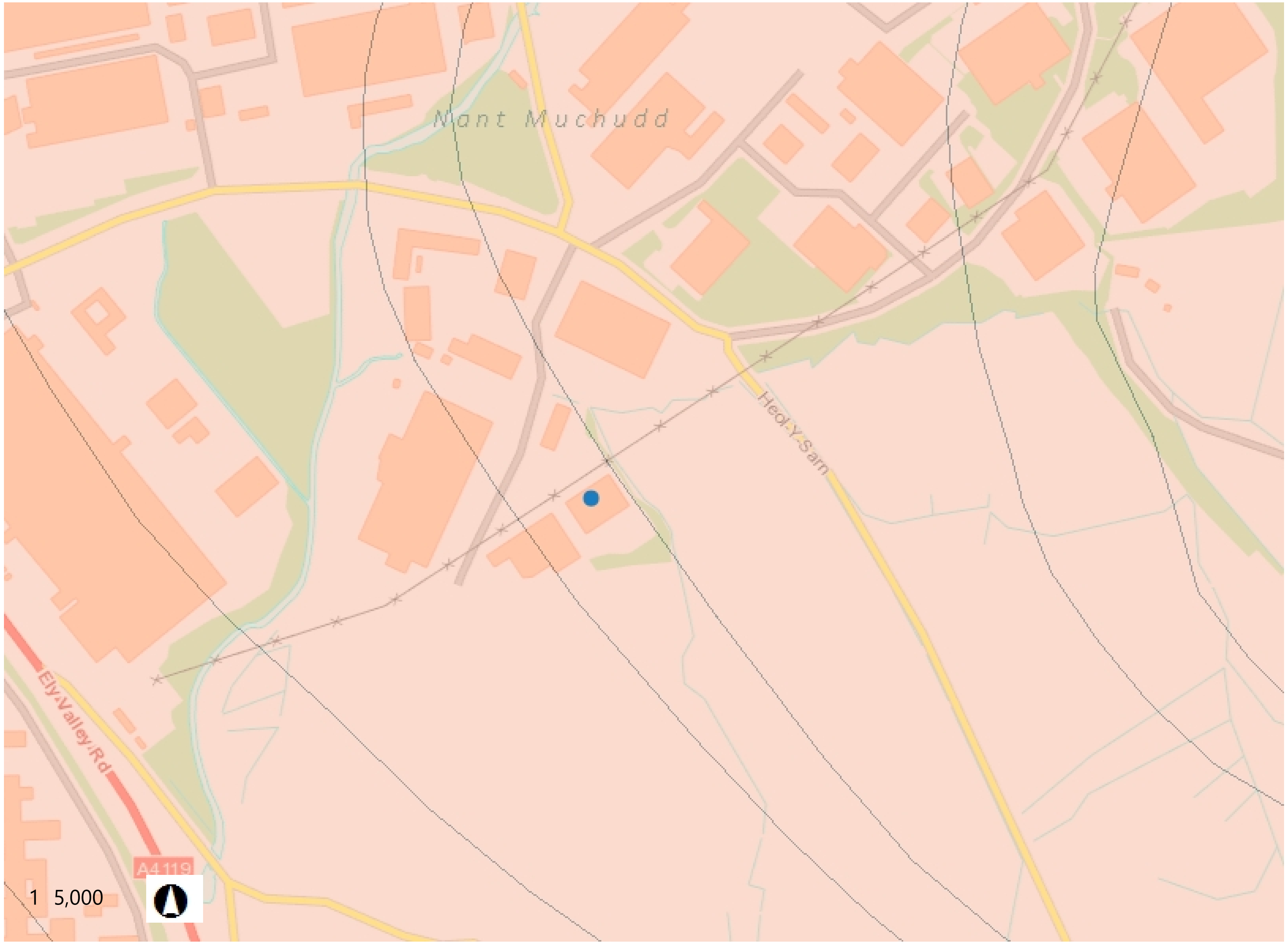
Aquifer Designation (Bedrock)

- Principal
- Secondary (undifferentiated)
- Secondary A
- Secondary B
- Unproductive

Aquifer Designation (Superficial)

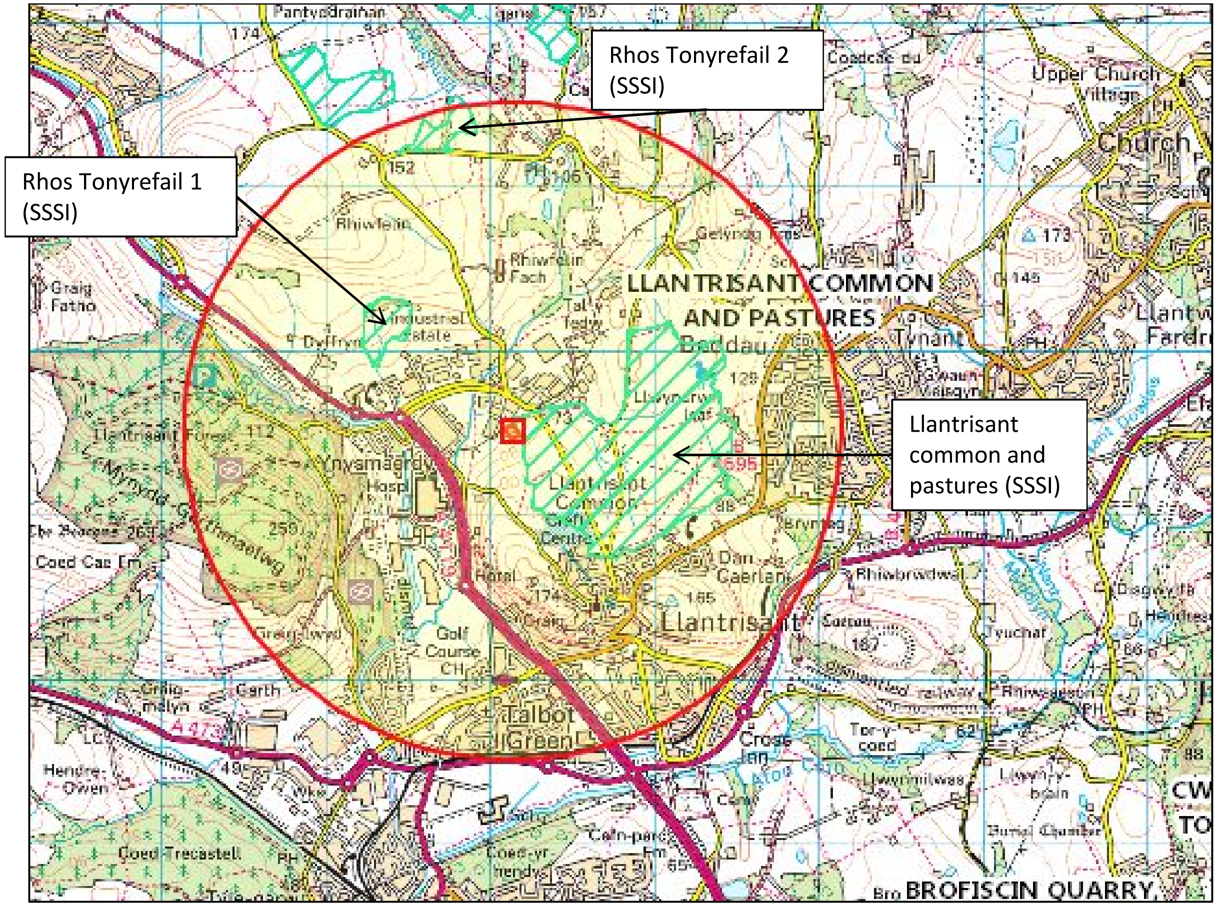
- <all other values>
- Secondary (undifferentiated)
- Secondary A
- Secondary B
- Unproductive

Notes



0.3 0 0.13 0.3 Kilometers

British_National_Grid



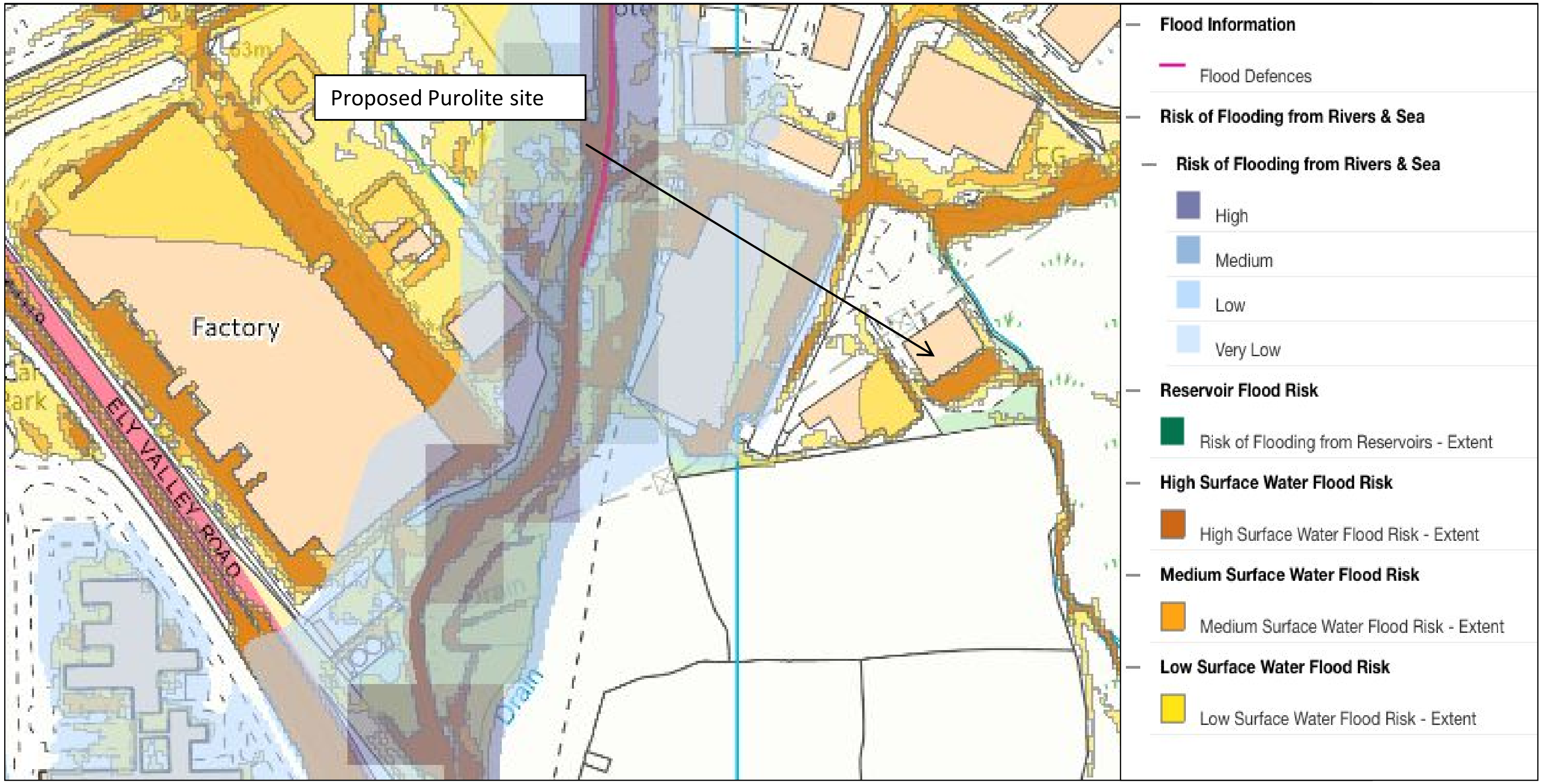
Project: Purolite, Unit C, Llantrisant Business Park, Llantrisant, Rhondda Cynon Taff, CF72 8LF

Title: Location of ecological receptors with 2km of site

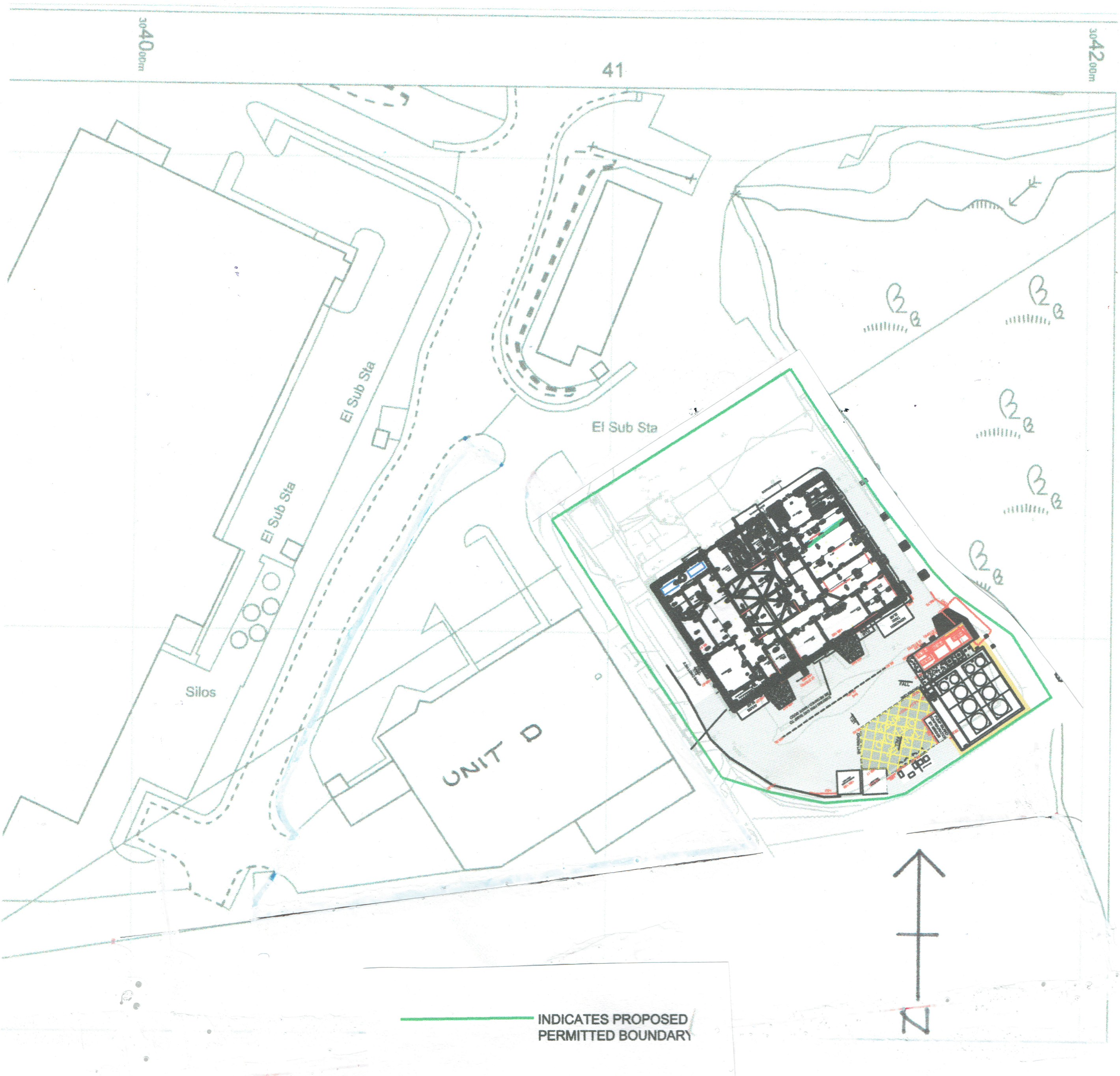
Reference number: SPC0055/ME17.11.23/Ecological Receptors/V1/Purolite

Date: December 2017

Produced by: Amy Wolff, Melbury Environmental Limited



Project: Purolite, Unit C, Llantrisant Business Park, Llantrisant, Rhondda Cynon Taff, CF72 8LF
Title: Flood Risk Plan
Reference number: SPC0055/ME17.11.23/Flood Risk Plan/V1/Purolite
Date: December 2017
Produced by: Amy Wolff, Melbury Environmental Limited



