Hayle Sludge Treatment Centre

Air Emissions Risk Assessment

On behalf of

South West Water Ltd.

Project Ref:331101267/100.030101 | Rev: Issued | Date: January 2022

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1 Introduction

1.1 Background

1.1.1 South West Water Ltd has commissioned Stantec UK Ltd (Stantec) to undertake an Air Emission Risk Assessment (AERA) to support the Environmental Permit (EP) application under the Industrial Emissions Directive (IED) for Anaerobic Digestion activities at Hayle Sludge Treatment Centre (STC).

1.1.2 The Installation is located within the administrative boundary of Cornwall Council. The location of the Site is shown in **Figure 1, Appendix E**.

1.1.3 The Installation includes a biogas combustion plant comprising three gas-fired Combined Heat and Power (CHP) plant units, two gas-fired boilers, and an emergency biogas flare.

1.2 Report Scope

1.2.1 The scope of the assessment is limited to the point source combustion emissions to air at the Installation (as defined above). Consistent with Environment Agency (EA) guidance (Environment Agency, 2021), for a combustion plant fired on biogas, the principal release of oxides of nitrogen (NOx) have been assessed alongside sulphur dioxide (SO_2) due to the potential sulphur content of biogas.

1.2.2 Emissions of NOx (in the form of nitrogen dioxide (NO_2)) and SO_2 have been assessed against the relevant Air Quality Standards for NO_2 and SO_2 for the protection of human health. An assessment has also been carried against the relevant Critical Levels (C_{Le}) for NOx and SO_2, and Critical Loads (C_{Lo}) for nitrogen and acid deposition which are designed for the protection of designated ecological sites.

1.2.3 This report outlines the approach, methodology and results of the AERA that has been undertaken, utilising atmospheric dispersion modelling, to support the EP application.

1.2.4 The results of the assessment have been interpreted in accordance with the requirements of the EA to identify if impacts represent 'significant pollution' as required by the EA to determine an EP application.

1.2.5 The AERA has been undertaken in accordance with relevant legislation, policy and guidance.

2 Legislation and Relevant Guidance

2.1 Environmental Permitting Guidance

2.1.1 Guidance Notes produced by DEFRA provide a framework for regulation of installations and additional technical guidance produced by the EA are used to provide the basis for permit conditions.

2.1.2 Of particular relevance to the assessment is the '*Air emissions risk assessment for your environmental permit*', also known as the AERA Guidance (Environment Agency, 2021). The purpose of the AERA Guidance is to assist operators to assess risks to the environment and human health when applying for a permit under the EP Regulations. Included in the AERA guidance are:

- an approach to screening assessment;
- guidance on when detailed atmospheric dispersion modelling is required; and
- Environmental Assessment Levels (EALs) for a range of pollutants not covered by other regulations, against which impact may be assessed.

2.2 National Air Quality Legislation and Guidance

Air Quality Standards

2.2.1 The Air Quality Standards Regulations 2010 (the AQSR) transposed the Air Quality Directive (2008/50/EC) and Fourth Daughter Directive (2004/107/EC). The Regulations include Limit Values, Target Values, Objectives, Critical Levels and Exposure Reduction Targets for the protection of human health and the environment.

2.2.2 Following the Transition Period after the UK's departure from the EU in January 2020, the Air Quality (Amendment of Domestic Regulations) (EU Exit) Regulations 2019 (and subsequent amendments for the devolved administrations) have amended the AQ Standards Regulations 2010 to reflect the fact that the UK has left the EU, but do not change the pollutants assessed or the numerical thresholds.

National Air Pollution Plan for NO_2 in the UK

2.2.3 The national Air Quality Plan for NO_2 (DEFRA, 2018) sets out how the Government plans to deliver reductions in NO_2 throughout the UK, with a focus on reducing concentrations to below the EU Limit Values throughout the UK within the 'shortest possible time'.

2.2.4 The plan requires all Local Authorities (LAs) in England which DEFRA identified as having exceedances of the Limit Values in their areas past 2020 to develop local plans to improve air quality and identify measures to deliver reduced emissions, with the aim of meeting the Limit Values within their area within "*the shortest time possible*". Potential measures include changing road layouts, encouraging public and private ultra-low emission vehicle (ULEV) uptake, the use of retrofitting technologies and new fuels and encouraging public transport. In cases where these measures are not sufficient to bring about the required change within 'the shortest time possible' then LAs may consider implementing access restrictions on more polluting vehicles (e.g. Clean Air Zones (CAZs)). A CAZ is defined within the plan as being "*an area where targeted action is taken to improve air quality and resources are prioritised and coordinated in a way that delivers improved health benefits and supports economic growth*" and may be charging or non-charging.

Air Quality Strategy

2.2.5 The Air Quality Strategy (AQS) 2007 for England, Scotland, Wales and Northern Ireland sets out a comprehensive strategic framework within which air quality policy will be taken forward in the short to medium term, and the roles that Government, industry, the Environment Agency, local government, business, individuals and transport have in protecting and improving air quality (DEFRA, 2007). The AQS contains Air Quality Objectives (AQOs) based on the protection of both human health and vegetation (ecosystems). The AQOs are maximum ambient pollutant concentrations that are not to be exceeded, either without exception or with a permitted number of exceedances allowable over a specified timescale. The AQOs are generally in accordance with the Limit Values specified in the AQSRs, however requirements for compliance differ slightly.

2.2.6 The Clean Air Strategy (2019) aims to lower national emissions of pollutants, thereby reducing background pollution and minimising human exposure to harmful concentrations of pollution. The Strategy aims to create a stronger and more coherent framework for action to tackle air pollution (DEFRA, 2019).

2.2.7 The Environment Agency's role in relation to the AQS is as follows:

"The Environment Agency is committed to ensuring that any industrial installation or waste operation we regulate will not contribute significantly to breaches of an AQS objective.

It is a mandatory requirement of EPR legislation that we ensure that no single industrial installation or waste operation we regulate will be the sole cause of a breach of an EU air quality limit value. Additionally, we have committed that no installation or waste operation will contribute significantly to a breach of an EU air quality limit value." (Environment Agency, 2008)

2.3 Standards for Air Quality

2.3.1 The standards applied in this assessment are taken from the AERA Guidance which are in accordance with the AQS and AQSR. The EALs that have been applied in this assessment are provided in **Table 2-1**.

Table 2-1 Applied EALs

Pollutant	Averaging Period	EAL (µg/m^3)	Source
Nitrogen dioxide (NO_2)	Annual Mean	40	AQS and AQSR
	1-hour Mean	200 (1-hour) not to be exceeded more than 18 times per year	AQS and AQSR
Sulphur Dioxide (SO_2)	15 minutes	266 µg/m^3 not to be exceed more than 35 times a year	AQS
	1-hour	350 µg/m^3 not to be exceeded more than 24 times a year	AQS and AQSR
	24-hour	125 µg/m^3 not to be exceeded more than 3 times a year	AQS and AQSR

2.3.2 DEFRA has published technical guidance for use in Local Air Quality Management (LAQM) (DEFRA, 2021). According to LAQM.TG (16), air quality strategy objectives should only apply to locations where "*members of the public are likely to be regularly present and are likely to be exposed for a period of time appropriate to the averaging period of the objective*". Authorities should not consider exceedances of the objectives at any location where relevant public exposure would not be realistic. Thus, short term objectives such as the 1-hour objective should apply to footpaths and other areas which may be regularly frequented by the public even for a short period of time. Longer term objectives such as annual means, should apply at houses or other locations which the public can be expected to occupy on a continuous basis. These objectives do not apply to exposure at the workplace.

Table 2-2 Relevant Public Exposure

Averaging Period	Air quality objectives should apply at:	Air quality objectives don't apply at:
Annual mean	All locations where members of the public might be regularly exposed. Building façades of residential properties, schools, hospitals, care homes etc.	Building façades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties. Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.
24-hour and 8-hour mean	All locations where the annual mean NAQO would apply, together with hotels and gardens of residences.	Kerbside sites Any other location where public exposure is expected to be short term.
1-hour mean	Any outdoor locations where members of the public might reasonably be expected to spend one hour or longer.	Kerbside sites where public would not be expected to have regular access
15-minute mean	All locations where members of the public might reasonably be regularly exposed for a period of 15 minutes or longer.	Locations where members of the public would not reasonably be expected to be regularly exposed for a period of 15 minutes or longer.

2.4 Protection of Ecological Receptors

2.4.1 Sites of nature conservation importance at a national and local level, are provided environmental protection from developments, including from atmospheric emissions. EALs for the protection of ecological receptors are known as Critical Levels (C_{Le}) for airborne concentrations and Critical Loads (C_{Lo}) for deposition to land from air.

2.4.2 The AERA Guidance requires that ecological habitats should be screened against relevant standards if they are located within the following set distances from the facility:

- Special Protection Areas (SPAs), Special Areas of Conservation (SACs) or Ramsar sites within 10km of the Installation; and
- Sites of Special Scientific Interest (SSSIs), National Nature Reserves (NNR), Local Nature Reserves (LNR), Local Wildlife Sites (LWS) and Ancient Woodland (AW) within 2km of the Installation.

Critical Levels (C_{Le})

2.4.3 C_{Le} are a quantitative estimate of exposure to one or more airborne pollutants in gaseous form, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge. The relevant C_{Le} for the protection of vegetation and ecosystems are specified within the UK Air Quality Regulations and AERA Guidance (see **Table 2-3**).

Table 2-3 Relevant C_{Le} for the Protection of Vegetation and Ecosystems

Pollutant	Concentration (µg/m^3)	Habitat and Averaging Period	Source
Nitrogen Oxides (NOx)	30	Annual mean (all ecosystems)	AQSR
	75	Daily mean (all ecosystems)	AERA
Sulphur Dioxide (SO_2)	10	Annual Mean (lichens and bryophytes)	AERA
	20	Annual Mean	AQSR

Critical Loads (C_{Lo})

2.4.4 C_{Lo} are a quantitative estimate of exposure to deposition of one or more pollutants, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge. Critical loads are set for the deposition of various substances to sensitive ecosystems. In relation to combustion emissions critical loads for eutrophication and acidification are relevant which can occur via both wet and dry deposition; however, on a local scale only dry (direct deposition) is considered significant.