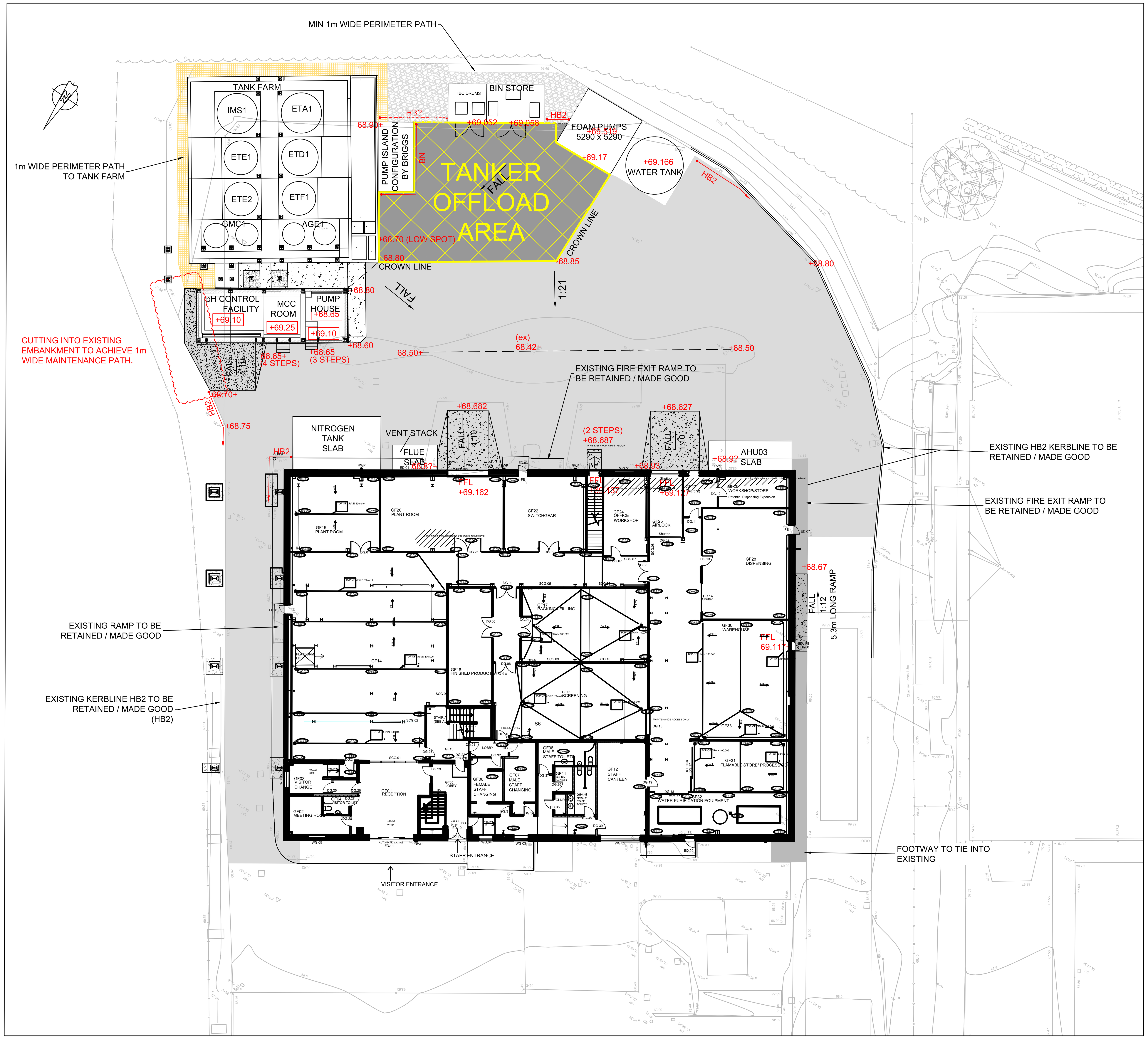
PROPOSED PERMITTED AREA PLAN 1:1250 @ A4

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

ALL WORK TO BE CARRIED OUT IN ACCORDANCE WITH CURRENT CDM REGULATIONS 2015 AND HSG150. IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, PLEASE NOTE THE FOLLOWING:

LEGEND / KEY TO SYMBOLS

- TARMAC SURFACE: REGRADING REQUIRED TO CREATE OPPOSING FALLS BETWEEN TANKER OFFLOAD AREA AND MAIN SERVICE YARD
- AREA OF MAKING GOOD / RESURFACING TO REGULATED LEVEL DIFFERENCE
- PAVING SLABS - PEDESTRIAN LOADING
- HB2 HALF BATTERED KERB
- BN BULLNOSED KERB LAID FLUSH
- PRIMROSE ROAD MARKINGS
- PROPOSED CONCRETE RAMP
- GRAVEL FILLED AREA
- +x.xx PROPOSED LEVEL



NOTES

1. DESIGN ASSUMES THAT TANKER OFFLOADING IS UNDERTAKEN ONLY WHEN TANKER IS STATIONARY AND WHOLLY POSITIONED WITHIN HATCHED AREA.
2. ASSUMED TANKER DIMENSIONS AND TYPICAL MANOUEVERS / SWEPT PATH ANALYSIS ARE ILLUSTRATED ON DRAWING CDGA-9021-100.
3. FOR SETTING OUT CO-ORDINATES REFER TO DRAWING CDGA-9021-105.
4. WHERE FULL CONSTRUCTION MAKE-UP IS REQUIRED CONTRACTOR TO UNDERTAKE CBR TESTING AT FORMATION LEVEL OF NEW SURFACE AND ADJUST SUB-BASE THICKNESS TO SUIT
5. WHERE FULL CONSTRUCTION MAKE-UP IS NOT REQUIRED & EXTERNALS ARE TO BE REGULATED TO SUIT NEW LEVELS ONLY; ON THE BASIS THAT THE EXISTING SERVICE YARD CONSTRUCTION IS FIT FOR PURPOSE FOR EQUIVALENT LOADING IN PROPOSED APPLICATION SURFACE COURSE TO BE USED AS REGULATING LAYER - 40mm MINIMUM THICKNESS OF ANY RE-SURFACED AREA.
6. FIRE EXIT RAMP WIDTHS, LENGTHS, GRADIENTS AND LANDING WIDTHS DO NOT ACHIEVE BUILDING REGS PART M DDA COMPLIANCE AND THE ARRANGEMENT IS SUBJECT TO REVIEW BY THE ARCHITECT INLINE WITH THEIR ACCESS AND FIRE STRATEGY.

REV	DESCRIPTION	BY	DATE
P1	FIRST ISSUE	GJ	08/12/2017

status: FOR INFORMATION

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client: PUROLITE

project: PUROLITE UNIT C, LLANTRISANT

drawing title: SITE LAYOUT SURFACING PLAN

drawn LKJ	chkd NF	project no. 9021	
date drawn 08/12/2017		drg no. 301	rev. P1
scale @A1 1:200			

NOTES: MAINTAINING FLOWS IN EXISTING DRAIN RUNS:

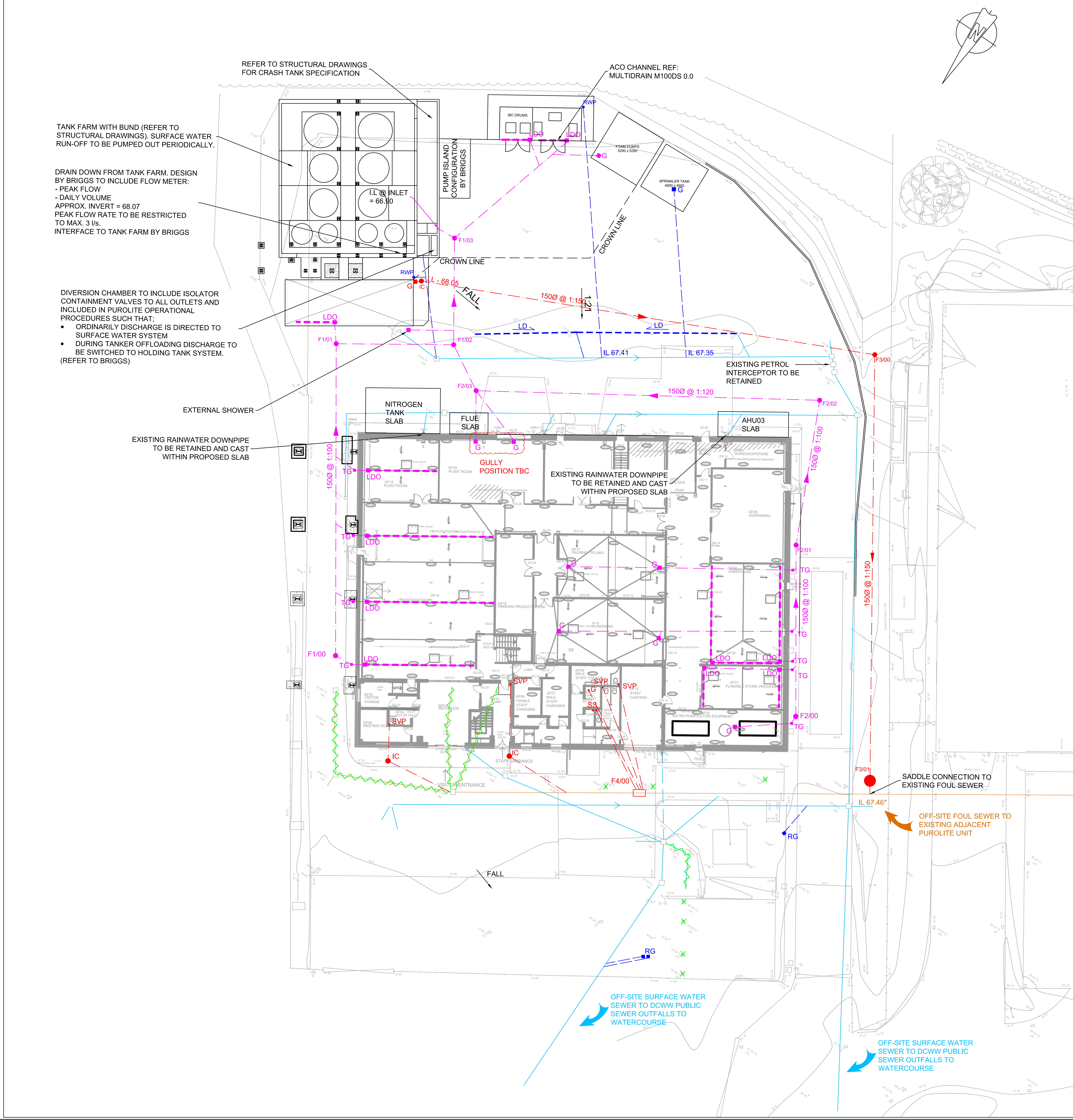
1. NO EXISTING DRAINS OR MANHOLES SHALL BE STOPPED UP, DIVERTED OR REMOVED WITHOUT THE PRIOR WRITTEN APPROVAL OF THE ENGINEER.
2. UNDER NO CIRCUMSTANCES SHALL SURFACE/GROUND WATER BE DISCHARGED INTO ANY FOUL DRAIN OR MANHOLE OR, FOUL FLOW DISCHARGED INTO ANY SURFACE WATER SYSTEM, EXISTING OR PROPOSED.

NOTES: EXISTING MANHOLES AND DRAINS

1. THE POSITIONS AND LEVELS SHOWN FOR EXISTING MANHOLES AND DRAINS ARE APPROXIMATE.
2. AT THE COMMENCEMENT OF WORKS THE CONTRACTOR SHALL UNDERTAKE A FULL SURVEY OF THE EXISTING DRAINAGE TO VERIFY THE DETAILS SHOWN. ANY SIGNIFICANT DISCREPANCIES OR ANY ADDITIONAL DRAINAGE NOT IDENTIFIED SHALL BE REPORTED TO THE ENGINEER IMMEDIATELY.
3. IF ANY EXISTING FOUL OR SURFACE WATER DRAIN THAT HAS NOT BEEN IDENTIFIED IS FOUND WITHIN THE SITE THE CONTRACTOR IS TO INVESTIGATE THE ORIGIN AND STATUS OF THE DRAIN AND REPORT TO THE ENGINEER FOR INSTRUCTION.
4. REDUNDANT DRAINS ARE TO BE DEALT WITH AS FOLLOWS:
   A. WITHIN THE FOOTPRINT OF THE NEW BUILDING:-DRAINS ARE TO BE REMOVED AND THE RESULTING TRENCH BACKFILLED AND COMPACTED WITH SUITABLE FILL MATERIAL.
   B. OUTSIDE THE BUILDING FOOTPRINT:
      DEPTH >1.0m FROM FINISHED LEVELS TO CROWN OF PIPE :-
      DRAINS ARE TO BE ABANDONED
      DEPTH <1.0m FROM FINISHED LEVELS TO CROWN OF PIPE:-
      DRAINS TO BE REMOVED AND BACKFILLED
   C. ALL ABANDONED DRAIN RUNS SHALL BE SEALED AT EACH END WITH GEN3 CONCRETE.
5. MANHOLES TO BE REMOVED SHALL BE COMPLETELY BROKEN OUT AND BACKFILLED WITH SUITABLE COMPACTED FILL MATERIAL. UNDAMAGED COVERS AND FRAMES SHALL BE RETAINED ON SITE FOR RE-USE WHERE APPROPRIATE.
6. WHERE NEW MANHOLES ARE TO BE CONSTRUCTED ON EXISTING DRAIN RUNS, ROCKER PIPES SHALL BE INSTALLED ON ALL ENTRIES, INCLUDING THE EXISTING RUN, IN ACCORDANCE WITH THE SPECIFICATION.

MANHOLE SCHEDULE

Manhole Number / Co-ordinates	Cover Level	Depth To Invert	Connections	Inverts		Pipe Dia.	Manhole Type/Size
F1/00 E: 304148.665 N: 184530.700	68.75	1.00	0, TG	0	67.75	150Ø	TYPE 3 500Ø D400
F1/01 E: 304165.929 N: 184504.998	68.75	1.30	G, 0, 1	1 0	67.45 67.45	150Ø 150Ø	TYPE 3 500Ø D400
F1/02 E: 304156.210 N: 184498.565	68.50	1.50	0, 1, 2	2 1 0	67.00 67.00 67.00	150Ø 150Ø 150Ø	TYPE 3 500Ø D400
F1/03 E: 304162.054 N: 184489.735	- -	0.85	LDO, 0, 1	1 0	66.92 66.92	150Ø 150Ø	TYPE 3 500Ø D400
F2/00 E: 304107.423 N: 184510.160	68.75	0.75	0, TG	0	68.00	150Ø	TYPE 4 500Ø B125
F2/01 E: 304116.906 N: 184496.050	68.75	1.62	0, 1	1 0	67.83 67.83	150Ø 150Ø	TYPE 4 500Ø B125
F2/02 E: 304123.009 N: 184482.822	68.70	1.02	0, 1	1 0	67.68 67.68	150Ø 150Ø	TYPE 3 500Ø D400
F2/03 E: 304151.809 N: 184501.103	68.65	1.25	0, 1, G, G	1 0	67.40 67.40	150Ø 150Ø	TYPE 3 500Ø D400
F3/00 E: 304121.004 N: 184476.012	69.00	1.10	1, 0	1 0	67.75 67.75	150Ø 150Ø	TYPE 4 500Ø B125
F3/01 E: 304097.774 N: 184511.344	68.50	1.03	1, 0	1 0	67.47 67.47	150Ø 150Ø	TYPE 3 PCC 1200Ø B125
F4/00 E: 304116.048 N: 184525.152	68.61	1.03	SS, G, SVP, SVP, 0	0	67.58	100Ø	AS-EXISTING B125 COVER



SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

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LEGEND / KEY TO SYMBOLS

- EXISTING SURFACE WATER DRAINAGE
- EXISTING FOUL WATER DRAINAGE
- EXISTING DRAINAGE TO BE MADE REDUNDANT
- PROPOSED SURFACE WATER DRAINAGE
- PROPOSED FOUL WATER TO DCWW NETWORK
- PROPOSED FOUL WATER TO CRASH TANK
- LINEAR DRAIN
- RG ROAD GULLY
- LDO LINEAR DRAIN OUTLET
- RWP RAINWATER DOWNPIPE
- SVP/SS/SC SOIL VENT PIPE / STACK / CONNECTION
- IC INSPECTION CHAMBER
- * DENOTES LEVEL TO BE CONFIRMED
- TG TRAPPED GULLY

NOTES

1. S106 APPROVALS FOR FOUL AND SURFACE WATER TO BE OBTAINED BY CONTRACTOR PRIOR TO CONNECTION TO SEWER
2. TRADE EFFLUENT LICENCE TO BE OBTAINED BY PUROLITE
3. REFER TO STRUCTURAL DRAWINGS FOR DETAILS OF EXTERNAL SLAB REINSTATEMENT
4. FOUL INTERNAL RUNS TO BE 100Ø AT A MINIMUM GRADIENT OF 1:40
5. REFER TO ARCHITECT FOR INTERNAL DRAINAGE SETTING OUT
6. SURFACE WATER RWP / GULLY / LINEAR DRAIN CONNECTIONS TO BE 150Ø AT A MINIMUM GRADIENT OF 1:100
7. ALL PIPES, CHAMBERS & FITTINGS TO BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURERS INSTRUCTIONS
8. IN FOUL MANHOLES WHERE THE ANGLE OF A BRANCH CONNECTION IS MORE THAN 45° A THREE QUARTER SECTION BRANCH SHOULD BE USED.
9. FOR PIPE BEDDING AND SURROUND DETAILS REFER TO CONSTRUCTION DETAILS.
10. MANHOLE COVERS, GULLYS AND LINEAR DRAINS SUBJECT TO TRAFFIC LOADING TO BE CLASS D400 NON-ROCKING, ALL OTHERS TO BE CLASS C250 TO BS EN124.
11. ALL SADDLE CONNECTIONS TO BE CROWN TO CROWN.
12. ALL CROSSOVERS <300mm CLEARANCE TO BE CONCRETE ENCASED.
13. DRAINS TO BE LAID TO CONSTANT FALLS BETWEEN LEVELS.
14. ALL CONNECTIONS SADDLED TO THE MAIN CARRIER DRAIN TO HAVE A RODDABLE ACCESS POINT ABOVE GROUND.
15. PRESENCE OF BELOW GROUND SERVICES UNKNOWN

REV	DESCRIPTION	BY	DATE
P1	FIRST ISSUE	GJ	08/12/2017

status: FOR INFORMATION

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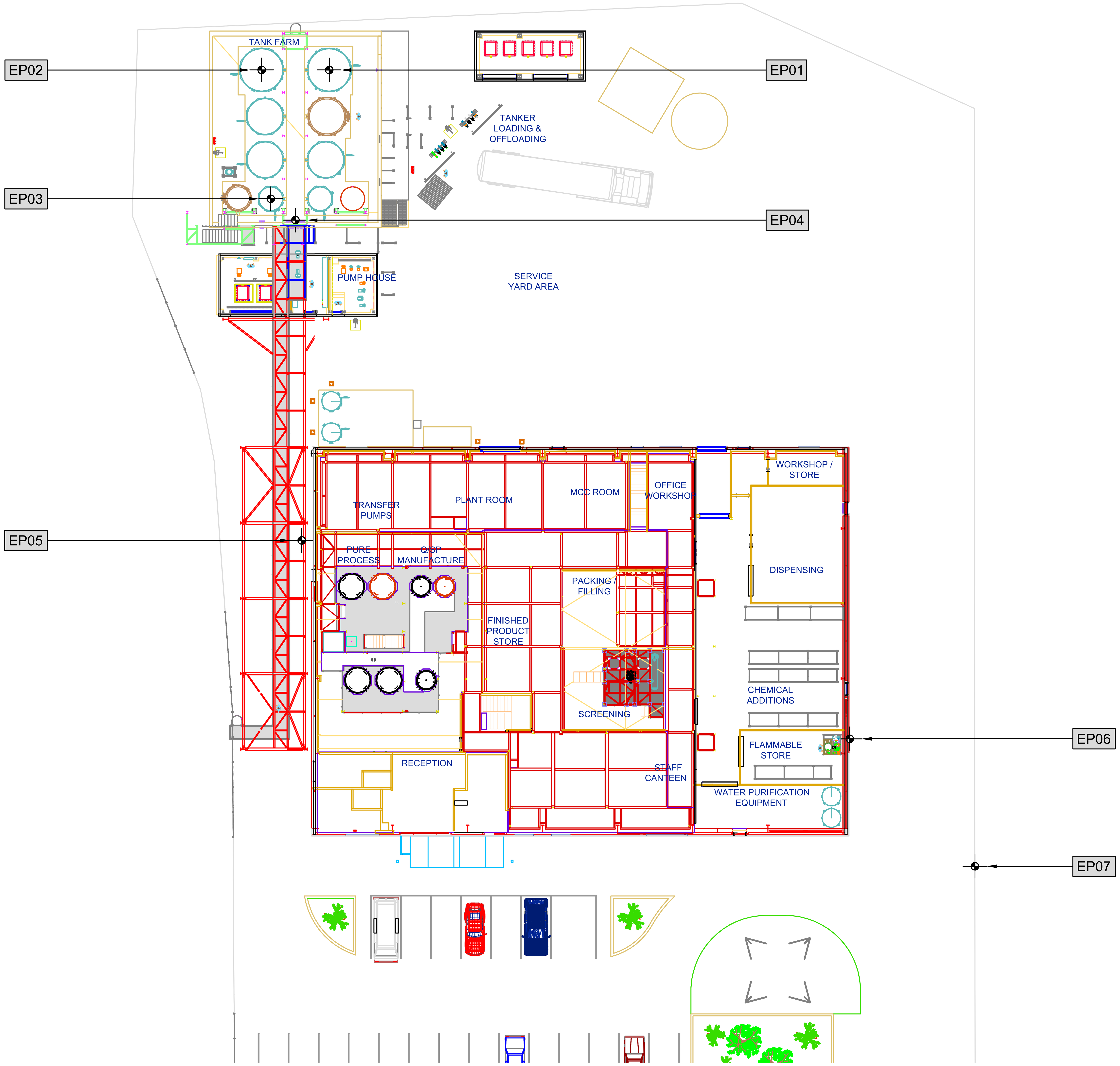
client: PUROLITE

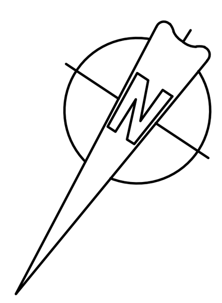
project: PUROLITE UNIT C, LLANTRISANT

drawing title: SITE DRAINAGE PLAN

drawn	chkd	project no.	
LKJ	DM	9021	
date drawn: 08/12/2017		drg no.: 300	rev.: P1
scale @A1: 1:200			



PLAN VIEW - BUILDING GROUND FLOOR



EMISSION POINT LOCATION

POINT No.	DUTY
EP01	IMS TANK VENT STACK
EP02	WASTE TANK A VENT STACK
EP03	TOLUENE TANK VENT STACK
EP04	COMMON VENT STACK
EP05	HYDROGEN VENT ROUTING
EP06	EPICHLOROHYDRIN TANK VENT STACK
EP07	FOUL DRAINS (CONNECTION TO MAIN FOUL DRAIN)

DRAWING CURRENT STATUS

ISSUE A

ISSUE	MOD DATE	ISSUE	MOD DATE	ISSUE	MOD DATE	ISSUE	MOD DATE	ISSUE	MOD DATE	ISSUE	MOD DATE	ISSUE	MOD DATE	ISSUE	MOD DATE	ISSUE	MOD DATE
RAISED BY	MRH No.	RAISED BY	MRH No.	RAISED BY	MRH No.	RAISED BY	MRH No.	RAISED BY	MRH No.	RAISED BY	MRH No.	RAISED BY	MRH No.	RAISED BY	MRH No.	RAISED BY	MRH No.

DO NOT SCALE

BRIGGS

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Telephone : +44 (0)1283 566661
Fax : +44 (0)1283 545978
www.briggsplc.co.uk

AREA	PROJECT REF AGAROSE MAN FACILITY	LOCATION LLANTRISANT, WALES	
DRAWN BY RKW	DATE 07 Dec 2017	CLIENT PURITE	
CHECKED CVG	DATE 12 Dec 2017	DESCRIPTION AGAROSE MAN FACILITY OVERALL GENERAL ARRG'T - EMISSIONS ZONES	
APPROVED TS	DATE 12 Dec 2017		
INITIAL ISSUE DATE A 12/12/2017	PROPOSAL No. EE3200		
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Appendix A Air Quality & Odour Impact Assessment

Air quality and odour impact assessment

Report for Purolite Ltd

Order No. 88850, Reference. BG/DJ/SH

Customer:

Purolite Ltd

Customer reference:

Order No. 88850, Reference. BG/DJ/SH

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1 Introduction

Ricardo Energy & Environment have been commissioned to carry out an atmospheric dispersion modelling study to assess the impact of emissions on ambient concentrations of applicable pollutants and odour from a proposed fine chemical manufacturing facility. The objectives of the study were:

- To forecast pollutant concentrations against short-term and long-term environmental assessment limits, as set out in the guidance on *'Air emissions risk assessment for your environmental permit'*, provided by the Environment Agency and the Department for Environment, Food & Rural Affairs[1].
- To forecast odour concentrations against the applicable odour benchmark, as per the Environment Agency's "H4 Odour Management" document[2].

This report draws on the results of emission estimations provided by the plant design consultants; Briggs of Burton Plc. This estimate provided emission concentrations for a number of volatile organic compounds (VOCs) emitted from the process. This data was used to calculate concentrations, and the relative odour impact, in ambient air at sensitive receptor sites in the local area, using the atmospheric dispersion model ADMS v5.1, run using meteorological data representative of the location.

[1] Environment Agency and Department for Environment, Food & Rural Affairs (2016) *Air emissions risk assessment for your environmental permit* via https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit#environmental-standards-for-air-emissions2

[2] Environment Agency (2011) *H4 Odour Management – How to comply with your environmental permit* via https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/296737/geho0411btqm-e-e.pdf

2 Methodology

2.1 Preamble

Once released to the atmosphere, the direction of spread of pollutants is totally dependent upon the direction of the wind. The rate of dispersion depends mainly on the wind speed, but other meteorological parameters, such as air temperature, also influence dispersion rates. The stability of the atmosphere also plays an important role in atmospheric dispersion.

There are also non-meteorological factors which influence downwind pollutant concentrations:

- Distance from source: The closer a receptor is to the emission source; the greater the likely pollutant concentration at that location and the greater the probability of impact or complaint.
- The height of release: Generally, the higher the point of release; the lower the pollutant concentration in the vicinity of the source.
- Emission characteristics: Higher concentrations can be expected to affect a larger area than lower concentrations.
- Building downwash: Pollutant emissions may be subject to highly turbulent wind flows in the wake of buildings.

The combined effect of these factors will influence the impact of the emissions from the proposed facility.

2.2 Modelling

2.2.1 Model description

Ground level concentrations of released substances have been modelled using the dispersion model ADMS V5.1. ADMS is an advanced dispersion model in which the boundary layer structure is characterised by the height of the boundary layer and the Monin-Obukhov length, a length scale dependent on the friction velocity and heat flux at the surface. The model represents the concentration distributions as Gaussian in stable and neutral conditions, but the vertical distribution is non-Gaussian in convective conditions to take account of the skewed structure of the vertical component of turbulence. The model contains a meteorological pre-processor which calculates the required boundary layer parameters from surface heat flux, wind speed and boundary layer height data. Complex modules within the model allow for the effects of plume rise and the presence of buildings.

ADMS has been chosen because it is 'fitted for the purpose of the modelling procedure' as defined by the guidelines published by the Royal Meteorological Society (R Met Soc. 1995) and Guidelines for the Preparation of Dispersion Modelling Assessments for Compliance with Regulatory Requirements; an Update to the 1995 Royal Meteorological Society Guidance.

2.2.2 Meteorology

A statistical dispersion modelling run requires a minimum of five years of hourly meteorological records.

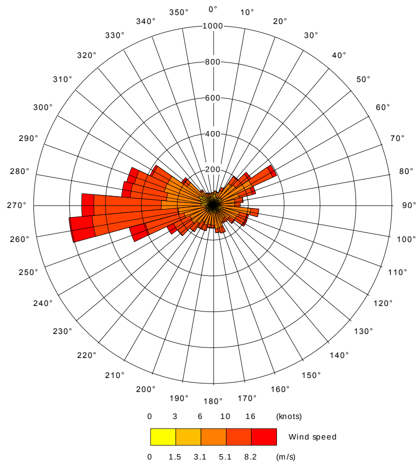
There is a meteorological station at Cardiff Airport, approximately 17 km south of the site. Due to the proximity and similarity of exposure of Cardiff Airport and the Llantrisant Business Park we consider that the records from Cardiff Airport will provide a reasonable illustration of the situation at the site and consequently they have been used in the modelling study.

Meteorological data was sourced from the NOAA surface observations archive and processed into hourly sequential ADMS format. Data filling was carried out where necessary according to the methodology provided by the USEPA in their “Meteorological Monitoring Guidance for Regulatory Modelling Applications” guidance document. The recommended filling procedure is based on the persistence method, where a missing value is replaced by the use of data from the previous hour(s). The data capture for wind direction and wind speed at the Cardiff Airport meteorological station was found to be good (>90 % data capture). Missing cloud cover data is quite common in meteorological data sets, and data for Cardiff Airport was found to have cloud cover data for ~85-90 % of hourly observations. As a result, in order to ensure data capture for all meteorological parameters was >90%, cloud cover data from nearby St Athan Airport was used to gap-fill.

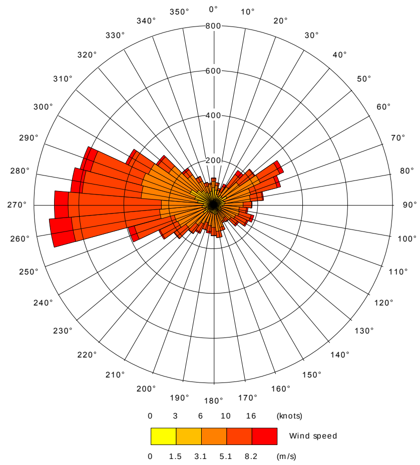
The wind rose for the weather files, derived from data from Cardiff Airport (2011- 2015) is shown in Figure 1. This illustrates the relative frequency of wind directions and wind speeds used in the modelling study.

Figure 1: Wind rose reflecting meteorological data recorded at Cardiff Airport (2011-2015)

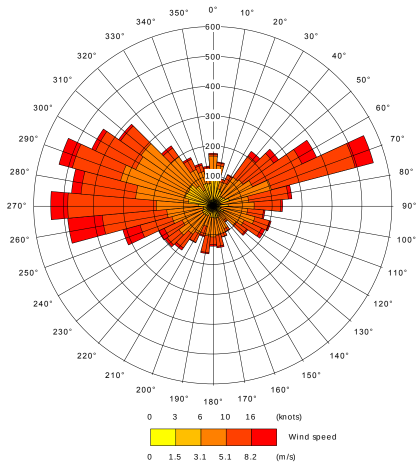
2011



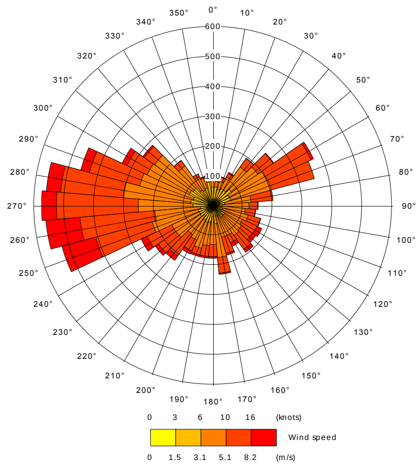
2012



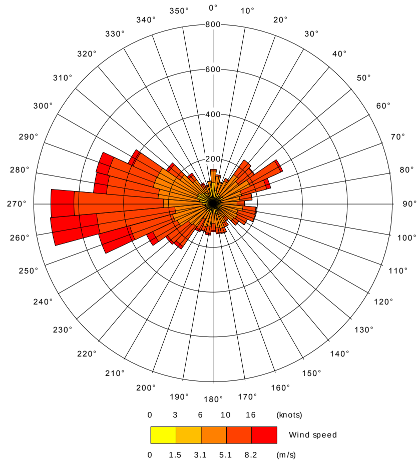
2013



2014



2015



2.2.3 Process information

This dispersion modelling exercise has been undertaken using discharge characteristics for the site provided by Purolite Ltd and Briggs, as shown in Table 1.

Table 1: Discharge characteristics

Stack parameters	Coordinates		Stack height (m)	Stack diameter (m)	Volumetric flow rate (m^3/s)	Velocity (m/s)	Temperature (°C)
	X (m)	Y (m)					
Main stack	304170	184500	9 / 12.7	0.1	0.118	15	45

The pollutants considered in the assessment are set out in Table 2. The modelling assessment was based on estimations of peak emission rates for each pollutant, which were provided by Purolite Ltd and Briggs.

Table 2: Emission rates

Pollutant	Peak emissions (g/s)
Acetic Acid	0.058
Allyl glycidyl ether (AGE)	0.38
Epichlorohydrin*	0.13
Ethanol	0.069
Ethanol (as IMS)	1.08
Hydrogen	0.88
Methanol	2.23
Toluene	1.14

The impact of these emissions was assessed by comparing the maximum ground level concentrations against their respective EALs, as set out below. Odour concentrations were calculated by dividing pollutants by their applicable published odour threshold values, and summing the total to provide the total impact in odour unit per cubic meter, which has then been assessed against an odour benchmark of 3 OU_E/m^3 as a 98th%ile, as per the Environment Agency's "H4 Odour Management"[2] Guidance.

Table 3: Environmental Assessment Levels and Odour Threshold Values

Pollutant	ST EAL (µg/m³)	LTEAL (µg/m³)	Odour threshold (mg/m³)	Odour benchmark
Acetic Acid	3,700[1]	250[1]	0.043[3]	3 OU_E/m^3 as a 98th%ile
Allyl glycidyl ether (AGE)	No EAL		44[4]	
Epichlorohydrin	No EAL		3.52[5]	
Ethanol	576,000[6]	19,200[6]	0.28[3]	
Hydrogen	No EAL		N/A	
Methanol	33,300[1]	2,660[1]	4[3]	
Toluene	8,000[1]	1,910[1]	0.644[3]	

[3] Woodfield, M. and Hall, D. (1994) Odour measurement and control – An update. AEA Technology National Environmental Technology Centre.

[4] Ruth, J.H.; Am Ind. Hyg. Assoc. J 47: A-142-51 (1986) Odor thresholds and irritation levels of several chemical substances: a review.

[5] https://www3.epa.gov/airtoxics/hlthef/epichlor.html

[6] https://www.sepa.org.uk/media/61377/ippc-h1-environmental-assessment-and-appraisal-of-bat-updated-july-2003.pdf

It is important to note that the estimation of odour concentration is based on an amalgamation of the individual compounds. The odour threshold values listed in Table 3 represent the thresholds for each substance individually, and it is possible that through their interaction, the point of detection could be different when emitted in combination.

2.2.4 Buildings affecting stack dispersion

Nearby buildings can influence the dispersion of pollutants from a stack. In order to address this, the dimensions of the main process building and the proposed tank farm, including to the height of the gantry and the tanks themselves, have been factored into the model. The parameters of these are summarised in Table 4.