2.4.5 Empirical C_{Lo} for eutrophication (derived from a range of experimental studies) are assigned based for different habitats, including grassland ecosystems, mire, bog and fen habitats, freshwaters, heathland ecosystems, coastal and marine habitats, and forest habitats and can be obtained from the UK Air Pollution Information System (APIS) website (APIS, 2021).

2.4.6 C_{Lo} for acidification have been set in the UK using an empirical approach for non-woodland habitats on a 1km grid square based upon the mineralogy and chemistry of the dominant soil series present in the grid square, and the simple mass balance (SMB) equation for both managed and unmanaged woodland habitats.

3 Assessment Methodology

3.1 Model Setup

3.1.1 Detailed atmospheric dispersion modelling has been undertaken using the most recent version (v.19191) of the AERMOD dispersion model which has been developed in conjunction with, and approved for use by, the US EPA. The dispersion modelling has been undertaken with due consideration to relevant guidance. The modelling approach is based upon the following stages:

- identification of sensitive receptors;
- review of process design and emission sources;
- compilation of the existing air quality baseline and review of LAQM status; and
- calculation of process contribution to ground level concentrations and evaluation against relevant environmental standards for both human and ecological receptors.

3.1.2 The AERMOD model calculates time-averaged ground level concentrations over any set of distances from the source. A 2km x 2km Cartesian grid with 25m spacing was used to predict the maximum predicted contribution to ground level (1.5m flagpole) concentrations. The pollutant concentrations were also predicted at specific human and ecological receptor locations.

3.1.3 The model requires inputs for:

- building effects;
- nature of the surface;
- physical characteristics of the emissions; and
- meteorology.

Building Effects

3.1.4 Buildings can influence the dispersion of pollutants from sources and can increase the maximum predicted ground level concentrations. The main effect of a building is to entrain pollutants into the cavity region in the immediate leeward side of the building, bringing them rapidly down to ground level. Therefore, concentrations near the building are increased but further away concentrations are decreased.

3.1.5 The buildings that are nearest (or attached) to the sources have been considered in the model. Buildings located horizontally within the distance equivalent to five stack heights of the stack and taller than approximately a third of the stack height have been included, in accordance with advice from the software provider. Details of buildings input to the model are provided in **Table 3-1** and **Table 3-2** below and shown in **Figure 2, Appendix E**. Building heights were obtained from OS Mastermap.

Table 3-1 Building Parameters – Circular Buildings

Building ID	X	Y	Radius (m)	Height above Ground (m)
1	154646.6	35750.6	8.6	12
2	154709.2	35749.4	5.6	8.2

Building ID	X	Y	Radius (m)	Height above Ground (m)
3	154718.3	35737.9	5.8	14.3
4	154726.7	35726.5	5.9	13.8
5	154731.6	35762.5	5.0	2
6	154739.9	35751.3	5.1	6.4
7	154748.8	35740	5.0	5.5

Table 3-2 Building Parameters – Rectangular Buildings

Building ID	X	Y	X Length (m)	Y Length (m)	Height above Ground (m)
8	154736.9	35746.4	4.7	9.4	3.8
9	154691.2	35754.2	12.5	3	2.7
10	154663.8	35741.1	11.6	17.7	9.5
11	154672.7	35724.6	10.1	19.9	8.2
12	154665.9	35718.9	8.2	12.2	6.9
13	154698.2	35724.6	16.6	9.8	9.1

Terrain

3.1.6 Topographical data covering the extent of the receptor grid and specific receptor locations has been included in the model and was obtained from the OS Land-Form Panorama dataset.

Meteorology

3.1.7 The model utilises a meteorological dataset that contains hourly values for wind speed, wind direction, and atmospheric stability to compute the dispersion of the emissions.

3.1.8 The assessment has used the site-specific five-year (2016 to 2020) sequential meteorological dataset from Camborne meteorological station which is considered to be representative of meteorological conditions at the Site. The 2016 to 2020 windroses are provided in **Appendix A**.

3.2 Emissions to Atmosphere

3.2.1 The technical specifications of the combustion plant are:

- One Naldo Energy Technic NUTEC165 CHP (165 kWe output);
- Two Naldo Energy Technic NUTEC85 CHPs (85 kWe output);
- Two Strebel RuS1-6 boilers (320 kWth output and 394.9 kWth thermal input);
- One UF10 205 biogas combustion flare.

3.2.2 The quantification of the pollutant emission rates for the CHPs has been based on physical discharge characteristics and emissions monitoring data (EnviroDat Limited, 2011) and standard operating parameters included within Environmental Protection UK's (EPUK's) 'CHP Air Quality Impacts Tool' (EPUK and Bureau Veritas, 2012). For the boilers, the quantification of pollutant emission rates has been based on typical physical discharge characteristics and standard operating parameters included within AEA's 'Biomass Unit Conversion and Screening Assessment Tool' (AEA, 2008).

3.2.3 The emission release rates have been calculated from the 'normalised' flue gas flow rates (see **Table 3-3**) and the relevant ELVs. The source parameters and emission rates used for the assessment of emissions are provided in **Table 3-3**. Emissions from each CHP plant and boiler are discharged via individual stacks (i.e. five stacks in total). The CHP flues have been modelled as horizontal stacks in AERMOD and the boiler flues have been modelled as vertical stacks.

3.2.4 As a worst-case scenario, the boilers and CHP plant have been assumed to operate throughout the year for 24-hours a day (8,760 hours per annum). This assumption is considered conservative; real-world boiler use in particular is substantially below this level of utilisation. All plant is periodically taken off-line for servicing which would also reduce total available annual operating hours.

3.2.5 The flare has not been included in the model as the CHPs are used in preference to the flare and the flare is not expected to be used when the CHPs are operational. Emissions rates have been calculated for the flare to demonstrate that the combined emission rates for the CHPs are greater than those for the flare. The calculated NOx emission rate for the flare is 0.0595 g/s using an ELV of 150 mg/Nm^3 (@STP, dry, 3% O_2) (EA, 2010) which is far less than the combined NOx emission rate for the CHPs (0.1513 g/s). Therefore, modelling the CHPs as opposed to the flare provides a worst-case assessment.

Table 3-3 Applied Physical Discharge Characteristics to Estimate Emissions and Estimated Emission Rates

Parameter / Source	CHP1 Flue	CHP2 Flue	CHP3 Flue	Boiler1 Flue	Boiler2 Flue
Stack Locations (x, y)	154696.9, 35721.8	154695.9, 35719.8	154694.9, 35717.8	154705.7, 35717.4	154704.8, 35715.5
Stack Release Height (m AGL)	8.1	8.1	8.1	10.1	10.1
Emission Temperature (ºC)	120	120	120	120	120
Stack Internal Diameter (m)	0.15	0.10	0.10	0.20	0.20
Emission Velocity (m/s)	12.45	15.28	15.28	7.61	7.61
Actual flow rate (Am^3/s)	0.22	0.12	0.12	0.24	0.24
Normalised flow rate, dry, 15% oxygen (Nm^3/s)	0.38	0.19	0.22	-	-
Normalised flow rate, dry, 3% oxygen (Nm^3/s)	-	-	-	0.10	0.10
NOx Emission Rate (g/s)	0.0725[a]	0.0368[a]	0.0420[a]	0.0251[c]	0.0251[c]
SO_2 Emission Rate (g/s)	0.0229[b]	0.0116[b]	0.0133[b]	0.0201[d]	0.0201[d]

a The NOx emission rate has been calculated using the MCP ELV of 190 mg/Nm^3 (@STP, dry, 15% O_2).
b The SO_2 emission rate has been calculated using the MCP ELV of 60 mg/Nm^3 (@STP, dry, 15% O_2)
c The NOx emission rate has been calculated using the MCP ELV of 250 mg/Nm^3 (@STP, dry, 3% O_2).
d The SO_2 emission rate has been calculated using the MCP ELV of 200 mg/Nm^3 (@STP, dry, 3% O_2).

3.3 Assessment of Impacts on Air Quality

NOx to NO_2 Conversion

3.3.1 Emissions of NOx from combustion sources include both NO_2 and NO, with the majority being in the form of NO. In ambient air, NO is oxidised to form NO_2, and it is NO_2 which has the greater potential health impacts. For this assessment, the conversion of NO to NO_2 has been estimated using the worst-case assumptions set out in EA AERA guidance, namely that:

- For the assessment of long term (annual mean) impacts at receptors, 70% of NOx is NO_2; and
- For the assessment of short term (hourly mean) impacts at receptors, 35% of NOx is NO_2.

3.3.2 The oxidation of NO to NO_2 is not, however, an instantaneous process and where the maximum impacts occur within up to 1km of the stacks the EA AERA guidance assumptions lead to a conservative assessment.

15-minute SO_2 Concentrations

3.3.3 In this assessment, the 99.9th percentiles of 1-hour mean SO_2 concentrations have been converted into 99.9th percentiles of 15-minute mean concentrations using a conversion factor 1.34, as recommended in the EA AERA guidance.

Assessment of Impact and Significance

3.3.4 To assess the potential impact on air quality, the predicted exposure is compared to the EALs, and the results of the dispersion modelling have been presented in the form of:

- tabulated concentrations at discrete receptor locations to facilitate the discussion of results; and
- illustrations of the impact as isopleths (contours of concentration) for the criteria selected enabling determination of impact at any locations within the study area.

3.3.5 In accordance with the EA's AERA guidance, the impact is considered to be insignificant or negligible if:

- the long-term process contribution is <1% of the long term EAL; and
- the short-term process contribution is <10% of the short term EAL.

3.3.6 For process contributions that cannot be considered insignificant further assessment has been undertaken and the Predicted Environmental Concentration (PEC: PC + existing background pollutant concentration) determined for comparison as a percentage of the relevant EAL. DEFRA 2018-based background maps for 2019 (DEFRA, 2021) have been applied to calculate the NO_2 PECs at receptor locations, whist the latest available DEFRA background maps for SO_2 (2001) have been applied to calculate the SO_2 PECs at receptor locations.