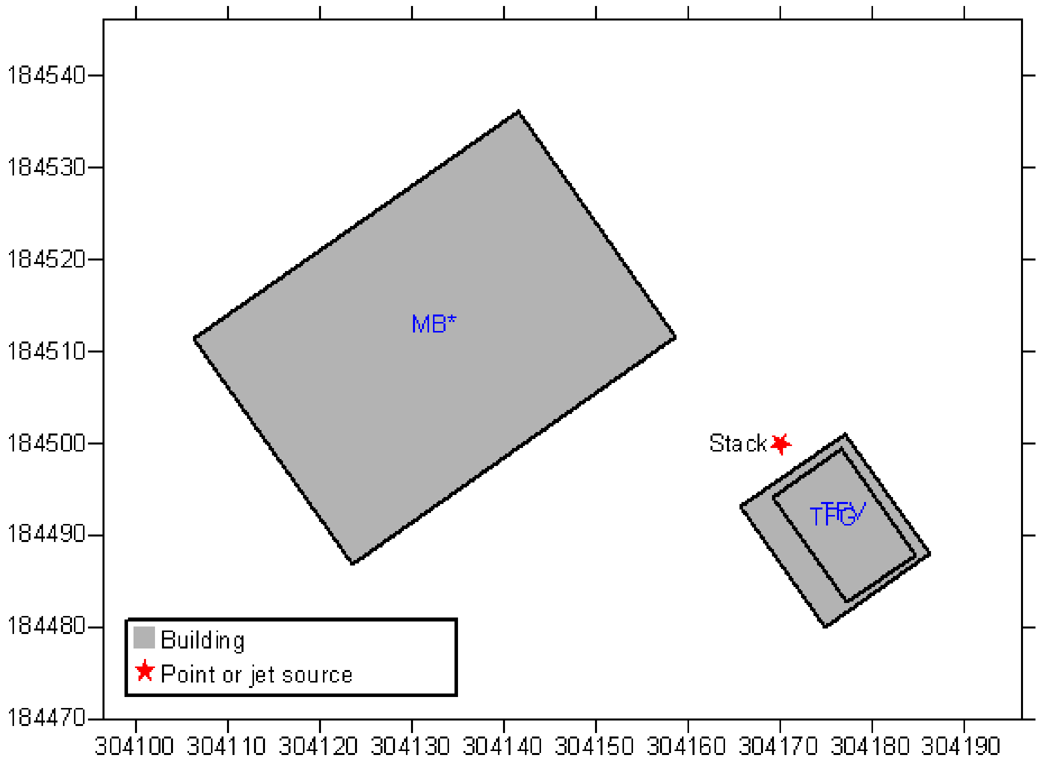
Table 4: Building parameters

Ref	Building	Centre-point		Height (m)	Length (m)	Width (m)	Angle (°)
		x (m)	y (m)				
MB	**Main building**	304133	184512	9.7	43	30	55
TFG	**Tank farm gantry**	304176	184491	6	14	16	55
TFV	**Tank farm vessels**	304177	184491	10	9	14	55

Figure 2 provides an illustration of the layout of the buildings factored into the modelling. The emission stack has been illustrated by a red star.

A screening assessment was carried out to determine which building, when identified as the "Main Building" in ADMS resulted in the highest ground level concentrations. This was found to be the main process building and as such, this was considered to be the "Main Building" for the remainder of the modelling.

Figure 2: Visualisation of buildings and emission point



2.2.5 Surface roughness and terrain

The proposed Purolite facility is located on an industrial estate in a semi-rural area to the north of the town of Llantrisant. Although there are not significant gradients in the immediate vicinity of the site, for the avoidance of doubt, the effects of terrain on dispersion of emissions from the proposed facility were considered in the assessment. Local terrain data was incorporated into the modelling study at the highest appropriate resolution.

Local land use patterns can affect the structure of the atmosphere. For example, the presence of high-rise buildings in an industrial or city centre area can result in increased turbulence in the atmosphere. Conversely, areas with low vegetation or open water may have less influence on the atmosphere, and tend to result in a more stable atmosphere. This is represented in the dispersion model using a parameter known as the “surface roughness length”. The surface roughness length used in this study was 0.2 metres, representative of the minimum surface roughness for agricultural areas.

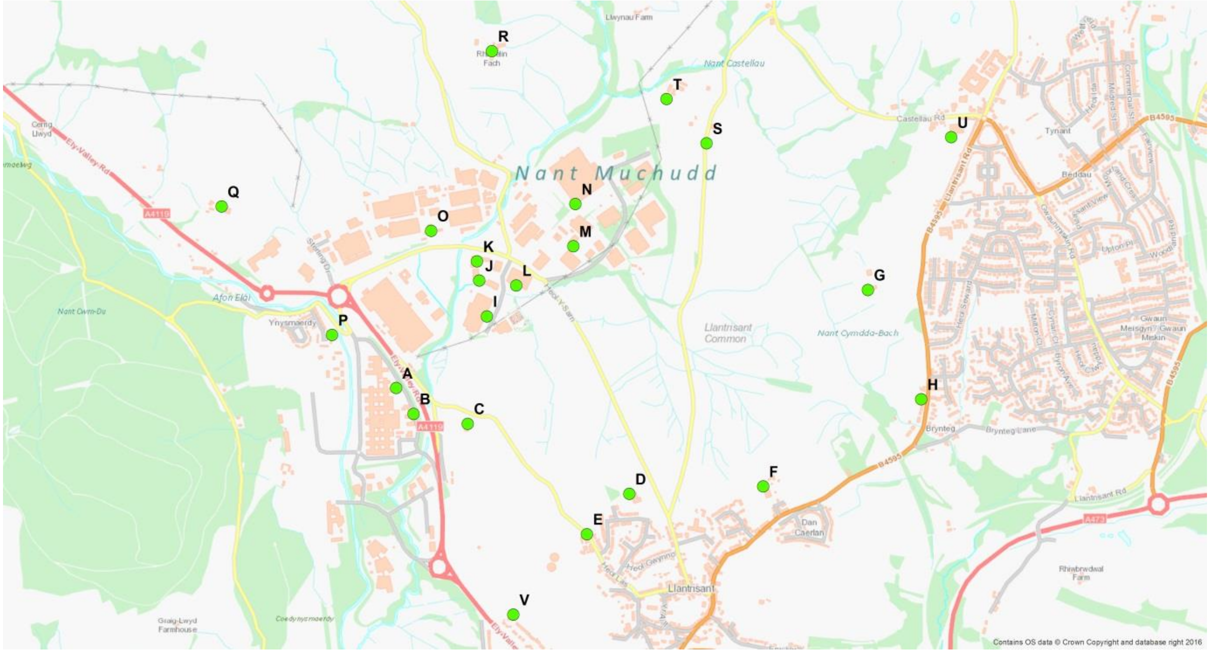
2.2.6 Discrete receptors

A selection of nearby receptor locations, including residential properties and commercial premises, have been identified to assess the impact of emissions from the proposed facility, and factored into the model as discrete receptors at 1 m above ground level. Details of the positions of the specified discrete receptor points are provided in Table 5 and illustrated in Figure 3, where the receptors are marked by green circles accompanied by their reference.

Table 5: Receptor locations used in this study

Ref.	Location	Type	X (m)	Y (m)	Approximate distance to site (km)
A	Royal Glamorgan Hospital 1	Hospital	303682	184247	0.54
B	Royal Glamorgan Hospital 2	Hospital	303747	184150	0.54
C	Farmhouse 1	Residential	303950	184113	0.44
D	Llantrisant Primary School	School	304556	183850	0.76
E	House - Heol Las	Residential	304397	183699	0.83
F	Llantrisant Rugby Football Club	Leisure	305058	183878	1.09
G	Farmhouse 2	Residential	305451	184615	1.29
H	House - B4595	Residential	305651	184205	1.52
I	RPC Containers	Commercial	304022	184516	0.14
J	The Kite Brewery	Commercial	303993	184650	0.23
K	Three Saints Hotel / The Red Mint	Hotel	303985	184722	0.29
L	Balmoral Tanks	Commercial	304132	184632	0.14
M	Euro Performance	Commercial	304346	184779	0.34
N	Universal Engineering	Commercial	304354	184937	0.48
O	The Royal Mint	Commercial / Leisure	303813	184837	0.49
P	Ynysmaerdy Terrace	Residential	303441	184446	0.72
Q	Farmhouse 3	Residential	303027	184928	1.22
R	Farmhouse 4	Residential	304041	185511	1.02
S	Farmhouse 5	Residential	304846	185165	0.96
T	Farmhouse 6	Residential	304696	185331	0.99
U	Ysgol Gymraeg Castellau	School	305764	185188	1.74
V	Dan Y Graig Heights	Residential	304121	183397	1.10

Figure 3: Illustration of discrete receptors selected around the proposed facility



2.2.7 Model scenarios considered

For the purpose of this study a series of modelling scenarios have been considered. The model runs set out in Table 6 consider the long and short-term impacts associated with emissions from the stack at a height of 9 m and 12.7 m. These stack heights have been selected as they are 3 m above the height of the Tank Farm Gantry and Main Building respectively. Pollutant concentrations have been modelled as annual average concentrations (long-term) and as maximum hourly concentrations (short-term). Odour concentrations have been modelled as a 98th%ile of 1 hour averages. This expresses the odour concentration at the worst 176th hour of the 8760 hours per year (i.e. 2% of the time).

Table 6: Modelling scenarios

<table>
<tr><th>Scenario</th><th>Substance</th><th>Stack height</th><th>Averaging period</th></tr>
<tr><td>1</td><td rowspan="4">Pollutants (individual VOCs)</td><td>9 m</td><td rowspan="2">Annual average</td></tr>
<tr><td>2</td><td>12.7 m</td></tr>
<tr><td>3</td><td>9 m</td><td rowspan="2">Max. hourly mean</td></tr>
<tr><td>4</td><td>12.7 m</td></tr>
<tr><td>5</td><td rowspan="2">Odour</td><td>9 m</td><td rowspan="2">98th%ile of hourly means</td></tr>
<tr><td>6</td><td>12.7 m</td></tr>
</table>

2.2.8 Guideline values and benchmarks

There are no mandatory or statutory numeric standards for determining whether the level of odour perceived at a specific location is acceptable or not. Numeric standards have been established by custom and practice. For example:

- A 5 OU_E/m^3 as a 98^{th}%ile 1 hour average criterion was first used at the Newbiggin-on-Sea waste water treatment works planning inquiry in 1993. The main application of this criterion is in the evaluation of statutory nuisance.
- According to the Chartered Institution of Water and Environmental management[7] *"CIWEM considers that the following framework [when dealing with sewage type odour] is the most reliable that can be defined on the basis of the limited research undertaken in the UK at the time of writing:*
  - *>10 OU_E/m^3 as a 98^{th}%ile 1 hour average - complaints are highly likely and odour exposure at these levels represents an actionable nuisance;*
  - *>5 OU_E/m^3 as a 98^{th}%ile 1 hour average - complaints may occur and depending on the sensitivity of the locality and nature of the odour this level may constitute a nuisance; and*
  - *<3 OU_E/m^3 as a 98^{th}%ile 1 hour average - 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."*

The Environment Agency has published guideline criteria for Agency permitted / regulated sites at 1.5, 3 and 6 OU_E/m^3 as 98^{th}%ile 1 hour averages for the most, moderate and least offensive process emissions[2]. In presenting this information the Environment Agency provides example processes which fall within each offensiveness category as shown in the following table.

Table 7: Odour benchmarks published by the Environment Agency

Offensiveness	Processes	Criterion
Most offensive	• Decaying animal or fish remains • Involving septic effluent or sludge • Biological landfill odours	1.5 OU_E/m^3 98th%ile 1 hr
Moderately offensive	• Intensive livestock rearing • Fat frying (food processing) • Sugar beet processing • Well aerated green waste composting	3 OU_E/m^3 98th%ile 1 hr
Less offensive	• Brewery • Confectionary • Coffee roasting • Bakery	6 OU_E/m^3 98th%ile 1 hr

[7] CIWEM (2012) Position Policy Statement – Control of Odour

The odour from the proposed process probably falls within the less offensive category and thus for this study we propose that a benchmark of 3 OU_E/m^3 as a 98^{th}%ile 1 hour average should be applied. The unit OU_E signifies "European Odour Units", however the odour thresholds applied in this study (see Table 3) are not European designated units, therefore the odour concentrations in this assessment are described as "OU" not "OU_E".

The prediction that a particular receptor location will experience odour concentrations above the EA thresholds does not necessarily imply that unreasonable annoyance will follow. However, it is suggested that the probability of such an occurrence is increased in proportion to the exceedance of the guideline.

2.3 Conservative approach

This study has assumed that the facility will operate continuously, whereas in practice there will be some process down-time. Furthermore, the assessment has assumed peak emissions will occur throughout the year, which again is likely to be an overestimate. Also, the assessment conditions do not include the effect of in-line process abatements (e.g. such as condensers on reaction vessels) which will almost certainly reduce emission concentrations. The assessment has also been based on the meteorological year which resulted in the highest impacts. This approach was adopted in order to ensure that modelled concentrations and impacts are more likely to be over-estimated than under-estimated.

3 Results

3.1 Maximum ground level concentrations

The following provides the maximum ground level concentrations found to occur across the 3 x 3 km gridded area, centred on the stack, applied in the modelling assessment. The results represent the maximum value from each of the five years of meteorological data used in the assessment.

3.1.1 Pollutant concentrations

Table 8 and Table 9 provide the results under Scenarios 1 – 4, including the short and long-term pollutant concentrations with a stack height of 9 m and 12.7 m.

Table 8: Maximum pollutant concentrations – 9 m stack

Pollutant	ST EAL ($\mu g/m^3$)	LT EAL ($\mu g/m^3$)	Annual mean	as % of LT EAL	100th%ile of hourly means	as % of ST EAL
Acetic Acid	**3,700**	**250**	14.4	6%	120.4	3%
Allyl glycidyl ether (AGE)	**No EAL**	**No EAL**	92.8	No EAL	774.1	No EAL
Epichlorohydrin	**No EAL**	**No EAL**	31.6	No EAL	263.8	No EAL
Ethanol	**576,000**	**19,200**	17.2	0.09%	143.4	0.02%
Ethanol (as IMS)	**576,000**	**19,200**	267.5	1.39%	2230.6	0.39%
Hydrogen	**No EAL**	**No EAL**	218.6	No EAL	1823.5	No EAL
Methanol	**33,300**	**2,660**	551.4	21%	4598.9	14%
Toluene	**8,000**	**1,910**	283.3	15%	2362.5	30%

Table 9: Maximum pollutant concentrations – 12.7 m stack

Pollutant	ST EAL ($\mu g/m^3$)	LT EAL ($\mu g/m^3$)	Annual mean	as % of LT EAL	100th%ile of hourly means	as % of ST EAL
Acetic Acid	**3,700**	**250**	3.6	1%	88.5	2%
Allyl glycidyl ether (AGE)	**No EAL**	**No EAL**	23.1	No EAL	569.0	No EAL
Epichlorohydrin	**No EAL**	**No EAL**	7.9	No EAL	193.9	No EAL
Ethanol	**576,000**	**19,200**	4.3	0.02%	105.4	0.02%
Ethanol (as IMS)	**576,000**	**19,200**	66.6	0.35%	1639.7	0.28%
Hydrogen	**No EAL**	**No EAL**	54.5	No EAL	1340.4	No EAL
Methanol	**33,300**	**2,660**	137.4	5%	3380.5	10%

Toluene	**8,000**	**1,910**	70.6	4%	1736.6	22%

The results presented in Table 8 and Table 9 show that, with stacks heights of both 9 m and 12 m, all pollutants for which EALs are available (EALs for AGE, epichlorohydrin and hydrogen are not available), fall within both the short and long-term EALs. The highest pollutant contributions, when compared with the relevant EAL, were found to be methanol for long-term contributions (21% of the LT EAL @ 9 m) and toluene for short-term contributions (30% of the ST EAL @ 9 m). With a stack height of 12.7 m the maximum long-term methanol contribution, as a percentage of the EAL, was found to fall by 16%, whilst short-term contributions of toluene were found to fall by 8%. In all cases the greatest contribution to the overall odour contribution comes from alcohol. In the event that in-line process abatement in the form of condensation is applied, then the pollutant contributions would be reduced.

These results indicate that the proposed facility is not forecast to have a detrimental impact on ambient concentrations of the substances assessed at either stack height.

3.1.2 Odour concentrations

The following table provides the results of Scenario 5 and 6, illustrating the maximum estimated odour concentrations (98th%ile of 1 hour averages) with a stack height of 9 m and 12.7 m.

Table 10: Maximum odour concentrations – 9 m stack

Averaging period	Odour threshold (mg/m^3)	98th%ile of hourly means	OU/m^3
Acetic Acid	**0.043**	48.9	1.1
Allyl glycidyl ether (AGE)	**44**	314.2	0.0
Epichlorohydrin*	**3.52**	107.1	0.0
Ethanol	**0.28**	58.2	0.2
Ethanol (as IMS)	**0.28**	905.3	3.2
Hydrogen	**-**	740.1	No DDT
Methanol	**4**	1866.5	0.5
Toluene	**1**	958.9	1.5
Total odour concentration (OU/m^3)		6.6	
as % of odour benchmark (3 OU/m^3)		219%	

Table 11: Maximum odour concentrations – 12.7 m stack

Averaging period	Odour threshold (mg/m^3)	98th%ile of hourly means	OU/m^3
Acetic Acid	**0.043**	18.5	0.4
Allyl glycidyl ether (AGE)	**44**	118.9	0.0

Epichlorohydrin*	**3.52**	40.5	0.0
Ethanol	**0.28**	22.0	0.1
Ethanol (as IMS)	**0.28**	342.6	1.2
Hydrogen	**-**	280.1	No DDT
Methanol	**4**	706.3	0.2
Toluene	**1**	362.9	0.6
Total odour concentration (OU/m³)		2.5	
as % of odour benchmark (3 OU_E/m^3)		83%	

The results in Table 10 show that with a stack of 9 m maximum ground level odour concentrations are forecast to exceed the odour benchmark of 3 OU_E/m^3 by 3.6 OU/m^3. However, with a stack height of 12.7 m, as shown in Table 11, maximum odour concentrations would fall below this threshold, at 2.5 OU/m^3. In all cases the greatest contribution to the overall odour contribution comes from alcohol. In the event that in-line process abatement in the form of condensation is applied, then the odour contribution would be reduced.

It is therefore recommended that, based on worst case emissions, a stack height of 12.7 m be adopted to ensure odour concentrations in ambient air around the facility remain below this benchmark, to avoid the potential for environmental nuisance at local receptors.

3.2 Dispersion plots

The following figures provide dispersion plots for:

- Odour arising from the proposed facility with stack heights of 9 m and 12.7 m;
- Annual mean emissions of methanol with stack heights of 9 m and 12.7 m; and
- Maximum hourly mean emissions of toluene with stack heights of 9 m and 12.7 m.

Projected pollutant and odour concentrations, under each Scenario, at all of the sensitive receptor sites listed in Table 5 are provided in Appendix 1.

Figure 4: Odour concentrations (98th%ile of hourly means) - 9 m stack

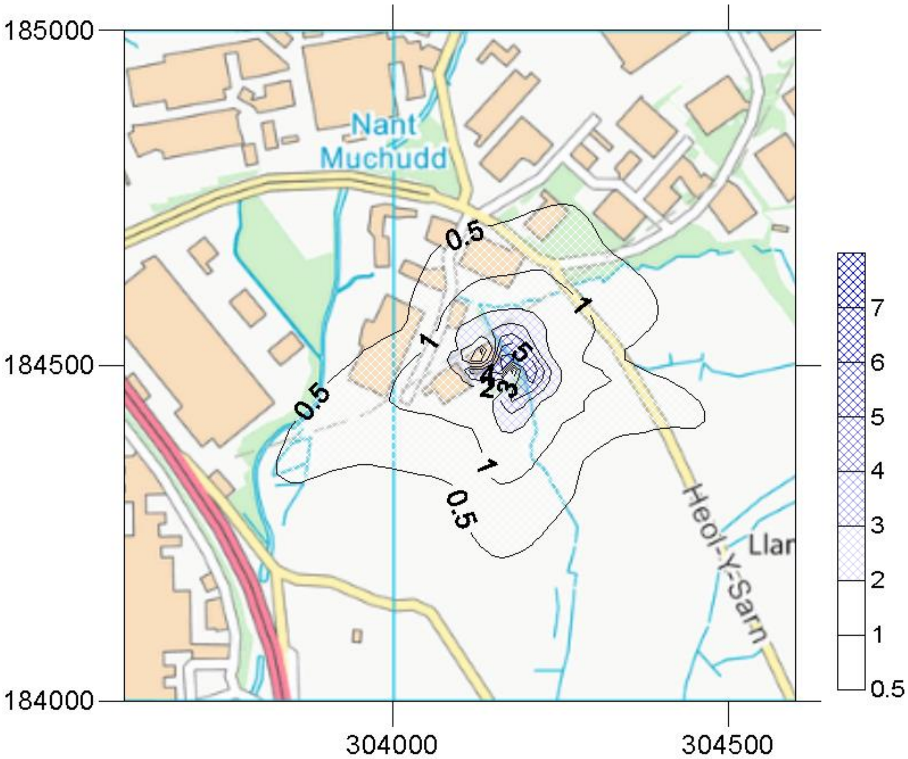


Figure 5: Odour concentrations (98th%ile of hourly means) – 12.7 m stack

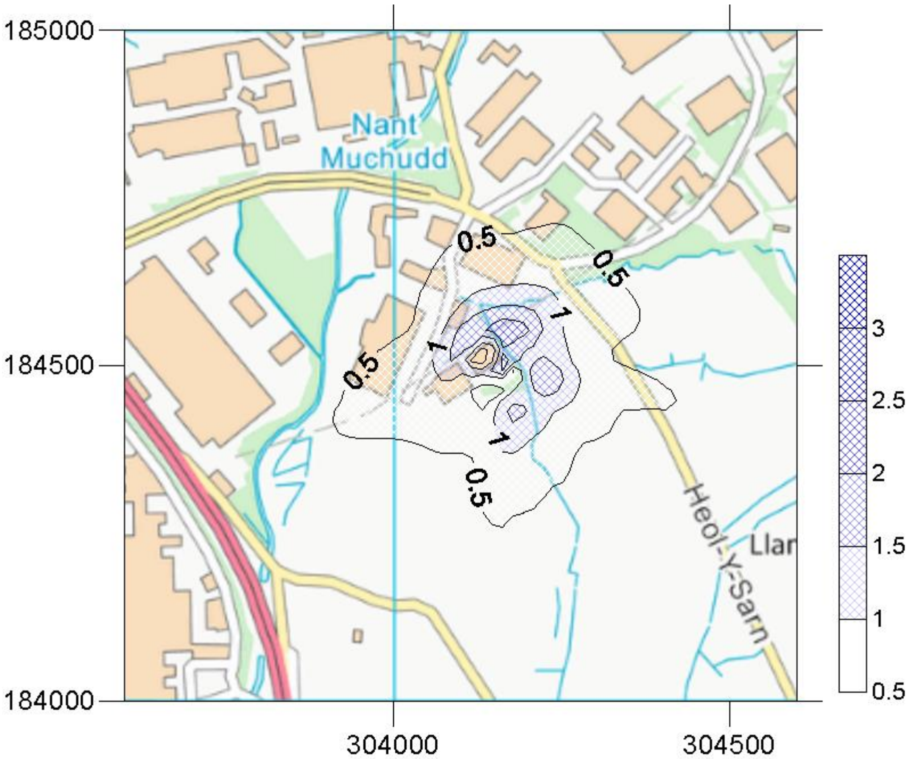


Figure 6: Methanol concentrations (annual mean) – 9 m stack

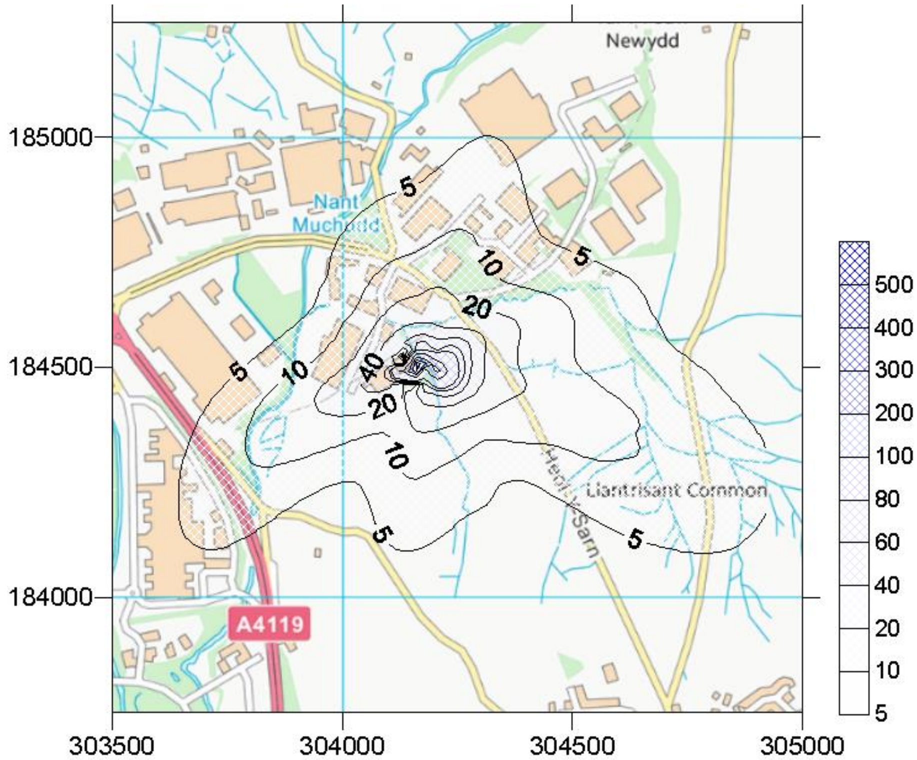


Figure 7: Methanol concentrations (annual mean) – 12.7 m stack

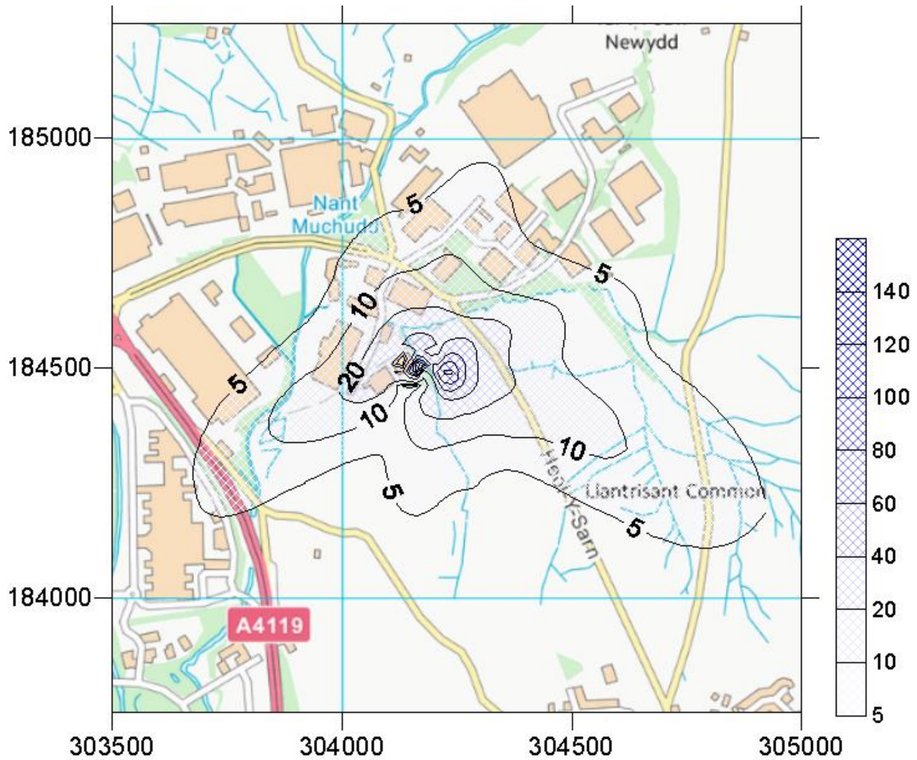


Figure 8: Toluene concentrations (maximum hourly means) – 9 m stack

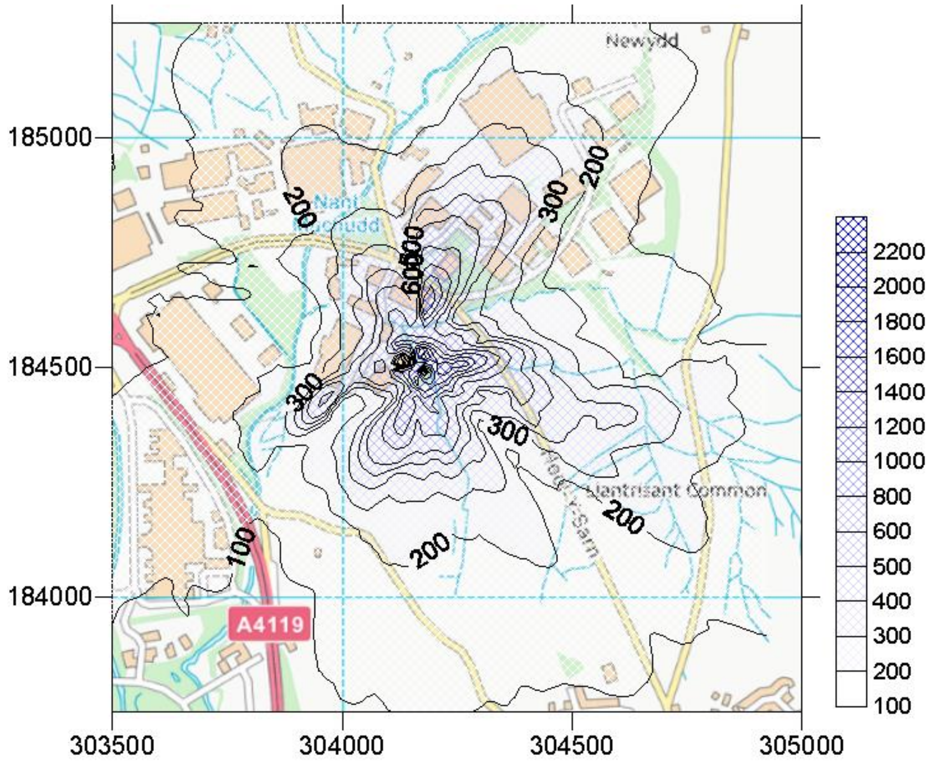
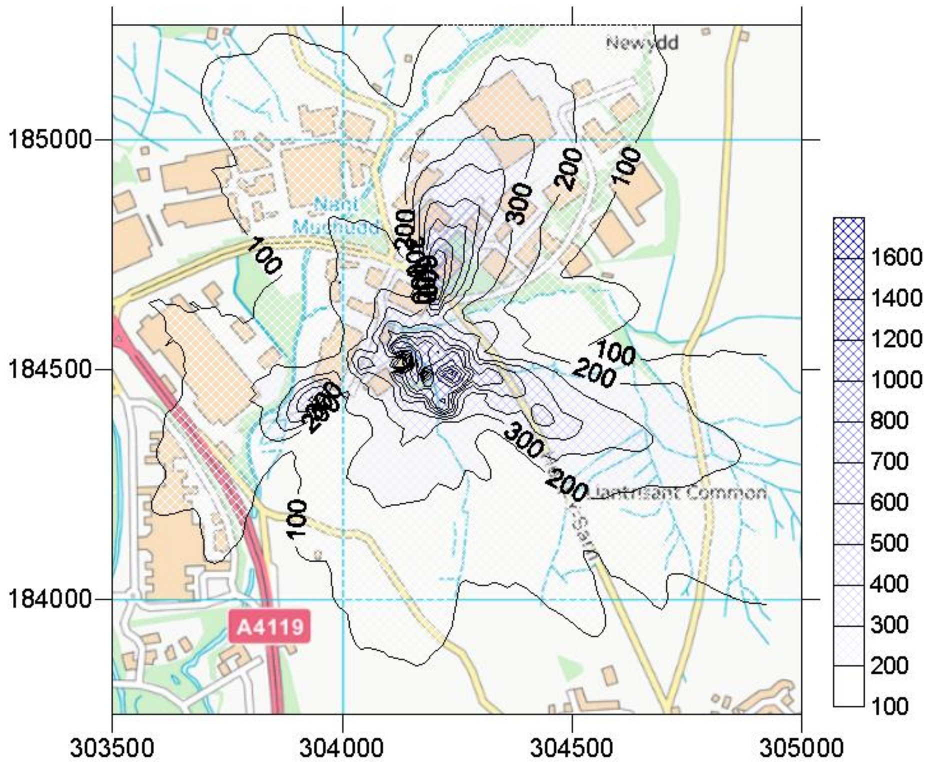


Figure 9: Toluene concentrations (maximum hourly means) – 12.7 m stack



4 Findings

1. This study provides an assessment of the likely impact on air quality and odour resulting from emissions arising from the proposed fine chemical manufacturing facility, at the Llantrisant Business Park. The study has combined estimated peak pollutant emissions data, provided by Purolite Ltd, with Environmental Assessment Levels, and published data on odour thresholds, applicable to the compounds identified in the flue gases.
2. The dispersion modelling itself has considered a range of scenarios, reflecting the long and short-term impacts of emissions with stack heights of 9 m and 12.7 m.
3. The study has shown that emissions of the substances assessed would not result in the exceedance of EALs in ambient air around the facility, or at any of the sensitive receptor sites included in the model, with a stack height of either 9 m or 12.7 m. However, by increasing the stack height to 12.7 m the level of impact would be reduced by up to 16%.
4. The study found that with a stack height of 9 m, emissions exceeded the Environment Agency's odour threshold value of 3 OU_E/m^3, for "moderately offensive" odours. Whereas a stack height of 12.7 m resulted in a maximum ambient odour concentration of 2.5 OU_E/m^3. It is therefore recommended that a stack of 12.7 m be adopted to minimise the potential for nuisance odour at sensitive receptor sites around the facility.
5. The point of maximum process contribution, for all long-term concentrations, was found to occur to the south east of the facility, close to the boundary of the site, in an area of open agricultural land, and that the impact at sensitive receptor sites (e.g. houses, the Royal Glamorgan Hospital etc.) was found to be considerably lower.
6. It should also be noted that had the effect of in-line process abatement, such as condensers on reaction vessels, been taken into account then the impact concentration predicted in this report would be lower.
7. The findings of this study are very dependent on the odour concentration estimates and subsequent odour emission rates assigned to the emission sources and the discharge characteristics provided by Purolite Ltd and Briggs. If for any reason the data used in this study is unrepresentative of the proposed facility this may influence the results of this study.