3.3.7 The EA's AERA guidance indicates that no further assessment is required, and impacts do not constitute 'significant pollution' if the resulting PEC is below the EAL and the applied emission levels comply with the BAT requirements.

3.4 Assessment of Impacts on Vegetation and Ecosystems

Calculation of Deposition Rates

3.4.1 Deposition rates were calculated using empirical methods recommended by the EA AQTAG06 (EA, 2014). Dry deposition flux was calculated using the following equation:

Dry deposition flux (µg/m²/s) = ground level concentration (µg/m³) x deposition velocity (m/s)

3.4.2 Wet deposition occurs via the incorporation of the pollutant into water droplets which are then removed in rain or snow and is not considered significant over short distances (AQTAG06) compared with dry deposition. Therefore, for the purposes of this assessment, wet deposition has not been considered.

3.4.3 The dry deposition velocities and conversion factors for NO_2 and SO_2 were taken from the EA's guidance document AQTAG 06 (EA, 2014) and are set out in **Table 3-4**.

Table 3-4 Applied Deposition Velocities

Chemical Species	Habitat	Recommended deposition velocity (m/s)	Conversion µg/m²/s to kgN/ha/yr	Conversion µg/m²/s to keq/ha/yr
NO_2	Grassland	0.0015	96.0	6.84
	Woodland	0.003		
SO_2	Grassland	0.012	-	9.84
	Woodland	0.024		

Assessment of Impact and Significance

3.4.4 In addition to the AERA guidance, the EA's Operational Instruction 66_12 (EA, 2012a) details how the air quality impacts on ecological sites should be assessed. This guidance provides risk-based screening criteria to determine whether impacts will have 'no likely significant effects (alone and in-combination)' for European sites, 'no likely damage' for SSSI's and 'no significant pollution' for other sites, as follows:

- PC <1% long-term C_{Le} and/or C_{Lo} or that the PEC <70% long-term C_{Le} and/or C_{Lo} for European sites and SSSIs;
- PC <10% short-term C_{Le} for NOx for European sites and SSSIs;
- PC <100% long-term C_{Le} and/or C_{Lo} for other conservation sites; and
- PC <100% short-term C_{Le} for NOx (if applicable) for other conservation sites.

3.4.5 Where impacts cannot be classified as resulting in 'no likely significant effect', more detailed assessment may be required depending on the sensitivity of the feature in accordance with EAs Operational Instruction 67_12 (EA, 2012b). This can require the consideration of the potential for in-combination effects, the actual distribution of sensitive features within the site, and local factors (such as the water table).

3.4.6 The guidance provides the following further criteria:

- if the PEC<100% of the appropriate limit, it can be assumed there will be no adverse effect;

- if the background is below the limit, but a small PC leads to an exceedance – decision based on local considerations;
- if the background is currently above the limit and the additional PC will cause a small increase – decision based on local considerations;
- if the background is below the limit, but a significant PC leads to an exceedance – cannot conclude no adverse effect; and
- if the background is currently above the limit and the additional PC is large - cannot conclude no adverse effect.

4 Baseline Environment

4.1 Site Setting and Sensitive Receptors

4.1.1 The site location is shown in **Figure 1, Appendix E**. A railway line lies directly to the north of the Hayle Wastewater Treatment Works (WwTW) boundary, beyond which is an area of open fields and the A30 Hayle Bypass. The River Hayle runs north to south along the eastern boundary of the WwTW. Beyond the river lies open fields, a golf course, Chenhalls Road and properties off Chenhalls Road. A LWS borders the southern and western boundary of the WwTW. Beyond the LWS to the west is an area of industrial uses, St Erth train station, a Park and Ride, the A30 and residential properties. The area to the south is predominantly farmland with a small number of residential properties. The modelled sensitive human and ecological receptor locations in proximity to the Site are detailed in the following sections.

Human Receptors

4.1.2 According to LAQM.TG (16), air quality standards should apply to locations where members of the public may be reasonably likely to be exposed to air pollution for the duration of the relevant limit value. The dispersion modelling has been completed using a receptor grid which allows the maximum ground level impact to be assessed including potential short-term exposure locations. As such, the impact concentration has been assessed at all potential exposure locations surrounding the Site. In addition, sensitive existing residential properties and a school have been modelled, details of which are shown in **Table B-1, Appendix B** and their locations are shown in **Figure 3, Appendix E**.

Ecological Receptors

4.1.3 European, national and local designated sites within the relevant AERA screening distances are presented in **Table B-2, Appendix B** and shown in **Figure 4** and **Figure 5, Appendix E.**

4.2 Ambient Air Quality

Local Air Quality Management

4.2.1 Cornwall Council has investigated air quality within its area as part of its responsibilities under the LAQM regime. The Council currently has nine AQMAs: Kerrier, Bodmin, Tideford, Gunnislake, St Austell, Truro, Grampound, Launceston and Camelford. The Tideford, Grampound, Kerrier, Bodmin and Camelford AQMAs have been declared due to exceedances of the annual mean NO_2 NAQO, whilst the Gunnislake, St Austell, Truro and Launceston AQMAs have been declared due to exceedances of both the annual and hourly mean NO_2 NAQOs.

4.2.2 The Site is not located within an AQMA, the closest of which is located 9.5 km north-east in Camborne.

Local Air Quality Monitoring Data

4.2.3 Cornwall Council carries out monitoring of NO_2 concentrations at a number of locations across the county. The closest and most representative locations are described below and shown in **Figure 1, Appendix E**. The latest publicly available monitoring data for 2015 – 2018 for these monitoring locations are provided in **Table 4-1**. Monitoring at these locations began in 2015 therefore data for years prior to 2015 are not available.

4.2.4 **Table 4-1** shows that there were exceedances of the annual mean NO_2 NAQO at LE9 between 2015 – 2017, and LE2 in 2015 and 2016. Both of these locations are adjacent to the A3074 Tyringham Road in Lelant, more than 1.2 km from the Installation. There were no other measured exceedances (in years where data were available) at the remaining monitoring locations presented in **Table 4-1**. Annual mean concentrations were below 60 $\mu g/m^3$ indicating that exceedances of the hourly mean NO_2 NAQO are unlikely to have occurred between 2015 – 2018.

Table 4-1 Measured NO_2 concentrations, 2014 - 2019

Site ID	Site Type	Annual Mean (µg/m^3)			
		2015	2016	2017	2018
LE1	Roadside	28.7	33.1	26.8	23.8
LE2	Roadside	44.3	43.5	37.7	-
LE3	Roadside	-	-	-	18.4
LE4	Roadside	29.0	28.6	25.1	-
LE5	Roadside	20.8	23.1	19.3	-
LE6	Roadside	-	-	-	38.3
LE8	Roadside	-	-	-	22.6
LE9	Roadside	**57.1**	**53.3**	**47.2**	-
NAQO		**40**			

Cornwall Council data obtained from the Council website (Cornwall Council, 2021).

4.3 Predicted Background Concentrations

4.3.1 Modelled background pollutant concentration data on a 1km x 1km spatial resolution is provided by DEFRA through the UK AIR website (DEFRA, 2020) and are routinely used to support LAQM and Air Quality Assessments.

4.3.2 The latest available background pollutant concentrations for NO_2 are based upon a 2018 base year and projected to future years. The projected 2019 background concentrations for the grid squares containing the Site and modelled receptor locations have been applied in this AERA and are shown in **Table 4-2**. Background NO_2 concentrations are well below the AQO.

Table 4-2 Estimated Annual Mean NO_2 Background Concentrations 2019 (µg/m^3)

Location (x_y)	Annual Mean (µg/m^3)	
	NOx	NO_2
154_035	6.7	5.4
154_036	7.9	6.3
155_035	5.9	4.7
155_036	7.9	6.3

4.3.3 The latest available modelled background pollutant data for SO_2 available from DEFRA is for 2001. The DEFRA predicted background concentrations of SO_2 for grid squares containing the Site and modelled receptor locations are provided in **Table 4-3**. The predicted annual mean SO_2 background concentrations have been applied to all modelled human receptor locations in this assessment.

Table 4-3 Estimated Annual Mean SO_2 Background Concentrations 2001 (µg/m³)

Location (x_y)	Annual Mean SO_2 Concentration (µg/m³)
154_035	1.4
154_036	1.4
155_035	1.4
155_036	2.1

4.4 Baseline Air Quality at Ecological Receptors

4.4.1 The APIS website, a support tool for assessment of potential effects of air pollutants on habitats and species developed in partnership by the UK conservation agencies and regulatory agencies and the Centre for Ecology and Hydrology, has been used to provide information on relevant C_{Lo} and current deposition rates for nutrient nitrogen and for acidity. For LWS receptor locations, the C_{Lo} have been obtained from APIS using the 'search by location' feature for the applied habitats in **Table 4-4**. For Marazion Marsh SPA, the 'site relevant critical loads' feature has been used and C_{Lo} for the most sensitive habitat present have been applied. At receptor locations within the Hayle Estuary and Carrack Gladden SSSI, the Project Ecologist has confirmed that the habitat types present at these receptor locations is coastal saltmarsh (SSSIa and SSSIc) and mudflats (SSSIb) and relevant C_{Lo} have been obtained using the 'search by location' feature in APIS. The 'site relevant critical loads' feature in APIS indicates that there are no comparable habitats with established C_{Lo} estimates available for sensitive features within the Tregonning Hill SAC. Therefore, C_{Lo} for 'dwarf shrub heath' have been obtained for Tregonning Hill SAC using the 'search by location' tool in APIS.

4.4.2 The relevant C_{Lo} used in this assessment and applied habitats are provided in **Table 4-4.** Baseline deposition rates and concentrations are provided in **Table 4-5** and **Table 4-6.** These have also been obtained from the APIS website.

4.4.3 **Table 4-5** shows that background nitrogen deposition exceeds the relevant C_{Lo} within all of the designated ecological sites in the study area, except for within the Marazion Marsh SPA and Hayle Estuary and Carrack Gladden SSSI.