Appendix 1: Pollutant and odour concentrations at sensitive receptors

Scenario 1: Long-term pollutant concentrations (µg/m^3) – 9 m stack

Pollutant		Sensitive receptor ref.																					
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
Acetic Acid		0.16	0.15	0.08	0.04	0.03	0.05	0.03	0.04	0.53	0.18	0.14	0.62	0.19	0.15	0.06	0.05	0.02	0.02	0.03	0.03	0.01	0.04
Allyl glycidyl ether (AGE)		1.01	0.98	0.50	0.25	0.19	0.32	0.21	0.28	3.40	1.16	0.91	4.00	1.24	0.94	0.35	0.29	0.12	0.16	0.18	0.22	0.08	0.23
Epichlorohydrin*		0.34	0.33	0.17	0.08	0.06	0.11	0.07	0.10	1.16	0.39	0.31	1.36	0.42	0.32	0.12	0.10	0.04	0.05	0.06	0.08	0.03	0.08
Ethanol		0.19	0.18	0.09	0.05	0.04	0.06	0.04	0.05	0.63	0.21	0.17	0.74	0.23	0.17	0.07	0.05	0.02	0.03	0.03	0.04	0.01	0.04
Ethanol (as IMS)		2.91	2.82	1.43	0.71	0.55	0.91	0.60	0.81	9.79	3.33	2.63	11.5	3.56	2.70	1.02	0.84	0.36	0.46	0.52	0.63	0.23	0.65
Hydrogen		2.38	2.31	1.17	0.58	0.45	0.75	0.49	0.67	8.00	2.73	2.15	9.42	2.91	2.21	0.83	0.69	0.29	0.38	0.43	0.52	0.19	0.53
Methanol		5.99	5.82	2.94	1.47	1.12	1.88	1.23	1.68	20.1	6.88	5.42	23.7	7.34	5.58	2.10	1.74	0.73	0.95	1.08	1.31	0.47	1.34
Toluene		3.08	2.99	1.51	0.76	0.58	0.97	0.63	0.86	10.3	3.53	2.79	12.2	3.77	2.86	1.08	0.89	0.38	0.49	0.55	0.67	0.24	0.69
	LT EAL	As % of LT EAL																					
Acetic Acid	250	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.1%	0.1%	0.2%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Allyl glycidyl ether (AGE)	No EAL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Epichlorohydrin*	No ELA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethanol	19,200	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Ethanol (as IMS)	19,200	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Hydrogen	No ELA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methanol	2,660	0.2%	0.2%	0.1%	0.1%	0.0%	0.1%	0.0%	0.1%	0.8%	0.3%	0.2%	0.9%	0.3%	0.2%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
Toluene	1,910	0.2%	0.2%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.5%	0.2%	0.1%	0.6%	0.2%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Scenario 2: Long-term pollutant concentrations (µg/m³) – 12.7 m stack

Pollutant		Sensitive receptor ref.																					
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
Acetic Acid		0.13	0.12	0.06	0.03	0.03	0.05	0.03	0.04	0.43	0.16	0.13	0.49	0.17	0.13	0.05	0.04	0.02	0.02	0.03	0.03	0.01	0.03
Allyl glycidyl ether (AGE)		0.85	0.75	0.37	0.22	0.16	0.30	0.20	0.27	2.74	1.05	0.83	3.15	1.07	0.81	0.33	0.27	0.11	0.14	0.17	0.21	0.08	0.19
Epichlorohydrin*		0.29	0.25	0.13	0.07	0.06	0.10	0.07	0.09	0.93	0.36	0.28	1.07	0.36	0.28	0.11	0.09	0.04	0.05	0.06	0.07	0.03	0.06
Ethanol		0.16	0.14	0.07	0.04	0.03	0.06	0.04	0.05	0.51	0.19	0.15	0.58	0.20	0.15	0.06	0.05	0.02	0.03	0.03	0.04	0.01	0.03
Ethanol (as IMS)		2.45	2.15	1.08	0.62	0.47	0.86	0.56	0.77	7.89	3.02	2.40	9.07	3.07	2.33	0.96	0.77	0.33	0.41	0.49	0.61	0.22	0.54
Hydrogen		2.01	1.76	0.88	0.51	0.39	0.70	0.46	0.63	6.45	2.47	1.97	7.41	2.51	1.90	0.79	0.63	0.27	0.34	0.40	0.50	0.18	0.44
Methanol		5.06	4.43	2.23	1.29	0.97	1.77	1.16	1.58	16.2	6.23	4.96	18.6	6.33	4.80	1.98	1.58	0.68	0.85	1.00	1.25	0.46	1.11
Toluene		2.60	2.28	1.14	0.66	0.50	0.91	0.60	0.81	8.36	3.20	2.55	9.60	3.25	2.46	1.02	0.81	0.35	0.44	0.51	0.64	0.24	0.57
	LT EAL	**As % of LT EAL**																					
Acetic Acid	**250**	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.1%	0.1%	0.2%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Allyl glycidyl ether (AGE)	**No ELA**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Epichlorohydrin*	**No ELA**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethanol	**19,200**	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Ethanol (as IMS)	**19,200**	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Hydrogen	**No ELA**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methanol	**2,660**	0.2%	0.2%	0.1%	0.0%	0.0%	0.1%	0.0%	0.1%	0.6%	0.2%	0.2%	0.7%	0.2%	0.2%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Toluene	**1,910**	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%	0.2%	0.1%	0.5%	0.2%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Scenario 3: Short-term pollutant concentrations (µg/m^3) – 9 m stack

Pollutant		Sensitive receptor ref.																					
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
Acetic Acid		7	7	7	6	4	4	3	3	20	17	14	39	23	19	8	4	3	4	5	4	1	3
Allyl glycidyl ether (AGE)		46	45	48	37	26	27	21	18	128	110	87	250	149	123	52	28	18	24	30	27	8	20
Epichlorohydrin*		16	15	16	13	9	9	7	6	44	37	30	85	51	42	18	10	6	8	10	9	3	7
Ethanol		8	8	9	7	5	5	4	3	24	20	16	46	28	23	10	5	3	4	5	5	1	4
Ethanol (as IMS)		132	130	138	107	76	79	61	52	368	316	250	721	430	353	150	80	51	69	85	78	22	58
Hydrogen		108	106	113	87	62	64	50	43	301	258	205	589	352	289	123	66	42	56	70	64	18	48
Methanol		272	268	285	220	157	162	125	107	758	651	516	1486	887	729	310	166	106	142	176	161	45	120
Toluene		140	138	146	113	81	83	64	55	390	335	265	763	456	374	159	85	54	73	90	83	23	62
	ST EAL	As % of ST EAL																					
Acetic Acid	3,700	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.5%	0.5%	0.4%	1.1%	0.6%	0.5%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.1%
Allyl glycidyl ether (AGE)	No ELA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Epichlorohydrin*	No ELA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethanol	576,000	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Ethanol (as IMS)	576,000	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Hydrogen	No ELA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methanol	33,300	0.8%	0.8%	0.9%	0.7%	0.5%	0.5%	0.4%	0.3%	2.3%	2.0%	1.6%	4.5%	2.7%	2.2%	0.9%	0.5%	0.3%	0.4%	0.5%	0.5%	0.1%	0.4%
Toluene	8,000	1.7%	1.7%	1.8%	1.4%	1.0%	1.0%	0.8%	0.7%	4.9%	4.2%	3.3%	9.5%	5.7%	4.7%	2.0%	1.1%	0.7%	0.9%	1.1%	1.0%	0.3%	0.8%

Scenario 4: Short-term pollutant concentrations (µg/m^3) – 12.7 m stack

Pollutant		Sensitive receptor ref.																					
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
Acetic Acid		7	6	5	4	3	3	3	3	15	12	11	18	15	20	6	4	3	3	3	5	1	2
Allyl glycidyl ether (AGE)		46	37	33	28	19	22	17	19	100	79	71	114	93	130	39	23	20	18	22	30	6	16
Epichlorohydrin*		16	13	11	9	6	8	6	6	34	27	24	39	32	44	13	8	7	6	7	10	2	5
Ethanol		8	7	6	5	3	4	3	3	18	15	13	21	17	24	7	4	4	3	4	6	1	3
Ethanol (as IMS)		131	107	96	80	54	65	49	54	287	229	203	329	269	373	111	66	56	53	63	87	17	45
Hydrogen		107	87	79	65	44	53	40	44	235	187	166	269	220	305	91	54	46	43	52	71	14	37
Methanol		270	220	198	164	111	133	100	110	592	472	419	678	554	770	230	135	116	108	130	180	36	93
Toluene		139	113	102	84	57	68	52	57	304	242	215	349	285	395	118	70	60	56	67	93	18	48
	ST EAL	As % of ST EAL																					
Acetic Acid	3,700	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.4%	0.3%	0.3%	0.5%	0.4%	0.5%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.1%
Allyl glycidyl ether (AGE)	No ELA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Epichlorohydrin*	No ELA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethanol	576,000	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Ethanol (as IMS)	576,000	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Hydrogen	No ELA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methanol	33,300	0.8%	0.7%	0.6%	0.5%	0.3%	0.4%	0.3%	0.3%	1.8%	1.4%	1.3%	2.0%	1.7%	2.3%	0.7%	0.4%	0.3%	0.3%	0.4%	0.5%	0.1%	0.3%
Toluene	8,000	1.7%	1.4%	1.3%	1.1%	0.7%	0.9%	0.6%	0.7%	3.8%	3.0%	2.7%	4.4%	3.6%	4.9%	1.5%	0.9%	0.7%	0.7%	0.8%	1.2%	0.2%	0.6%

Scenario 5: Odour concentrations (98th%ile of hourly means OU/m^3) – 9 m stack

Pollutant	Sensitive receptor ref.																				
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
OU/m^3	0.25	0.24	0.16	0.08	0.05	0.07	0.03	0.06	0.87	0.31	0.24	0.98	0.31	0.21	0.09	0.07	0.03	0.04	0.05	0.05	0.02	0.08
As % of Odour Threshold Value	8.4%	7.9%	5.4%	2.5%	1.6%	2.4%	0.9%	1.9%	29.0%	10.2%	8.2%	32.6%	10.5%	7.0%	2.9%	2.4%	1.0%	1.3%	1.5%	1.7%	0.6%	2.7%

Scenario 6: Odour concentrations (98th%ile of hourly means OU/m^3) – 12.7 m stack

Pollutant	Sensitive receptor ref.																				
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
OU/m^3	0.21	0.17	0.13	0.07	0.04	0.07	0.03	0.05	0.70	0.28	0.23	0.83	0.27	0.19	0.09	0.07	0.03	0.04	0.04	0.05	0.02	0.07
As % of Odour Threshold Value	7.0%	5.8%	4.4%	2.3%	1.5%	2.2%	0.9%	1.7%	23.4%	9.3%	7.6%	27.6%	9.1%	6.4%	2.9%	2.3%	1.0%	1.2%	1.5%	1.6%	0.6%	2.3%

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Appendix B Briggs Emission Summary

BRIGGS

Project No	MG1939
Project Title	Purolite Agarose Manufacturing Facility
Doc Title	Emissions Summary Rev B
Doc Date	10-Nov-16

Rev	By	Checked	App (Briggs)	Date
A	GY / TDS	JLB	JLB	07-Nov-16
B	GY	TDS	TDS	10-Nov-16

Notes
1. Cells highlighted in light orange are latest figures following process review for PURE, SP and Q, as well as emission data for bulk and waste tanks breathing. These should be used for subsequent emissions calculations.
2. Volumetric flow rates are calculated based on 101.3 kPa and 20°C.
3. Any changes / updates in the latest issue will be highlighted in blue.

Assumptions
1. No regular repeats of beads washing for all steps. No requirements for regular nitrogen backflushing to loosen packed bed of agarose beads during filtering.
2. Negligible emissions for screening process with water.
3. Filling of bulk tanks and emptying of waste tanks will be vented back into tankers.
4. Nitrogen flow at 21 Nm3/hr (for a 2 hours window - per reaction batch) for dilution of hydrogen gas generated during process will be completed prior to epichlorohydrin addition (for PURE process).

Stack parameters	Coordinates	
	x	y
Main stack	304170	184500

* Grid reference = ST 04170 84500
i.e. 51.5512°N, 3.3835°W.

Height information (from floor level of existing building)

Height of building (to roof apex)	approx	9.7 m
Height of building (to top of side wall)	approx	6.4 m
Height of tank farm gantry (to floor)	approx	6.0 m
Max height of any vessel in tank farm	approx	10.0 m

Pollutant	Estimated Average Emissions (annually) (kg/yr)		Estimated Average Emissions (annually) (g/s)		Estimated Average Emissions (hourly) (kg/hr)		Estimated Average Emissions (hourly) (g/s)		Estimated Mean Gas Flow (hourly) (m3/hr)	Estimated Mean Gas Flow (hourly) (m3/s)	Estimated Peak Emissions (hourly) (kg/hr)	Estimated Peak Emissions (hourly) (g/s)	Estimated Peak Gas Flow (hourly) (m3/hr)		Estimated Peak Gas Flow (hourly) (m3/s)		Velocity (m/s)	Diameter (m)	Temp (°C)
	Previous	Current	Previous	Current	Previous	Current	Previous	Current	Current	Current	Current	Current	Previous	Current	Previous	Current			
Acetic Acid	0.3	5.81	9.51E-06	1.84E-04	0.21	7.21E-04	6.66E-06	2.00E-04	2.89E-04	8.01E-08	0.07	1.86E-05	4	0.03	0.001	7.44E-06	15		50
Allyl glycidyl ether (AGE)	0.9	118.39	2.85E-05	3.75E-03	1.35	1.47E-02	4.28E-05	4.08E-03	3.09E-03	8.59E-07	0.32	8.75E-05	60	0.07	0.017	1.84E-05	15		45
Epichlorohydrin*	3.6	7.11	1.14E-04	2.26E-04	0.46	8.82E-04	1.46E-05	2.45E-04	2.29E-04	6.37E-08	0.03	6.94E-06	5.4	0.01	0.002	1.80E-06	15		50
Ethanol	5.8	131.93	1.84E-04	4.18E-03	0.25	1.64E-02	7.93E-06	4.56E-03	8.54E-03	2.37E-06	3.85	1.07E-03	4	2.01	0.001	5.58E-04	15		Now - 25, Prev - 35
Ethanol (as IMS - Industrial Methylated Spirits)	177.6	579.28	5.63E-03	1.84E-02	3.89	7.18E-02	1.23E-04	2.00E-02	3.75E-02	1.04E-05	2.27	6.30E-04	60	1.18	0.017	3.29E-04	15		70
Glycidyltri-methyl-ammonium chloride (GMAC)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15		35
Hydrogen	67	97.50	2.12E-03	3.09E-03	3.18	1.21E-02	1.01E-04	3.36E-03	1.44E-01	4.00E-05	0.93	2.58E-04	42.4	11.07	0.012	3.07E-03	15		50
Methanol (as IMS - Industrial Methylated Spirits)	14.9	49.81	4.72E-04	1.58E-03	8.02	6.18E-03	2.54E-04	1.72E-03	4.64E-03	1.29E-06	0.19	5.38E-05	60	0.15	0.017	4.04E-05	15		70
Toluene	40.8	225.93	1.29E-03	7.16E-03	4.12	2.80E-02	1.31E-04	7.78E-03	7.31E-03	2.03E-06	1.40	3.89E-04	60	0.37	0.017	1.01E-04	15		70
Total							**0.0007**	**0.0419**	**0.21**	**0.0001**	**9.0492**	**0.0025**	**295.8000**	**14.8715**	**0.0822**	**0.0041**	15	**0.08**	-

Diameter based on current data **0.02**
Diameter to use for modelling (incorporating a fan to assist flow) 0.10

Other Information
1. Nitrogen flow at 21 Nm3/hr to dilute hydrogen gas generated during process. This applies for 2 hours window for AGE emissions (per reaction batch). Original emission value was for 15 mins only.

Information used by Ricardo, provided by Briggs previously - 11Oct16

Material	CAS	Concentration (w/w)	Estimated Emissions (annually)	Estimated Peak Emissions (hourly)	Estimated Peak Gas Flow (hourly)	Temperature	Pressure	Target (**tbc**)	Comments
Acetic Acid	64-19-7	60%	**0.3 kg/yr**	0.21 kg/hr	4.0 m^3/hr	50 °C	Atmos.	**25 mg/m³**	
Allyl glycidyl ether (AGE)	106-92-3	100%	**0.9 kg/yr**	1.35 kg/hr	60.0 m^3/hr	45 °C	Atmos.	**23 mg/m³**	
Epichlorhydrin	106-89-8	100%	**3.6 kg/yr**	0.46 kg/hr	5.4 m^3/hr	50 °C	Atmos.	**2 mg/m³**	
Ethanol	64-17-5	100%	**5.8 kg/yr**	0.25 kg/hr	4.0 m^3/hr	35 °C	Atmos.	**1920 mg/m³**	
Ethanol (as IMS - Industrial Methylated Spirits)	64-17-5	96%	**177.6 kg/yr**	3.89 kg/hr	60.0 m^3/hr	70 °C	Atmos.	**1920 mg/m³**	
Glycidyltri-methyl-ammonium chloride (GMAC)	3033-77-0	100%	0.0 kg/yr	0.00 kg/hr	0.0 m^3/hr	35 °C	Atmos.	**n/a**	Trace amounts only anticipated
Hydrogen	133-74-0	100%	**67.0 kg/yr**	**3.18 kg/hr**	42.4 m^3/hr	50 °C	Atmos.	**n/a**	
Methanol (as IMS - Industrial Methylated Spirits)	67-56-0	4%	**14.9 kg/yr**	8.02 kg/hr	60.0 m^3/hr	70 °C	Atmos.	**266 mg/m³**	
Toluene	108-88-3	100%	**40.8 kg/yr**	4.12 kg/hr	60.0 m^3/hr	70 °C	Atmos.	**191 mg/m³**	

Appendix C Drainage Philosophy

CIVIL & STRUCTURAL ENGINEERS

DRAINAGE PHILOSOPHY

PUROLITE
CDGA-9021-REP01-R4

December 2017

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5-6 DERYN COURT
WHARFEDALE ROAD
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Contents

1 INTRODUCTION

1.1 Purolite are proposing to expand pharmaceutical processing into an existing industrial unit in Llantrisant Business Park.

1.2 CD Gray & Associates Ltd have been appointed as Civil and Structural Consulting Engineers to provide a high level drainage philosophy to support Purolite's planning application and subsequent NRW licencing application(s). This report has been informed by consultation with statutory undertakers, known site constraints, mindful of existing infrastructure and current best practice and industry standards.

2 EXISTING SITE & DRAINAGE PROVISION

2.1 The site is located within Llantrisant Business Park, immediately adjacent to Purolite's existing premises, It consists of a currently vacant industrial unit, understood to have formerly been associated with the production of orange juice, car park and rear service yard, set within approximately 0.5ha.

2.2 Dwr Cymru Welsh Water (DCWW) public sewer records have been obtained and show the existing drainage infrastructure in the area to be separate in nature.

2.3 With reference to Figure 1 below, the DCWW asset database identifies a 150mm diameter foul public sewer running north-south parallel to the Business Park's distributor road and serves the proposed development unit and those of the surrounding area. The system upsizes to a 300mm diameter at the former Sogefi Filtration factory some 250m downstream.

2.4 The DCWW surface water network running south-north parallel to the foul sewer is 450mm diameter and outfalls into an unnamed watercourse / drainage ditch, culverted in part, to convey flows to the Nant Muchudd to the west.

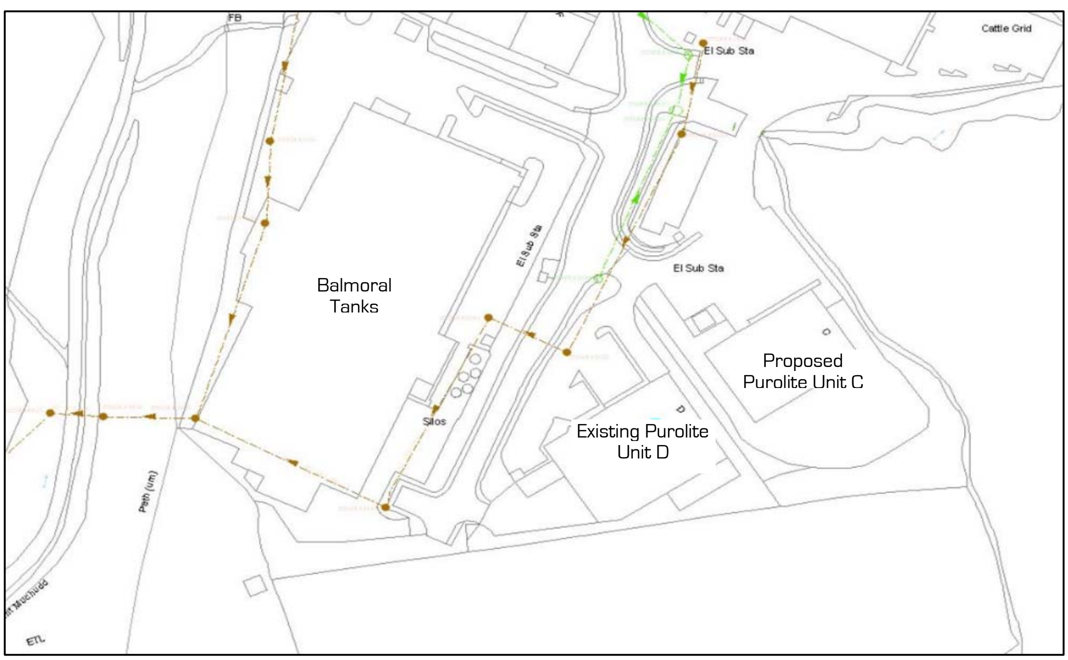


Figure 1 – Extract from DCWW Public Sewer Records

2.5 The site itself is served by separate foul and surface water drainage infrastructure.

2.6 Foul Water

2.6.1 The existing foul network runs parallel to the frontage of the existing unit in a southwesterly direction. The network continues through the adjacent existing Purolite unit before connecting to the recognised DCWW public sewer shown in Figure 1 to lie within the carpark of the existing Purolite unit. However, as part of the recent sewer transfer legislation, ownership of the off-site sewer would have transferred to DCWW on the basis that the network serves more than one land owner.

2.6.2 The on-site foul sewer is 100mm diameter pipe laid at a gradient of 1:205 which has a full bore capacity of 3.6l/s. The foul loading (domestic / trade effluent) associated with the building's former use is unknown.

2.7 Surface Water

2.7.1 The site consists wholly of hardstanding areas comprising the building of approximately 1,350m^2 with surrounding tarmac / concrete slab access road, car park and service yard. The existing surface water run-off sources are rainwater downpipes and external gullys.

2.7.2 There is a traditional three stage petrol interceptor serving the rear service yard area.

2.7.3 There are two offsite surface water conveyances to the DCWW surface water public sewerage network. The rear building and service yard run-off runs through the unit's access road and off-site to make connection via a 225mm diameter pipe. The front of the building and car park area has a separate 150mm diameter pipe which makes connection to the DCWW network approximately 30m downstream.

2.7.4 A drainage CCTV survey has been commissioned to inform the condition of the existing network and its suitability for reuse.

3 PROPOSED DEVELOPMENT

3.1 Proposals are largely limited to internal refurbishment of the existing industrial unit.

3.2 Minor re-configuration is proposed to the front car park area which includes a new dedicated turning off the access road to segregate front and back of house vehicular movements.

3.3 More significant changes are proposed to the rear service yard area where a tank farm of above vessels is to be located to the southeastern corner along with an associated tanker offload area, pump house, new sprinkler system housing and general waste and IBC storage areas.

3.4 An extract of the proposed site layout is shown in Figure 2 below;

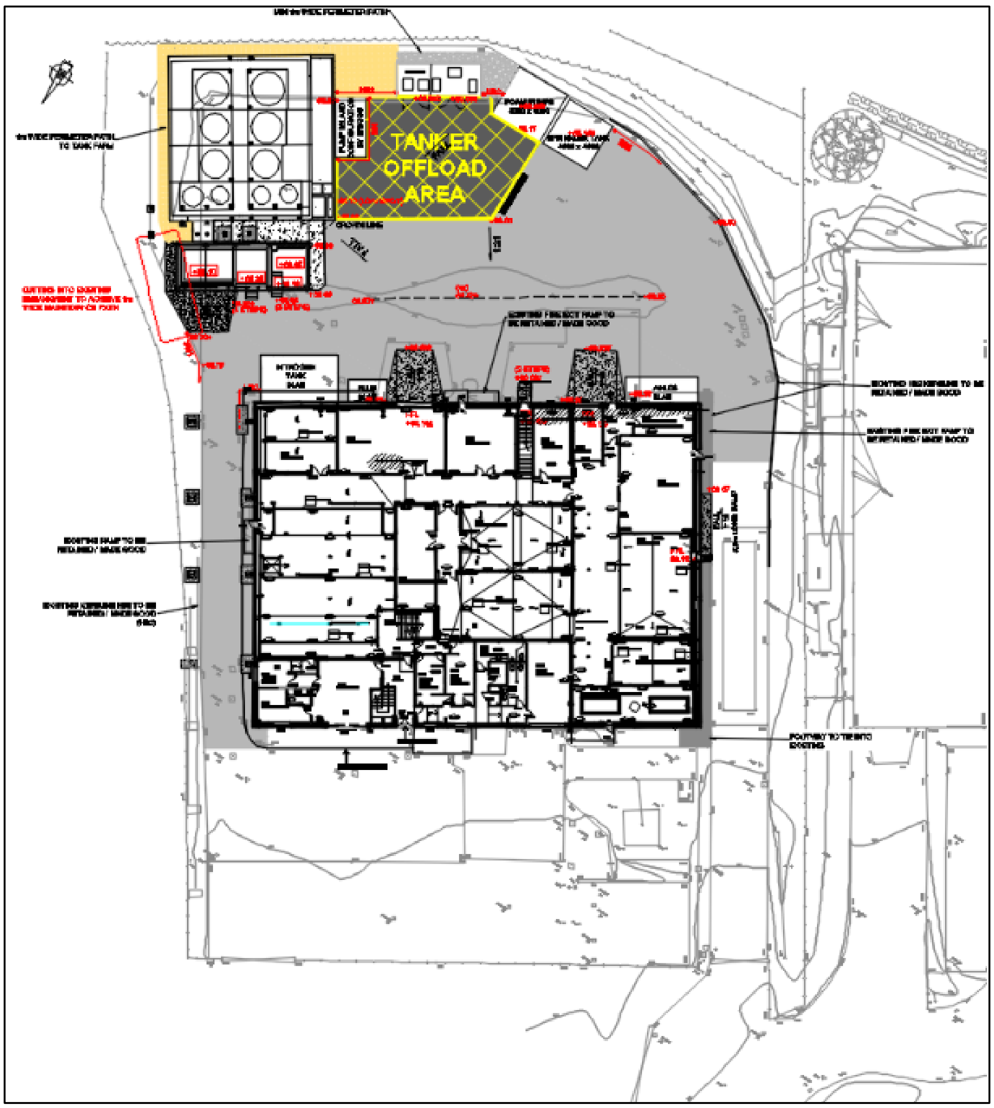


Figure 2 – Proposed Site Layout

(Source: CDGA-9021-106-C3)

3.5 Tanker Offloading Procedure

3.5.1 The proposed tanker offload area has been designed with a high level / ridged crown line on its outside edge with falls created to direct run-off within this area towards the crash tank inlet holes on the surface.

3.5.2 The crash tank has been designed with a containment volume suitable to cater for tanker deliveries with a maximum load of 28,000 litres.

3.5.3 **Tanker offloading should only be commenced when the tanker is stationary and positioned wholly within the designated tanker offload hatched area.**

3.5.4 Ordinarily, the penstock within the crash tank's receiving chamber will direct run-off to the surface water network. **Prior to tanker offloading, the penstock valve must be closed** so that there is no risk of run-off or spillage entering the surface water network during offloading activity.

3.5.5 Should a spillage occur, the escaped effluent will be contained within the below ground crash tank. From this location, Purolite have the option to pump to holding tanks within the tank farm, discharge to the foul network if within licensing limits or remove by specialist disposal methods off-site as required to suit the nature of the spillage.

3.5.6 Once the off-loading procedure is complete and without incident the penstock valve should be switched back to its default position to allow run-off to be directed to the surface water network.

3.5.7 This procedure will form part of Purolite's formal Operation and Management procedures.

3.6 Drainage - General

3.6.1 It is intended to reuse, as far as reasonably practical, the existing drainage infrastructure and mimic the existing drainage regime.

3.6.2 Pre-planning advice has been sought from DCWW, their feedback has been incorporated into the proposals presented.

3.6.3 It is understood that S106 agreements are required in addition to a trade effluent license. Statutory approvals will be sought as part of the design development.

3.7 Foul Water

3.7.1 Foul water discharge has been considered as two separate elements to cover domestic flow and that associated with trade effluent arising from the industrial processing.

3.7.2 <u>Domestic Flow</u>

3.7.2.1 Peak flow loadings arising from domestic flow sources is approximated at 0.08l/s based on a maximum of 20 persons over a standard 8 hour shift (as advised by Bryan Griffiths, Purolite, email 11.03.16) in accordance with British Water, Flows and Loads 3 for a factory without canteen. See Appendix B for calculations.

3.7.2.2 The domestic loadings for the former building usage are unknown however, based on the existing office space, number of toilets and parking spaces it is anticipated that the staff numbers and thereby domestic loading are comparable pre and post development.

3.7.2.3 The proposed toilets, staff changing and canteen areas are located near the existing foul drainage infrastructure. Gravity connection to the existing system is therefore considered achievable.

3.7.2.4 The existing foul drainage run (100mm diameter @ 1:205) does not achieve self cleansing guidance in compliance with Building Regulations, Document H. The sewer may therefore be prone to holding / build-up of solids. Roddable access is provided for maintenance and blockages should therefore be readily cleared should they occur.

3.7.2.5 There is no hot food preparation intended and therefore no inclusion for grease treatment in the current drainage proposals.

3.7.3 Trade Effluent

3.7.3.1 Purolite are in consultation with DCWW to establish agreeable limits of daily discharge volume, COD and solids levels.

3.7.3.2 All discharge from processing operations will be treated internally and regulated within above ground holding tanks in the tank farm, tested for pH and TOC prior to direct release to the below ground drainage network.

3.7.3.3 DCWW have advised that pH values within the range of 6-11 are acceptable to be received by the foul network. In the event of exceedance of the pH and TOC testing thresholds, flows will be retained within the holding tank and either regulated by Purolite operators and retested for release, or held for removal by specialist waste carrier.

3.7.3.4 Connection to the existing foul sewerage network from the holding tanks / crash tank will require pumping and forms part of the mechanical / process engineering package. A pump rate of 3l/s is proposed which allows ample tolerance below the DCWW agreed limit of 3.5l/s for the domestic flow element.

3.7.3.5 Flow monitoring will be required to verify the volume communicated to the public sewerage network. A metering device will therefore be introduced to the foul network for this purpose.

3.7.4 Spillage / Containment Events

3.7.4.1 The tank farm is not to have any positive, gravity drainage provision. In the event of vessel rupture within the tank farm, liquid will be held within the above ground bund (wall height approximately 1.2m) and dealt with on the surface rather than below ground. The bund has been designed in accordance with CIRIA Report C736 – Containment Systems for the Prevention of Pollution and appropriate allowances for rainfall events have been incorporated in the containment capacity – calculations available within Appendix B. Surface water run-off collected within the bunded area will be tested and pumped out periodically. Contaminated or stagnant water is to be discharged to the foul network via a gully located on the outside of the perimeter bund or by specialist disposal if levels are outside of acceptable limits. This will form part of the operational management procedures.

3.7.4.2 A secondary 'crash tank' is provided below ground to cater for emergency spillages primarily associated with spillage within the building or during tanker offloading activity. This has been sized based on the same principles as the tank farm bund, to Ciria C736, as the largest of 25% complete volume or 110% of the largest tank.

3.7.4.3 Conveyance of surface water run-off from external areas designated 'high risk' has been avoided as far as practically possible. Design measures have included covering the bin store and IBC waste storage area, removing positive drainage provision to the bunded tank farm and operationally managing the tanker offload area so that ordinarily the area drains to the surface water network and switched (via penstock or similar mechanism) to close this outlet during offloading activity only.

3.7.4.4 On the basis that spillage / rupture will be dealt with on occurrence, the tanker delivery is considered the worst case source in terms of volume by a substantial margin when compared with the significantly smaller volumes associated with materials held internally in storage racking, IBC waste storage and so on.

3.7.4.5 The crash tank has therefore been sized on the on the following contributing factors;

Table 1: Volume of Crash Tank Required

<table>
<tr><th colspan="2">Area / Scenario</th><th>Storage Criteria</th><th>Required Storage Volume (m³)</th></tr>
<tr><td rowspan="2">Emergency Spillage / Rupture Scenario</td><td>Tank Farm</td><td colspan="2">No positive drainage provision – if rupture occurs spill to be held within above ground bund but option to over pump to crash tank as an overflow / alternative if required.</td></tr>
<tr><td>Tanker Delivery</td><td>110% complete volume (28,000litres)</td><td>30.8</td></tr>
<tr><td colspan="2">Process Waste</td><td colspan="2">Internally tested - bypass holding tank</td></tr>
<tr><td>Rainfall / Storm Event Contribution</td><td colspan="3">Contributing areas designed out – tank farm area not to be drained whilst tanker offloading activity is in progress.</td></tr>
</table>

3.7.4.6 A crash tank of providing minimum storage volume of 31m³ has therefore been determined to be required.

3.7.4.7 On the basis that rainfall run-off from the tanker offload area will ordinarily continually discharge to the surface water network there will be no accumulation of rainwater within the crash tank. Tanker offloading will not be permitted or realistic during an extreme rainfall event and should a spillage occur the penstock valve should be shut once the escaped effluent has been captured so that in instance of an extreme rainfall event occurring immediately after a spillage, run-off would be directed to the surface water drainage network or held on the surface and not have any contribution to the crash tank capacity requirements. That being said, with reference to the calculations contained within Appendix B, the provided crash tank volume totals 35m³ and is in excess of the minimum 31 m³.