Table 4-4 Nitrogen and Acid Deposition Critical Loads

Receptor	Designated Site	Applied Habitat	Critical Load	
			Nitrogen Deposition (kgN/ha/yr)	Acid Deposition (MaxN) (keqN/ha/yr)
LWS1a – LWS1j	St Erth Pools LWS	Broadleaved, mixed and yew woodland	10	2.243
LWS2	Carbismill to Relubbus Tregenhorne Valley LWS	Broadleaved, mixed and yew woodland	10	2.243
LWS3	Hayle Estuary LWS	Coastal saltmarsh	10	Not sensitive
SAC1	Tregonning Hill SAC	Dwarf Shrub Heath	10	1.475
SPA	Marazion Marsh SPA	Fen, marsh and swamp	15	Not sensitive

Receptor	Designated Site	Applied Habitat	Critical Load	
			Nitrogen Deposition (kgN/ha/yr)	Acid Deposition (MaxN) (keqN/ha/yr)
SSSI1a – SSSI1c	Hayle Estuary and Carrack Gladden SSSI	Coastal saltmarsh	20	Not sensitive

Table 4-5 Baseline Deposition Rates

Receptor	Nitrogen Deposition (kgN/ha/yr)	Acid Deposition	
		Nitrogen (keq N/ha/yr)	Sulphur (keq S/ha/yr)
LWS1a – LWS1j	26.7	1.91	0.23
LWS2	26.7	1.91	0.23
LWS3	12.6	0.90	0.18
SAC1	13.4	0.96	0.16
SPA	13.0	0.90	0.20
SSSI1a – SSSI1c	16.5	1.20	0.20

Table 4-6 Baseline Concentrations

Receptor	Annual Mean Concentration (µg/m^3)	
	NOx	SO_2
LWS1a – LWS1j	6.9	0.5
LWS2	6.9	0.5
LWS3	8.0	1.4
SAC1	5.0	0.6
SPA	6.3	0.7
SSSI1a – SSSI1c	8.3	0.6

5 Assessment Results

5.1.1 Dispersion modelling has been undertaken using the input data specified in this report. **Figure 6** to **Figure 10, Appendix E** should be referred to for graphical visualisations of modelling results. The impacts at modelled human and ecological receptor locations are described in the following sections.

5.2 Impacts on Sensitive Human Receptors

Nitrogen Dioxide (NO_2)

5.2.1 **Figure 6, Appendix E** illustrates the predicted annual mean NO_2 PC contour whilst **Figure 7, Appendix E** shows the 1-hour mean NO_2 PC contour. Contours are presented for the year of the maximum PC which is 2018 for annual mean NO_2 and 2020 for 1-hour mean NO_2. Predicted annual mean NO_2 concentrations at sensitive receptor locations are summarised in **Table C-1, Appendix C,** whilst predicted 1-hour mean NO_2 concentrations are provided in **Table C-2, Appendix C**. Results for the worst-case meteorological year of the five years assessed (2016 - 2020) are presented.

5.2.2 The predicted annual mean NO_2 PC exceeds 1% of the EAL at sensitive receptors R05, R06 and R13. For all remaining receptors, the predicted annual mean NO_2 PC is less than 1% of the EAL and can therefore be classified as 'insignificant' according to EA guidance.

5.2.3 As the predicted annual mean NO_2 concentrations are well below the relevant EAL at all sensitive human receptor locations, the predicted annual mean NO_2 impacts do not constitute 'significant pollution'.

5.2.4 The predicted 1-hour mean NO_2 PC is less than 10% of the EAL at all modelled receptor locations and can therefore be classified as 'insignificant' according to the EA guidance.

Sulphur Dioxide (SO_2)

5.2.5 **Figure 8, Appendix E** illustrates the predicted 24-hour mean SO_2 PC contour, **Figure 9, Appendix E** shows the 1-hour mean SO_2 PC contour and **Figure 10, Appendix E** shows the 15-minute mean SO_2 contour. Contours are presented for the year of the maximum PC which is 2019 for 24-hour mean SO_2, 2020 for 1-hour mean SO_2 and 2016 for 15-minute mean SO_2. Predicted SO_2 concentrations at sensitive receptor locations are summarised in **Table C-3 – C-6, Appendix C**. Results for the worst-case meteorological year of the five years assessed (2016 - 2020) are presented.

5.2.6 The predicted 24-hour mean, and 1-hour mean SO_2 PCs, do not exceed 10% of the EAL at any of the modelled sensitive receptor locations and can therefore be classified as 'insignificant' according to the EA guidance.

5.2.7 The predicted 15-minute mean SO_2 PCs exceed 10% of the EAL at the majority of modelled sensitive receptor locations. However, the predicted 15-minute mean SO_2 PECs are well below the relevant EAL and therefore do not constitute 'significant pollution'.

5.2.8 Impact predictions have been based on a worst-case assessment scenario of the boilers and CHP plant operating constantly throughout the year and emitting the maximum permitted NOx concentration. Therefore, the predicted concentrations presented in this report are likely to be overestimations of the actual impacts of the Installation.

5.3 Impacts on Ecological Receptors

Nitrogen Oxides (NO_x)

5.3.1 Predicted annual and 24-hour mean NO_x concentrations at sensitive ecological receptor locations are summarised in **Table D-1** and **Table D-2, Appendix D.** Results for the worst-case meteorological year of the five years assessed (2016 - 2020) are presented.

5.3.2 The predicted annual mean NOx PCs are less than 100% of the C_{Le} at all of the locally designated ecological receptor locations, and can therefore be considered 'insignificant'.

5.3.3 The predicted 24-hr NOx PCs are less than 100% of the C_{Le} at receptor locations within locally designated sites, except for at receptors LWS1b – LWS1e (Hayle Estuary LWS), where the 24-hour NOx PC exceeds the C_{Le}, as does the PEC. The effects of nitrogen on vegetation are additive over long periods of time and therefore vegetation is affected by long-term changes in nitrogen deposition (and NOx concentrations) (Institute of Air Quality Management, 2020). Vegetation is much less likely to be affected by short-term (i.e. 24-hour) changes in NOx concentrations, and resulting nitrogen deposition, particularly where SO_2 and ozone (O_3) concentrations are below the relevant critical levels, which is generally the case across the UK, including within the study area. Therefore, it is considered that the predicted 24-hour NOx PC is unlikely to result in a significant effect on the Hayle Estuary LWS and the likelihood for significant effects should be focussed on whether the annual mean NOx C_{Le} is exceeded, which it is not within the Hayle Estuary LWS.

5.3.4 Within national and European designated sites, the 24-hour mean NOx PC does not exceed 10% of the C_{Le}. Therefore, the 24-hour mean NOx PCs at national and European designated sites can be considered 'insignificant'.

5.3.5 The annual mean NOx PC exceeds 1% of the C_{Le} at SSSI1a and SSSI1b (Hayle Estuary and Carrack Gladden SSSI). The annual mean NOx PC at all remaining European designated sites is below 1% and can therefore be considered 'insignificant'. Within the Hayle Estuary and Carrack Gladden SSSI, the PEC is well below the C_{Le} and therefore there are considered to be no adverse effects on the SSSI resulting from the Installation in relation to annual mean NOx concentrations.

Sulphur Dioxide (SO_2)

5.3.6 Predicted annual mean SO_2 concentrations at sensitive ecological receptor locations are summarised in **Table D-3, Appendix D.**

5.3.7 The predicted annual mean SO_2 PCs are less than 100% of the C_{Le} at all of the locally designated ecological receptor locations and can therefore be considered 'insignificant'.

5.3.8 The predicted annual mean SO_2 PCs are less than 1% of the C_{Le} at all of the national and European ecological receptor locations, except for SSSI1a (Hayle Estuary and Carrack Gladden SSSI). However, the PEC at SSSI1a is well below the C_{Le} therefore adverse effects are unlikely to occur on the SSSI as a result of the Installation.

Nitrogen and Acid Deposition

5.3.9 Predicted annual mean nitrogen and acid deposition rates at sensitive ecological receptor locations are summarised in **Table D-4** and **Table D-5, Appendix D.**

5.3.10 The predicted annual nitrogen and acid deposition PCs are less than 100% of the C_{Lo} at all locally designated ecological receptor locations, and less than 1% of the C_{Lo} at all national and European designated ecological receptor locations and can therefore be considered 'insignificant' in accordance with EA guidance.

5.3.11 Impact predictions have been based on a worst-case assessment scenario of the boilers and CHP plant operating constantly throughout the year and emitting the maximum permitted NOx concentration. Therefore, the predicted concentrations and deposition rates presented in this report are likely to be overestimations of the actual impacts of the Installation.

6 Summary and Conclusions

6.1.1 An Air Emission Risk Assessment utilising atmospheric dispersion modelling has been undertaken to support the EP application under the IED for Anaerobic Digestion activities at the Hayle STC. The Installation includes biogas combustion plant comprising three CHP plant units, two boilers and biogas flare.

6.1.2 In relation to human health, where impacts are not classified as 'insignificant' (i.e. PC less than 1% of the EAL for long-term concentrations or 10% for short-term) the predicted impacts of the Installation do not lead to any exceedances of EALs and do not constitute 'significant pollution'.

6.1.3 In relation to the impact of the Installation on locally designated ecological sites, the predicted annual mean NOx and SO_2 PCs, as well as nitrogen and acid deposition PCs are less than 100% of the relevant C_{Le} or C_{Lo} and are therefore considered to be 'insignificant'. The 24-hour mean NOx PC exceeds 100% of the C_{Le} within the Hayle Estuary LWS, as does the PEC. However, significant effects resulting from the 24-hour NOx PC are considered unlikely due to the short-term nature of impacts on vegetation.

6.1.4 Within the assessed national and European designated ecological sites, the predicted 24-hour mean NOx and annual nitrogen and acid deposition PCs are less than 1% (or 10% for 24-hour mean NOx) and are therefore considered to be 'insignificant'. The annual mean NOx and SO_2 PCs exceed 1% of the C_{Le} at the Hayle Estuary and Carrack Gladden SSSI, however the PECs are well below the C_{Le} therefore there are considered to be no adverse effects on the SSSI.

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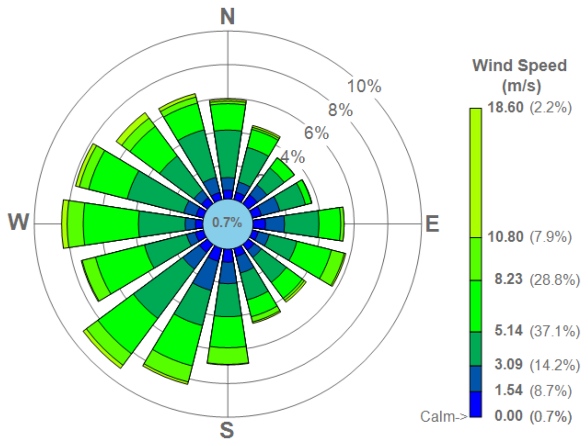
Appendix A Camborne 2016 – 2020 Windroses



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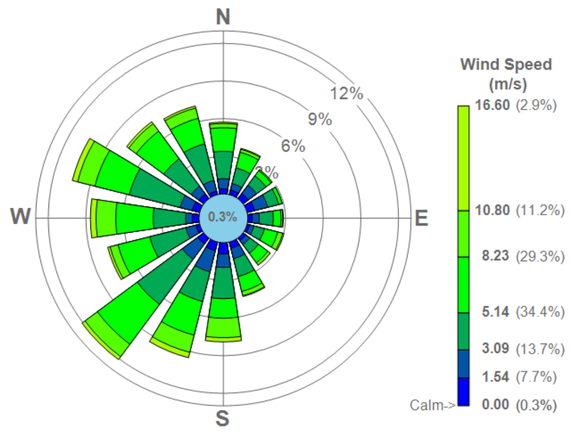

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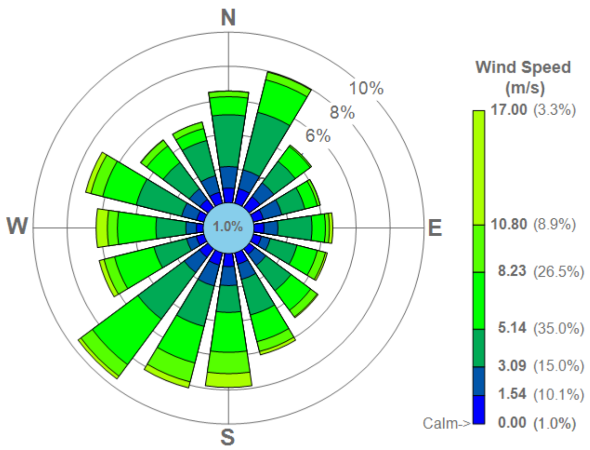

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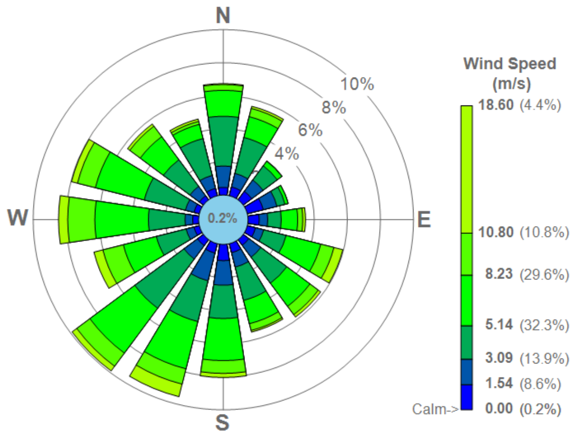
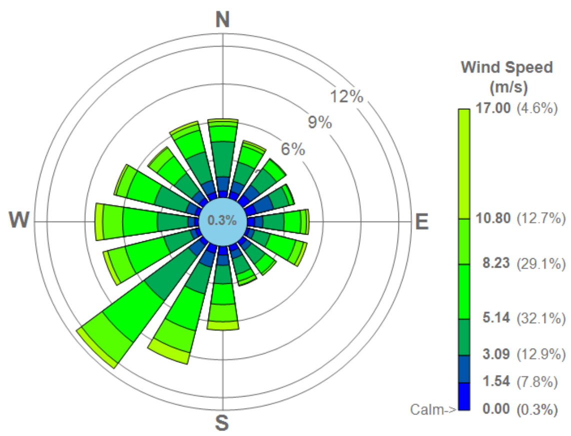


2019



2020

Appendix B Modelled Receptor Locations

Table B-1 Modelled Human Receptor Locations

Receptor	Description	X Coordinate	Y Coordinate	Height (m)	Approximate Distance and Direction from Stacks (m)
R01	25 Meadowside Close	155335.8	36223.6	1.5	810m northeast
R02	60 Chenhalls Road	155114.4	35970.4	1.5	490m northeast
R03	56 Chenhalls Road	155112.4	35942.1	1.5	474m northeast
R04	1 Cledma Bank	155127.3	35908.7	1.5	473m northeast
R05	51, Chenhalls Road	155080.2	35828.9	1.5	401m east
R06	43 Chenhalls Road	155106.5	35673.1	1.5	414m east
R07	41 Chenhalls Road	155114.7	35640.1	1.5	427m southeast
R08	St Erth Community Primary School	155308.8	35297.2	1.5	745m southeast
R09	Land NNE of Cemementry, Chenhalls Road	155039.1	35370.7	1.5	489m southeast
R10	1 Chenhalls Close	154989.4	35277.7	1.5	530m southeast
R11	19 Little Mill Lane	154759.8	35329.1	1.5	395m south
R12	23 Treloweth Close	154627.0	35233.6	1.5	491m south
R13	10, Treloweth Lane	154386.6	35444.2	1.5	414m southwest
R14	1, A30 Hayle	154042.3	35680.6	1.5	655m west
R15	Gateway Court, Station Approach	154091.0	35738.9	1.5	606m west
R16	Ashford House, A30	154180.0	35832.0	1.5	528m northwest
R17	1, Porthia Cottages, A30	154200.2	35853.7	1.5	514m northwest
R18	Acorn House, Nut Lane	154273.4	36257.3	1.5	682m northwest
R19	7 Wideon Way	154327.3	36387.7	1.5	761m northwest
R20	Dowans, A30	154494.4	36308.3	1.5	620m north

Table B-2 Modelled Ecological Sites

Receptor	Grid Reference		Site Name (Designation)	Interest Status	Approximate Distance and Direction from Stacks (m)
	X	Y			
LWS1a	154586.6	35805.6	St Erth Pools LWS	Local	142m northwest
LWS1b	154592.1	35758.1	St Erth Pools LWS	Local	114m northwest
LWS1c	154623.2	35724.2	St Erth Pools LWS	Local	76m west
LWS1d	154668.0	35702.1	St Erth Pools LWS	Local	35m southwest
LWS1e	154712.8	35680.0	St Erth Pools LWS	Local	40m south
LWS1f	154755.2	35653.5	St Erth Pools LWS	Local	85m southeast
LWS1g	154791.6	35663.9	St Erth Pools LWS	Local	107m southeast
LWS1h	154827.5	35698.7	St Erth Pools LWS	Local	130m east
LWS1i	154867.4	35728.8	St Erth Pools LWS	Local	168m east
LWS1j	154905.9	35760.6	St Erth Pools LWS	Local	210m northeast
LWS2	154911.6	35058.9	Carbismill to Relubbus Tregenhorne Valley LWS	Local	695m southeast
LWS3	155646.7	37348.6	Hayle Estuary LWS	Local	1,886m northeast
SAC1	159855.4	30081.3	Tregonning Hill SAC	European	4,020m southwest
SPA	152331.2	32468.6	Marazion Marsh SPA	European	7,642m southeast
SSSI1a	154909.0	36206.6	Hayle Estuary & Carrack Gladden SSSI	National	531m northeast
SSSI1b	154598.3	36318.9	Hayle Estuary & Carrack Gladden SSSI	National	606m north
SSSI1c	154433.1	36344.8	Hayle Estuary & Carrack Gladden SSSI	National	678m northwest

Appendix C Modelled Human Receptor Results

Table C-1 Predicted Annual Mean NO_2 Concentrations

Receptor	Annual Mean NO_2 Concentration (µg/m^3)			
	PC	PC as % of EAL	PEC	PEC as % of EAL
R01	0.2	0.45%	6.4	16.1%
R02	0.4	0.98%	5.1	12.8%
R03	0.4	0.93%	5.1	12.8%
R04	0.3	0.87%	5.1	12.7%
R05	0.5	1.13%	5.2	13.0%
R06	0.4	1.01%	5.1	12.9%
R07	0.4	0.93%	5.1	12.8%
R08	0.1	0.28%	4.9	12.1%
R09	0.2	0.55%	5.0	12.4%
R10	0.2	0.47%	5.6	13.9%
R11	0.4	0.98%	5.8	14.4%
R12	0.3	0.75%	5.7	14.2%
R13	0.5	1.23%	5.9	14.6%
R14	0.2	0.54%	5.6	14.0%
R15	0.2	0.59%	5.6	14.0%
R16	0.3	0.67%	5.6	14.1%
R17	0.3	0.65%	5.6	14.1%
R18	0.2	0.38%	6.4	16.1%
R19	0.2	0.39%	6.4	16.1%
R20	0.2	0.56%	6.5	16.3%