3.8 Surface Water

3.8.1 Pre and post development hardstanding areas are comparable and therefore no additional run-off will be generated by the proposed development. There will be a small reduction in contributing area due to the introduction of some soft landscaping.

3.8.2 The building footprint and rainwater downpipe positions are to remain. Similarly, the front carpark is limited to minor reconfiguration and the majority of gully positions are to remain as is.

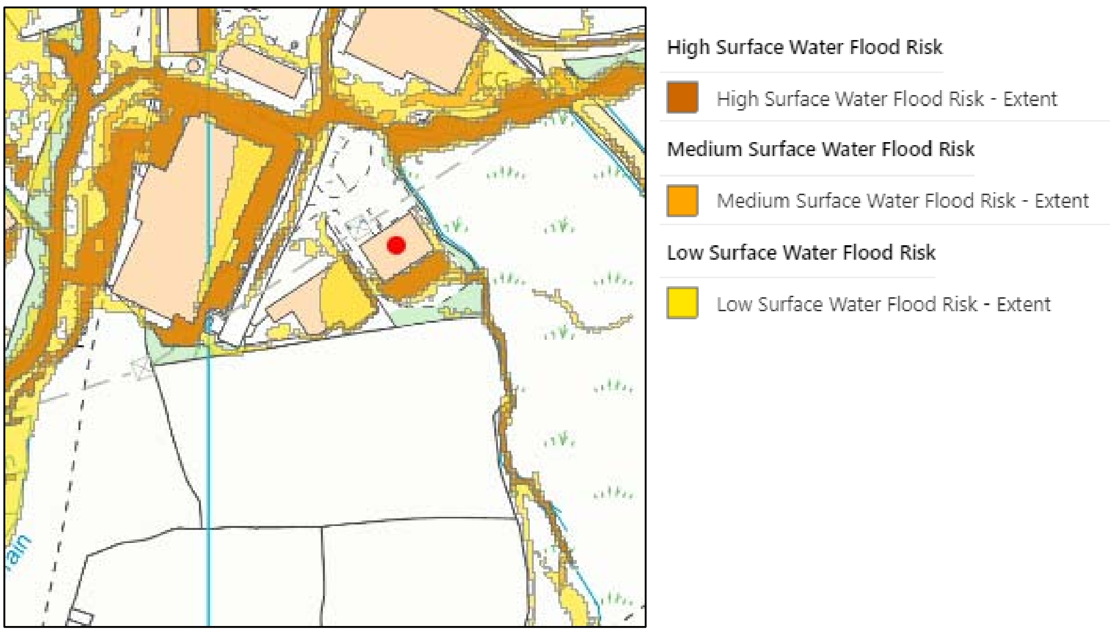
3.8.3 The front car park area is below the threshold (by number of spaces and contributing area) to require a petrol interceptor in accordance with PPG3. It is however, intended to retain the existing petrol interceptor serving the rear service yard as a precautionary measure.

3.8.4 NRW have been consulted and the principles of the drainage philosophy were agreeable.

3.8.5 <u>Surface Water Flood Risk</u>

3.8.5.1 NRW mapping indicates a low to medium surface water risk affecting the rear service yard only which appears to originate from the ordinary watercourse on the site's eastern boundary which is a tributary to the Nant Muchudd. A medium risk corresponds to an annual event probability of occurrence between 1 in 30 and 1 in 100.

Figure 3 – NRW Mapping: Surface Water Flood Risk



3.8.5.2 Should a storm event of sufficient magnitude occur which results in channel exceedance, flows would escape the bank and an overland flow path would be generated, governed by local topography, channelled by physical / obstructive above ground features. In this instance floodwaters propagating in the rear service yard would be directed initially toward the linear drain where a valleyed low spot exists in the profile of the existing service yard at a topographical survey level of 68.42m. Here flows would either re-enter the network if capacity allowed or begin ponding on the surface at this location.

3.8.5.3 Should ponding spread, the levels are such that flows would be directed around the building rather than inundating the main building through its threshold positions on the rear elevation. The existing building's lowest finish floor level for the rear thresholds is 69.127m therefore affording the building protection at a level of 700mm higher than the external service yard low spot.

3.8.5.4 Similarly, the slab levels of the pump house, IBC storage, foam pumps and sprinkler tanks are all higher in their relative surroundings. The tank farm, which is bunded, would remain protected from inundation in the most extreme of flood events.

4 CONCLUSIONS

4.1 It is intended to mimic the existing drainage regime and reuse the existing drainage infrastructure and off-site connections where condition and position is suitable.

4.2 All discharge from processing operations will be regulated internally and the above ground holding tanks / vessels located in the tank farm will be tested for pH and TOC prior to release to the below ground drainage network in accordance with the agreed trade effluent licence. The tank farm is appropriately bunded to cater for the eventuality of a rupture in this area.

4.3 A below ground crash tank will be introduced to cater for spillages within the building or during tanker offloading activity. The detailed tanker offload procedure should form part of Purolite's operational management procedures and should be strictly observed.

4.4 The trade effluent portion of the foul contributing discharge will be restricted to a pump rate of 3l/s to the existing private network.

4.5 Surface water infrastructure is to remain largely unaltered with gullys positioned to suit the minor reconfiguration to the front car park.

4.6 The design philosophy is presented for illustrative purposes within drawing referenced CDGA-9021-101-C7, within Appendix A.

4.7 Consultations are ongoing with DCWW and NRW. Appropriate Section agreements, discharge consents and trade effluent licensing will be sought as necessary.

APPENDIX A – DRAWINGS

APPENDIX B – CALCULATIONS

Appendix D Schematic showing waste arising

[redacted]

[redacted]

[redacted]

[redacted]

Appendix E Planning Permission

STRONG HERITAGE | STRONG FUTURE
RHONDDA CYNON TAF
TREFTADAETH GADARN | DYFODOL SICR

Uwchadran Adfywio a Chynllunio
Regeneration and Planning Division
Tŷ Sardis House, Heol Sardis Road, Pontypridd CF37 1DU
E-bost: gwasanaethaucynllunio@rctcbc.gov.uk
Email: planningservices@rctcbc.gov.uk

Town and Country Planning Act 1990

FULL PLANNING PERMISSION

Client's Name and Address	Applicant's Name and Address (if different)
Mr G James	Purolite
James Partnership	Unit D
2 Cwrt y Parc	Llantrisant Business Park
Cardiff Business Park	Llantrisant
Llanishen	CF72 8LF
Cardiff	
CF14 5GH	

Part I - Particulars of Application Number 16/0255/10

Proposal:	Construction of new entrance lobby and canopy, re-cladding front elevation, minor alterations to other elevations, creating additional floor space at first and second floor level and installation of external storage tanks, gantry and alterations to site layout.
Location:	UNIT C SUNJUICE LTD, LLANTRISANT BUSINESS PARK, LLANTRISANT, PONTYCLUN, CF72 8LF
Grid Ref:	304144, 184659

Part II - Particulars of decision
In pursuance of its powers under the Town and Country Planning Act 1990, the Rhondda Cynon Taf County Borough Council GRANTS permission for the carrying out of the development as specified in the application and plans submitted, subject to the following conditions:-

1 The development hereby permitted shall be begun before the expiration of five years from the date of this permission.

Reason: To comply with Sections 91 and 93 of the Town and Country Planning Act 1990.

2 The development hereby approved shall be carried out in accordance with the approved plan(s) no(s):

- Proposed site plan, Drawing no. PL(0)01, dated 10th March 2016
- Proposed ground floor plan, Drawing no. PL(0)02, dated 10th March 2016
- Proposed second floor plans and sections, Drawing no. PL(0)04, dated 10th March 2016
- Proposed elevations – sheet 1, Drawing no. PL(0)05, dated 10th March 2016
- Proposed elevations – sheet 2, Drawing no. PL(S)05, dated 10th March 2016
- Proposed drainage strategy, Drawing no. 101 revision P0, dated 10th March 2016
- Proposed drainage strategy, Drawing no. 101 revision P3, dated 10th March 2016

and documents received by the Local Planning Authority on *<insert date>,* unless otherwise to be approved and superseded by details required by any other condition attached to this consent.

Reason: To ensure compliance with the approved plans and documents and to clearly define the scope of the permission.

3 Any facilities for the bulk storage of fuel, oils and chemicals, including their emptying and filling points, shall be located within a sealed bunded area, details of which shall be submitted to and approved in writing by the Local Planning Authority before installation.

Reason: To prevent pollution of nearby watercourses and drainage systems in accordance with Policy AW10 of the Rhondda Cynon Taf Local Development Plan.

4 Building operations shall not be commenced until samples of the proposed materials to be used have been submitted to and approved in writing by the Local Planning Authority and all materials used shall conform to the sample(s) so approved.

Reason: To ensure that the external appearance of the proposed development will be in keeping with the character of the area and adjoining buildings in the interests of visual amenity in accordance with Policies AW5 and AW6 of the Rhondda Cynon Taf Local Development Plan.

5 The development hereby permitted shall not begin until a scheme to deal

with contamination has been submitted to and approved in writing by the Local Planning Authority. The scheme shall include all of the following measures unless otherwise agreed in writing by the Local Planning Authority:

1. A desk-top study to identify and evaluate all potential sources and impacts of contamination relevant to the site. The desk top study should contain a conceptual site model.

2. A site investigation shall be carried out to fully and effectively characterise the nature and extent of any contamination and its implications. The site investigation shall not be commenced until a desk-top study has been agreed in writing with the Local Planning Authority.

3. A written method statement for the remediation of contamination affecting the site

Reason: In the interest of health and safety and environmental amenity and so as to accord with Policy AW10 of the Rhondda Cynon Taf Local Development Plan.

6 No dwelling, hereby permitted, shall not be occupied until the measures approved in the scheme (referred to in Condition have been implemented and a suitable validation report of the proposed scheme has been submitted to and approved in writing by the Local Planning Authority

Reason: In the interest of health and safety and environmental amenity and so as to accord with Policy AW10 of the Rhondda Cynon Taf Local Development Plan.

7 If during development works any contamination is encountered which was not previously identified and is derived from a different source and/or of a different type to those included in the contamination proposals then work shall cease and revised contamination proposals shall be submitted to the Local Planning Authority. The development shall not re-commence until the additional proposals have been agreed in writing by the Local Planning Authority.

Reason: In the interest of health and safety and environmental amenity and so as to accord with Policy AW10 of the Rhondda Cynon Taf Local Development Plan.

8 No development shall commence until all relevant matters outlined in “Planning Requirements Relating to Flood Risk Management” including full drainage details have been approved in writing by the Planning Authority. These details shall indicate how the development is to comply with the

requirements of Section 8.3 of Technical Advice Note 15.

Reason: To ensure that drainage from the proposed development does not cause or exacerbate any adverse condition on the development site, adjoining properties, environment and existing infrastructure arising from inadequate drainage in accordance with Policy AW10 of the Rhondda Cynon Taf Local Development Plan.

9 The development hereby permitted shall not be brought into beneficial use until the drainage works have been completed in accordance with the approved plans.

Reason: To ensure adequate disposal of foul and surface water drainage in accordance with Policy AW10 of the Rhondda Cynon Taf Local Development Plan.

Dated: 26/05/2016
Signed

Service Director Planning

NOTES TO APPLICANT:

1 If you are aggrieved by the decision of your local planning authority to refuse permission for the proposed development or to grant it subject to conditions, then you can appeal to the Welsh Ministers under section 78 of the Town and Country Planning Act 1990.

If you want to appeal against your local planning authority's decision then you must do so within 12 weeks of the date of this notice for Householder or Minor Commercial Developments or within 6 months of the date of this notice for all other appeals.

Appeals must be made using a form which you can get from the Welsh Ministers, Planning Inspectorate at Crown Buildings, Cathays Park, Cardiff CF10 3NQ, or online at www.planningportal.gov.uk/pcs.

The Welsh Ministers can allow a longer period for giving notice of an appeal, but are not normally prepared to use this power unless there are special circumstances which excuse the delay in giving notice of appeal.

The Welsh Ministers need not consider an appeal if it seems to them that the local planning authority could not have granted planning permission for the proposed development or could not have granted it without the conditions they imposed, having regard to the statutory requirements, to the provisions of any development order and to any directions given under a development order.

In practice, the Welsh Ministers do not refuse to consider appeals solely because the local planning authority based their decision on a direction given by them.

Appendix F [redacted]

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Appendix G Draft Trade Effluent consent

Dŵr Cymru
Welsh Water

Pentwyn Road
Nelson
Treharris
Mid Glamorgan
CF46 6LY

Tel: +44 (0)1443 452 300
Fax: +44 (0)1443 452 323
Web site: www.dwrcymru.com

Heol Pentwyn
Nelson
Treharris
Morgannwg Ganol
CF46 6LY

Ffôn: +44 (0)1443 452 300
Ffacs: +44 (0)1443 452 323
Safle gwe: www.dwrcymru.com

DRAFT COPY ONLY

Date 7th September 2016

Ian Horton
Managing Director
Purolite Limited
Unit D
Llantrisant Business Park
Llantrisant
Rhondda Cynon Taff
CF72 8LF

Dear Mr Horton,

Ref:- Authorisation for Temporary Disposal of Wastewater from the manufacture of pharmaceutical grade resins at Purolite Limited, Unit C Llantrisant Business Park to the Public Foul Sewer

Thank you for your recent enquiry regarding an authorisation to discharge trade effluent to the public foul sewer from the above address.

Based on the information provided, I can confirm that authorisation is given to discharge the trade effluent into the public foul sewer, subject to the following conditions and not otherwise:

1. The premises from which the trade effluent may be discharged is: Purolite Limited, Unit C Llantrisant Business Park, Llantrisant, Rhondda Cynon Taff CF72 8LF.

2. The maximum volume of trade effluent that may be discharged shall not exceed 100 cubic metres per day at a flow rate of no more than 3 litres/second.

3. The trade effluent to be discharged is derived from;
   - the manufacture of agarose based resin for pharmaceutical use, i.e. aqueous process waste from two waste holding tanks within the bunded area at the tank farm; and each tank tested for pH and Total Organic Carbon (TOC) prior to discharge into the underground tank.
   - potentially contaminated surface water from the tank farm bund, and from the underground storage tank.

   All the trade effluent from these sources is to be combined and stored within the underground storage tank, and each batch tested for pH and Total Organic Carbon (TOC) prior to discharge to ensure compliance with the consent limits outlined below.

4. The trade effluent is expected to contain traces of:
   COD, Solids (fine agarose particles), Ethanol, Sodium Hydroxide, Epichlorohydrin, Acetic Acid, Sodium Sulphate, Glycidyltrimethylammonium chloride (GMAC).

Commented [d1]: Added "aqueous".

Commented [d2]: Bryan Griffiths Comment

5. The combined trade effluent discharge from Unit C will be subject to the following consent limits:
   - Settled Chemical Oxygen Demand load of 100 kilograms per day;
   - Total Suspended Solids limit of 100 milligrams per litre;
   - Ammonia (as N) 10 milligrams per litre;
   - Ethanol load of 10 kilograms per day;
   - Toluene 1.0 milligram per litre;
   - Total Sulphate 1800 milligrams per litre.

6. Compliance with consent limits will be determined by spot samples taken from the trade effluent monitoring point.

7. A flow meter must be installed downstream of the underground storage tank, and daily flow meter readings taken and recorded whilst discharging to provide cumulative volumes both for compliance purposes (i.e. determining daily loads), and for charging purposes according to Dwr Cymru's current Scheme of Charges.

8. This permission is given on the understanding that:
   a) it may be reviewed from time to time in accordance with the frequency applying in respect of a trade effluent consent issued under the Water Industry Act 1991, section 124.
   b) Dwr Cymru-Welsh Water may review its Trade Effluent Policy and require a review of this permission subject to the restrictions in a) above.
   c) If the nature of the discharge is changed then Dwr Cymru-Welsh Water must be informed of this and shall be entitled to review the permission.

9. This permission is valid for 6 months only from the date of this letter. After this initial 6 month period, it will be a requirement to replace this authorisation with a full trade effluent discharge consent, to be based on the volume and effluent quality data collected during the initial authorised period.

Commented [d3]: Clarify whether date from commissioning or issue. When would issue come?

The standard trade effluent consent application fee of £321 (zero rated for VAT) is payable in respect of this application. You will be sent an invoice for this amount in due course.

In the meantime, if you have any queries or should the operation change in any way so as to affect the nature and volume of wastewater for disposal, please contact Heather Pepper, Trade Effluent Officer on (029) 20 478822 or on e-mail at heather.pepper@dwrcymru.com.

Yours sincerely

Richard Ingles
Process Scientist

Appendix H [redacted]

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Appendix I Material safety data sheets

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