Table C-2 Predicted 1-hour Mean NO_2 Concentrations

Receptor	99.79%ile 1-hour Mean NO_2 Concentration ($\mu g/m^3$)			
	PC	PC as % of EAL	PEC	PEC as % of EAL
R01	4.2	2.09%	16.7	8.3%
R02	9.7	4.83%	19.1	9.6%
R03	8.3	4.17%	17.8	8.9%
R04	9.3	4.64%	18.8	9.4%
R05	10.9	5.46%	20.4	10.2%
R06	8.5	4.26%	18.0	9.0%
R07	7.2	3.60%	16.7	8.3%
R08	2.9	1.46%	12.4	6.2%
R09	5.0	2.51%	14.5	7.3%
R10	4.4	2.22%	15.2	7.6%
R11	9.1	4.56%	19.9	9.9%
R12	7.1	3.54%	17.8	8.9%
R13	19.5	9.73%	30.2	15.1%
R14	7.0	3.48%	17.7	8.8%
R15	7.1	3.57%	17.9	8.9%
R16	9.1	4.57%	19.9	9.9%
R17	8.1	4.07%	18.9	9.4%
R18	4.6	2.28%	17.1	8.6%
R19	4.3	2.16%	16.9	8.4%
R20	6.1	3.07%	18.7	9.4%

Table C-3 Predicted 24-hour Mean SO_2 Concentrations

Receptor	99.19%ile 24-hour Mean SO_2 Concentration (µg/m^3)			
	PC	PC as % of EAL	PEC	PEC as % of EAL
R01	1.1	0.89%	5.3	4.2%
R02	2.7	2.18%	5.6	4.4%
R03	2.4	1.89%	5.2	4.1%
R04	2.5	1.98%	5.3	4.2%
R05	2.9	2.29%	5.7	4.5%
R06	1.9	1.56%	4.8	3.8%
R07	1.9	1.50%	4.7	3.8%
R08	0.7	0.57%	3.5	2.8%
R09	1.2	0.97%	4.0	3.2%
R10	1.1	0.85%	3.8	3.0%
R11	2.3	1.86%	5.0	4.0%
R12	1.7	1.35%	4.4	3.5%
R13	3.9	3.11%	6.6	5.3%
R14	1.6	1.26%	4.3	3.4%
R15	1.7	1.38%	4.4	3.6%
R16	2.1	1.70%	4.8	3.9%
R17	2.0	1.56%	4.7	3.7%
R18	1.4	1.10%	4.2	3.4%
R19	1.0	0.84%	3.9	3.1%
R20	1.3	1.08%	4.2	3.3%

Table C-4 Predicted 1-Hour Mean SO_2 Concentrations

Receptor	99.73%ile 1-hour Mean SO_2 Concentration (µg/m^3)			
	PC	**PC as % of EAL**	**PEC**	**PEC as % of EAL**
R01	4.5	1.28%	8.7	2.5%
R02	9.5	2.73%	12.4	3.5%
R03	8.9	2.53%	11.7	3.3%
R04	9.2	2.63%	12.0	3.4%
R05	10.8	3.08%	13.6	3.9%
R06	7.5	2.16%	10.4	3.0%
R07	7.2	2.07%	10.1	2.9%
R08	2.9	0.83%	5.7	1.6%
R09	5.3	1.51%	8.1	2.3%
R10	4.8	1.38%	7.6	2.2%
R11	9.9	2.84%	12.7	3.6%
R12	7.7	2.19%	10.4	3.0%
R13	20.4	5.82%	23.1	6.6%
R14	7.5	2.15%	10.2	2.9%
R15	7.5	2.16%	10.3	2.9%
R16	8.9	2.55%	11.6	3.3%
R17	8.6	2.45%	11.3	3.2%
R18	5.0	1.43%	7.8	2.2%
R19	4.4	1.27%	7.3	2.1%
R20	6.4	1.82%	9.2	2.6%

Table C-5 Predicted 15-minute Mean SO_2 Concentrations

Receptor	99.90%ile 15-minute Mean SO_2 Concentration (µg/m^3)			
	PC	PC as % of EAL	PEC	PEC as % of EAL
R01	20.1	7.6%	24.3	9.1%
R02	56.6	21.3%	59.4	22.3%
R03	66.8	25.1%	69.7	26.2%
R04	62.2	23.4%	65.1	24.5%
R05	81.2	30.5%	84.0	31.6%
R06	43.2	16.3%	46.1	17.3%
R07	40.4	15.2%	43.2	16.3%
R08	20.5	7.7%	23.4	8.8%
R09	25.3	9.5%	28.1	10.6%
R10	18.3	6.9%	21.1	7.9%
R11	36.0	13.5%	38.7	14.5%
R12	36.9	13.9%	39.6	14.9%
R13	77.9	29.3%	80.6	30.3%
R14	37.5	14.1%	40.2	15.1%
R15	33.1	12.5%	35.8	13.5%
R16	37.8	14.2%	40.5	15.2%
R17	53.7	20.2%	56.4	21.2%
R18	17.6	6.6%	20.4	7.7%
R19	14.2	5.3%	17.0	6.4%
R20	21.1	7.9%	23.9	9.0%

Appendix D Modelled Ecological Receptor Results

Table D-1 Predicted Annual Mean NO_x Concentrations

Receptor	Designated Site	Annual Mean NOx Concentration (µg/m³)			
		PC	**PC as % of EAL**	**PEC**	**PEC as % of EAL**
LWS1a	St Erth Pools LWS	3.4	11.2%	10.3	34.3%
LWS1b	St Erth Pools LWS	4.5	15.1%	11.5	38.2%
LWS1c	St Erth Pools LWS	9.2	30.5%	16.1	53.7%
LWS1d	St Erth Pools LWS	10.9	36.2%	17.8	59.4%
LWS1e	St Erth Pools LWS	12.1	40.5%	19.1	63.6%
LWS1f	St Erth Pools LWS	5.2	17.2%	12.1	40.4%
LWS1g	St Erth Pools LWS	3.9	12.9%	10.8	36.0%
LWS1h	St Erth Pools LWS	3.7	12.5%	10.7	35.6%
LWS1i	St Erth Pools LWS	2.7	8.9%	9.6	32.0%
LWS1j	St Erth Pools LWS	1.9	6.3%	8.8	29.4%
LWS2	Carbismill to Relubbus Tregenhorne Valley LWS	0.2	0.6%	7.1	23.7%
LWS3	Hayle Estuary LWS	0.1	0.3%	8.1	27.0%
SAC1	Tregonning Hill SAC	0.0	0.0%	5.0	16.8%
SPA	Marazion Marsh SPA	0.0	0.1%	6.3	21.1%
SSSI1a	Hayle Estuary & Carrack Gladden SSSI	0.7	**2.4%**	9.0	30.0%
SSSI1b	Hayle Estuary & Carrack Gladden SSSI	0.4	**1.3%**	8.7	29.0%
SSSI1c	Hayle Estuary & Carrack Gladden SSSI	0.3	0.9%	8.6	28.6%

Table D-2 Predicted 24-hour Mean NOx Concentrations

Receptor	Designated Site	24-hour Mean NOx Concentration (µg/m^3)			
		PC	**PC as % of EAL**	**PEC**	**PEC as % of EAL**
LWS1a	St Erth Pools LWS	53.7	71.6%	67.6	90.1%
LWS1b	St Erth Pools LWS	82.4	**109.9%**	96.3	**128.4%**
LWS1c	St Erth Pools LWS	94.1	**125.5%**	108.0	**144.0%**
LWS1d	St Erth Pools LWS	126.3	**168.4%**	140.2	**187.0%**
LWS1e	St Erth Pools LWS	99.1	**132.1%**	113.0	**150.6%**
LWS1f	St Erth Pools LWS	36.5	48.7%	50.4	67.2%
LWS1g	St Erth Pools LWS	21.5	28.6%	35.3	47.1%
LWS1h	St Erth Pools LWS	30.6	40.8%	44.5	59.3%
LWS1i	St Erth Pools LWS	23.1	30.8%	37.0	49.3%
LWS1j	St Erth Pools LWS	17.2	23.0%	31.1	41.5%
LWS2	Carbismill to Relubbus Tregenhorne Valley LWS	2.3	3.1%	16.2	21.6%
LWS3	Hayle Estuary LWS	1.1	1.5%	17.1	22.8%
SAC1	Tregonning Hill SAC	0.0	0.1%	10.1	13.5%
SPA	Marazion Marsh SPA	0.3	0.4%	12.9	17.2%
SSSI1a	Hayle Estuary & Carrack Gladden SSSI	6.8	9.0%	23.4	31.1%
SSSI1b	Hayle Estuary & Carrack Gladden SSSI	4.5	6.0%	21.0	28.1%
SSSI1c	Hayle Estuary & Carrack Gladden SSSI	5.8	7.8%	22.4	29.9%

Table D-3 Predicted Annual Mean SO_2 Concentrations

Receptor	Designated Site	Annual Mean SO_2 Concentration (µg/m^3)			
		PC	PC as % of EAL	PEC	PEC as % of EAL
LWS1a	St Erth Pools LWS	1.4	7.0%	1.9	9.7%
LWS1b	St Erth Pools LWS	1.9	9.3%	2.4	12.0%
LWS1c	St Erth Pools LWS	3.6	17.9%	4.1	20.6%
LWS1d	St Erth Pools LWS	4.1	20.5%	4.6	23.2%
LWS1e	St Erth Pools LWS	5.3	26.5%	5.8	29.2%
LWS1f	St Erth Pools LWS	2.2	11.1%	2.8	13.8%
LWS1g	St Erth Pools LWS	1.7	8.3%	2.2	11.0%
LWS1h	St Erth Pools LWS	1.6	7.9%	2.1	10.6%
LWS1i	St Erth Pools LWS	1.1	5.7%	1.7	8.4%
LWS1j	St Erth Pools LWS	0.8	4.0%	1.3	6.7%
LWS2	Carbismill to Relubbus Tregenhorne Valley LWS	0.1	0.4%	0.6	3.1%
LWS3	Hayle Estuary LWS	0.0	0.2%	1.4	7.0%
SAC1	Tregonning Hill SAC	0.0	0.0%	0.6	2.8%
SPA	Marazion Marsh SPA	0.0	0.0%	0.7	3.6%
SSSI1a	Hayle Estuary & Carrack Gladden SSSI	0.3	**1.6%**	0.9	4.4%
SSSI1b	Hayle Estuary & Carrack Gladden SSSI	0.2	0.8%	0.7	3.7%
SSSI1c	Hayle Estuary & Carrack Gladden SSSI	0.1	0.6%	0.7	3.5%

Table D-4 Predicted Annual Nitrogen Deposition Rates

Receptor	Designated Site	Annual Nitrogen Deposition (kgN/ha/yr)			
		PC	PC as % of C_{Le}	PEC	PEC as % of C_{Le}
LWS1a	St Erth Pools LWS	0.68	6.76%	27.4	**274.2%**
LWS1b	St Erth Pools LWS	0.91	9.11%	27.7	**276.5%**
LWS1c	St Erth Pools LWS	1.85	18.47%	28.6	**285.9%**
LWS1d	St Erth Pools LWS	2.19	21.91%	28.9	**289.3%**
LWS1e	St Erth Pools LWS	2.45	24.48%	29.2	**291.9%**
LWS1f	St Erth Pools LWS	1.04	10.43%	27.8	**277.8%**
LWS1g	St Erth Pools LWS	0.78	7.80%	27.5	**275.2%**
LWS1h	St Erth Pools LWS	0.75	7.54%	27.5	**274.9%**
LWS1i	St Erth Pools LWS	0.54	5.36%	27.3	**272.8%**
LWS1j	St Erth Pools LWS	0.38	3.79%	27.1	**271.2%**
LWS2	Carbismill to Relubbus Tregenhorne Valley LWS	0.04	0.37%	26.8	**267.8%**
LWS3	Hayle Estuary LWS	0.01	0.04%	12.6	63.0%
SAC1	Tregonning Hill SAC	0.00	0.00%	13.4	**134.0%**
SPA	Marazion Marsh SPA	0.00	0.01%	13.0	86.8%
SSSI1a	Hayle Estuary & Carrack Gladden SSSI	0.07	0.37%	16.6	83.0%
SSSI1b	Hayle Estuary & Carrack Gladden SSSI	0.04	0.20%	16.6	82.8%
SSSI1c	Hayle Estuary & Carrack Gladden SSSI	0.03	0.14%	16.5	82.7%

Table D-5 Predicted Annual Acid Deposition Rates

Receptor	Designated Site	Annual Acid Deposition (keq/ha/yr)			
		PC	PC as % of C_{Le}	PEC	PEC as % of C_{Le}
LWS1a	St Erth Pools LWS	0.378	16.8%	2.5	**112.2%**
LWS1b	St Erth Pools LWS	0.507	22.6%	2.6	**118.0%**
LWS1c	St Erth Pools LWS	0.977	43.5%	3.1	**139.0%**
LWS1d	St Erth Pools LWS	1.126	50.2%	3.3	**145.6%**
LWS1e	St Erth Pools LWS	1.429	63.7%	3.6	**159.1%**
LWS1f	St Erth Pools LWS	0.600	26.8%	2.7	**122.2%**
LWS1g	St Erth Pools LWS	0.450	20.1%	2.6	**115.5%**
LWS1h	St Erth Pools LWS	0.429	19.1%	2.6	**114.6%**
LWS1i	St Erth Pools LWS	0.306	13.6%	2.4	**109.0%**
LWS1j	St Erth Pools LWS	0.216	9.6%	2.4	**105.0%**
LWS2	Carbismill to Relubbus Tregenhorne Valley LWS	0.021	0.9%	2.2	96.4%
LWS3	Hayle Estuary LWS	0.005	Not Sensitive	1.1	Not Sensitive
SAC1	Tregonning Hill SAC	0.000	0.0%	1.1	75.9%
SPA	Marazion Marsh SPA	0.001	Not Sensitive	1.1	Not Sensitive
SSSI1a	Hayle Estuary & Carrack Gladden SSSI	0.042	Not Sensitive	1.4	Not Sensitive
SSSI1b	Hayle Estuary & Carrack Gladden SSSI	0.023	Not Sensitive	1.4	Not Sensitive
SSSI1c	Hayle Estuary & Carrack Gladden SSSI	0.016	Not Sensitive	1.4	Not Sensitive

Appendix E Figures

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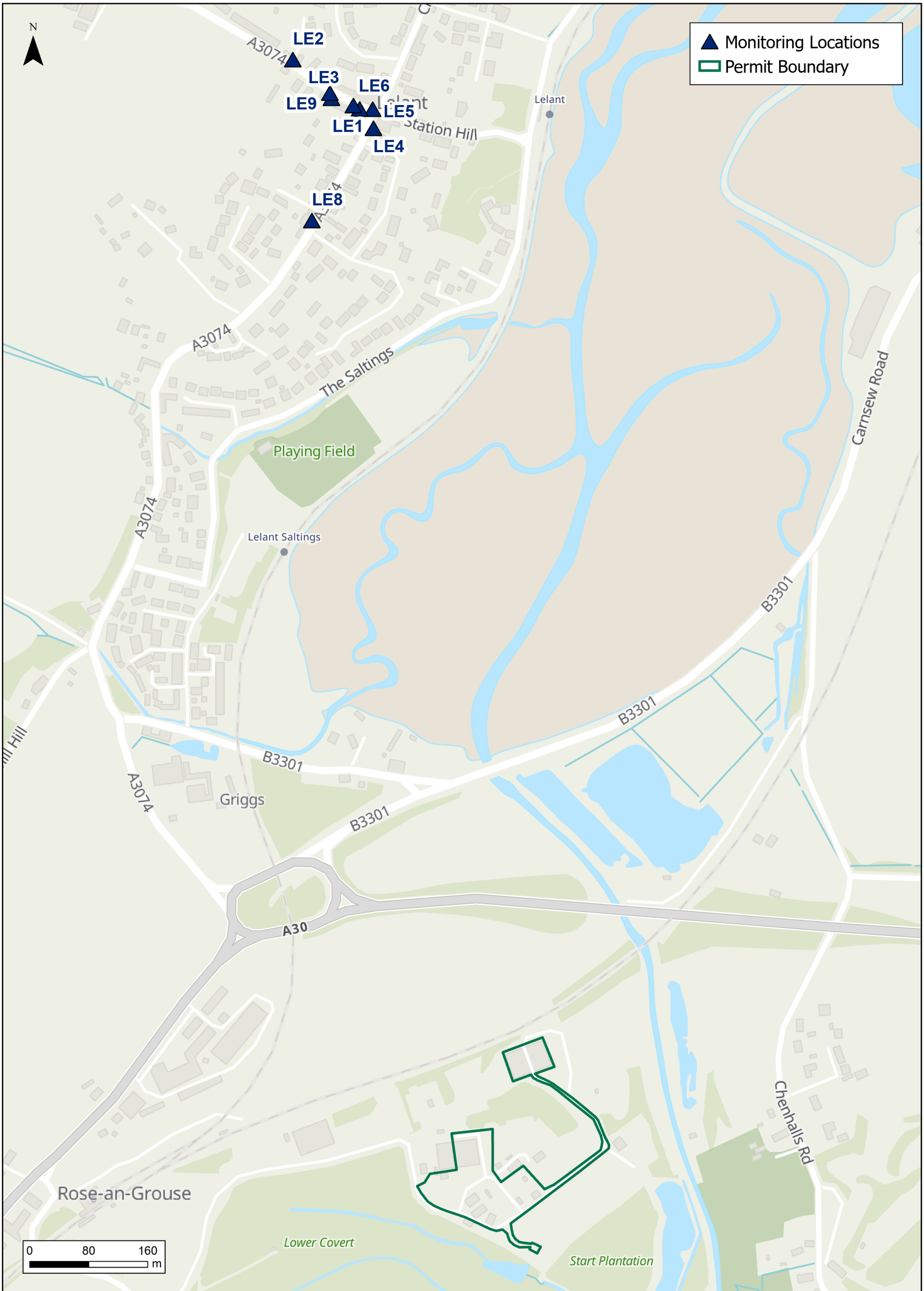

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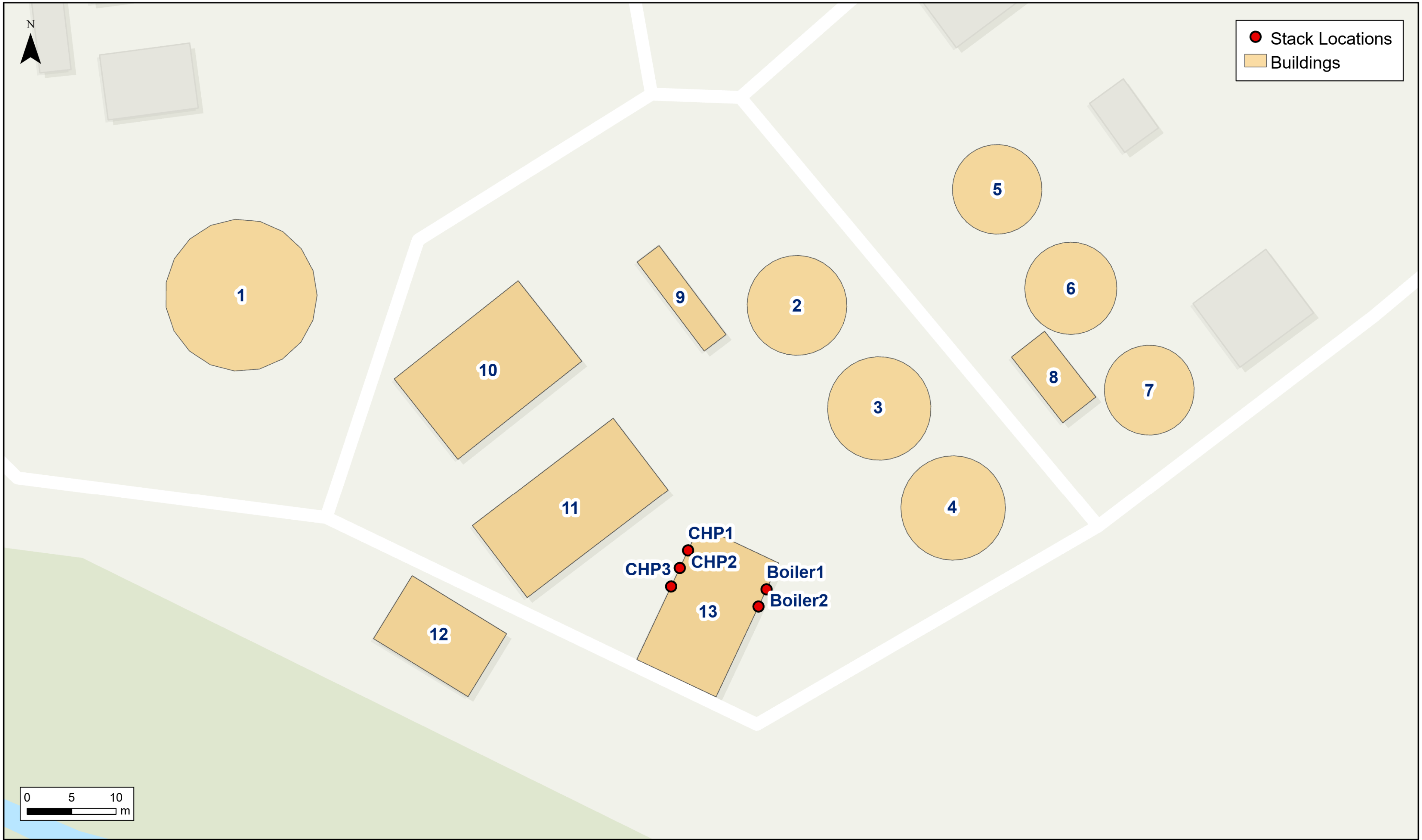

Stantec	South West Water	**Hayle Sludge Treatment Centre** Modelled Buildings and Stack Locations	GB Topographic: Contains OS data © Crown Copyright and database right 2020 Contains data from OS Zoomstack	1:550 @ A4	Date: 17/11/2021
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				Figure 02	Rev A

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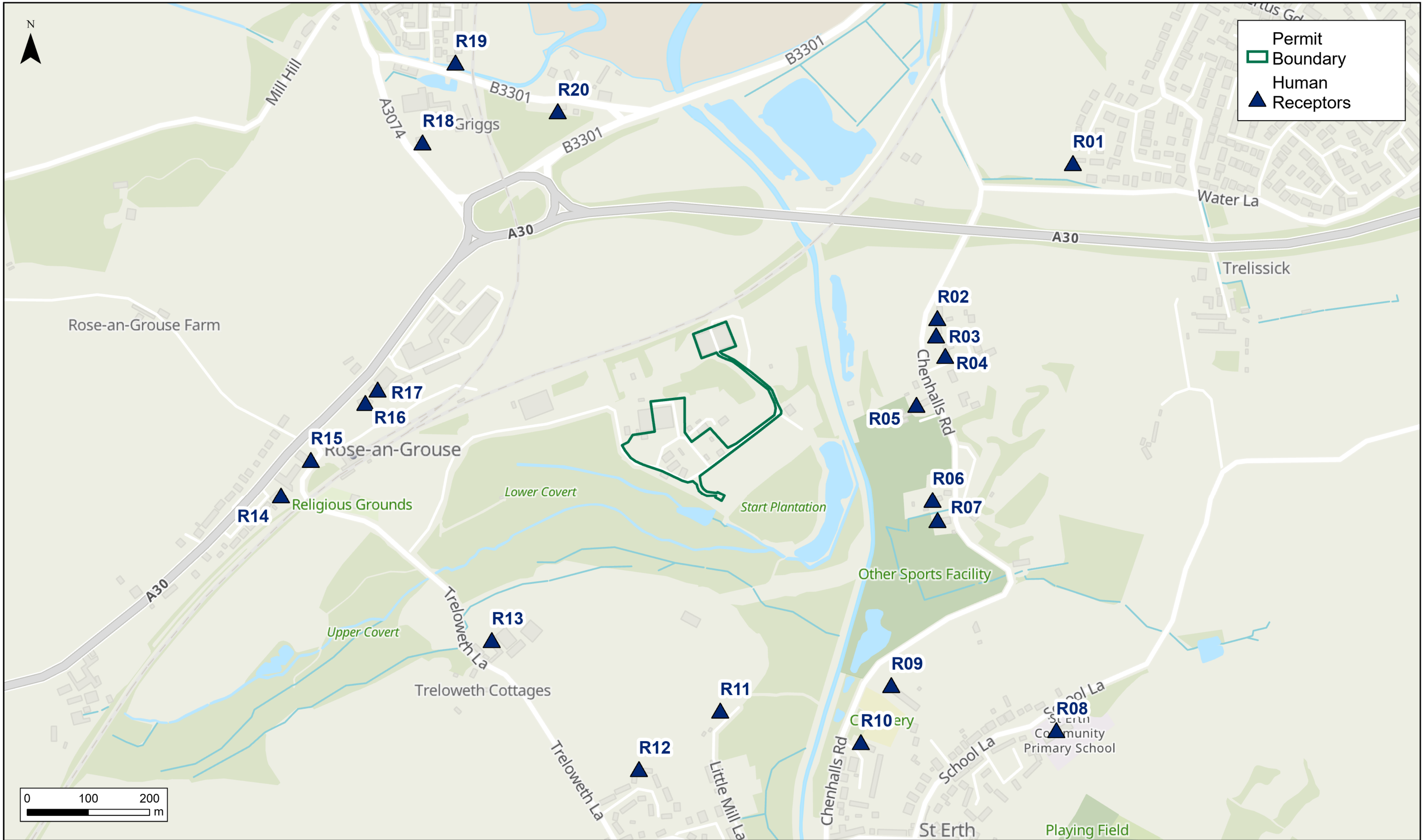

Stantec	South West Water	**Hayle Sludge Treatment Centre** Modelled Discrete Human Receptor Locations	GB Topographic: Contains OS data © Crown Copyright and database right 2020 Contains data from OS Zoomstack	1:8,004 @ A4	Date: 19/11/2021
				Drawn: LS	Checked: KH
				Figure 03	Rev A

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Stantec	South West Water	**Hayle Sludge Treatment Centre** Modelled Ecological Receptor Locations within 2km of the Installation	GB Topographic: Contains OS data © Crown Copyright and database right 2020 Contains data from OS Zoomstack	1:15,000 @ A4	Date: 18/11/2021
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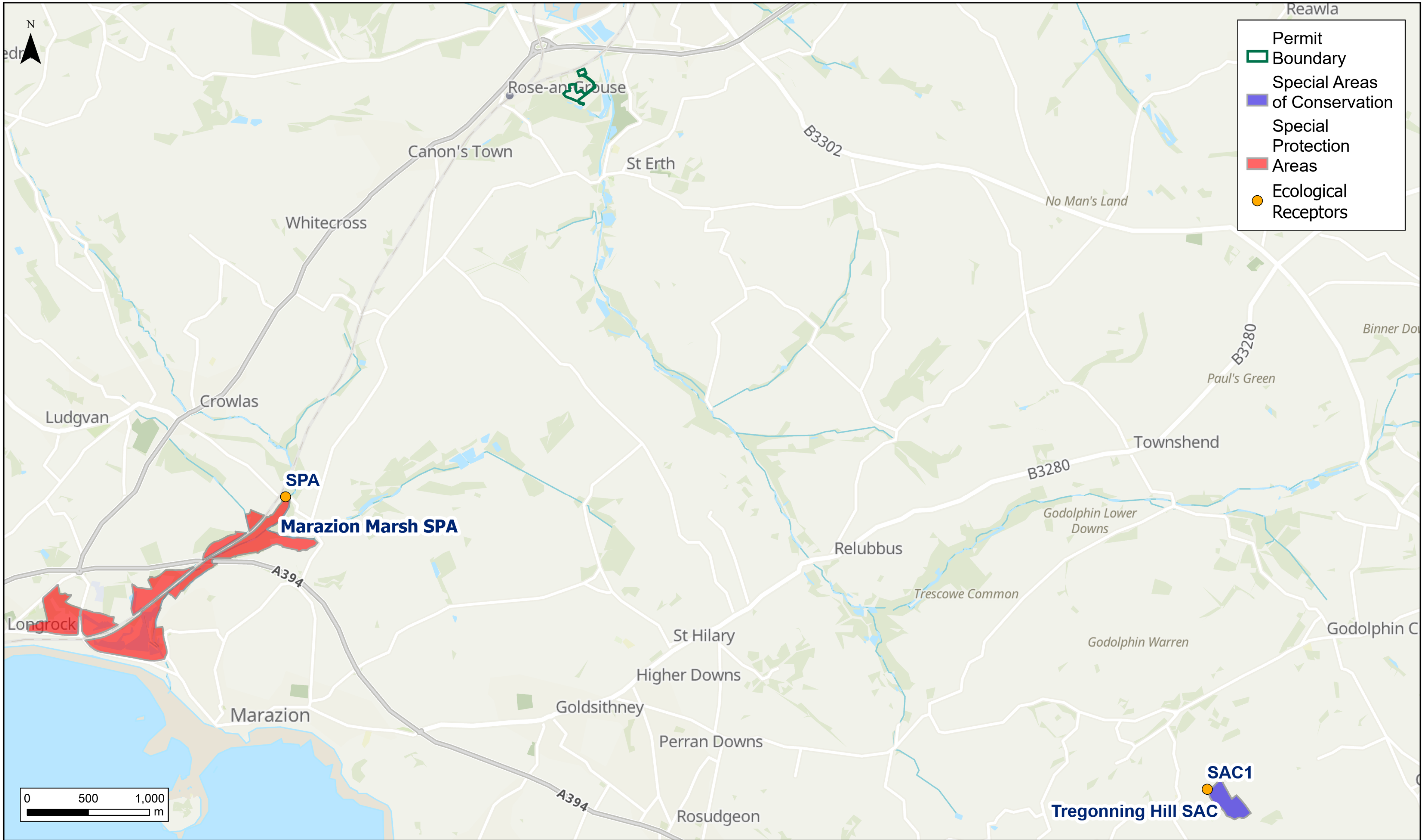

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Modelled Ecological Receptors between 2 - 10km of the Installation

GB Topographic: Contains OS data © Crown Copyright and database right 2020
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Figure 05	Rev A

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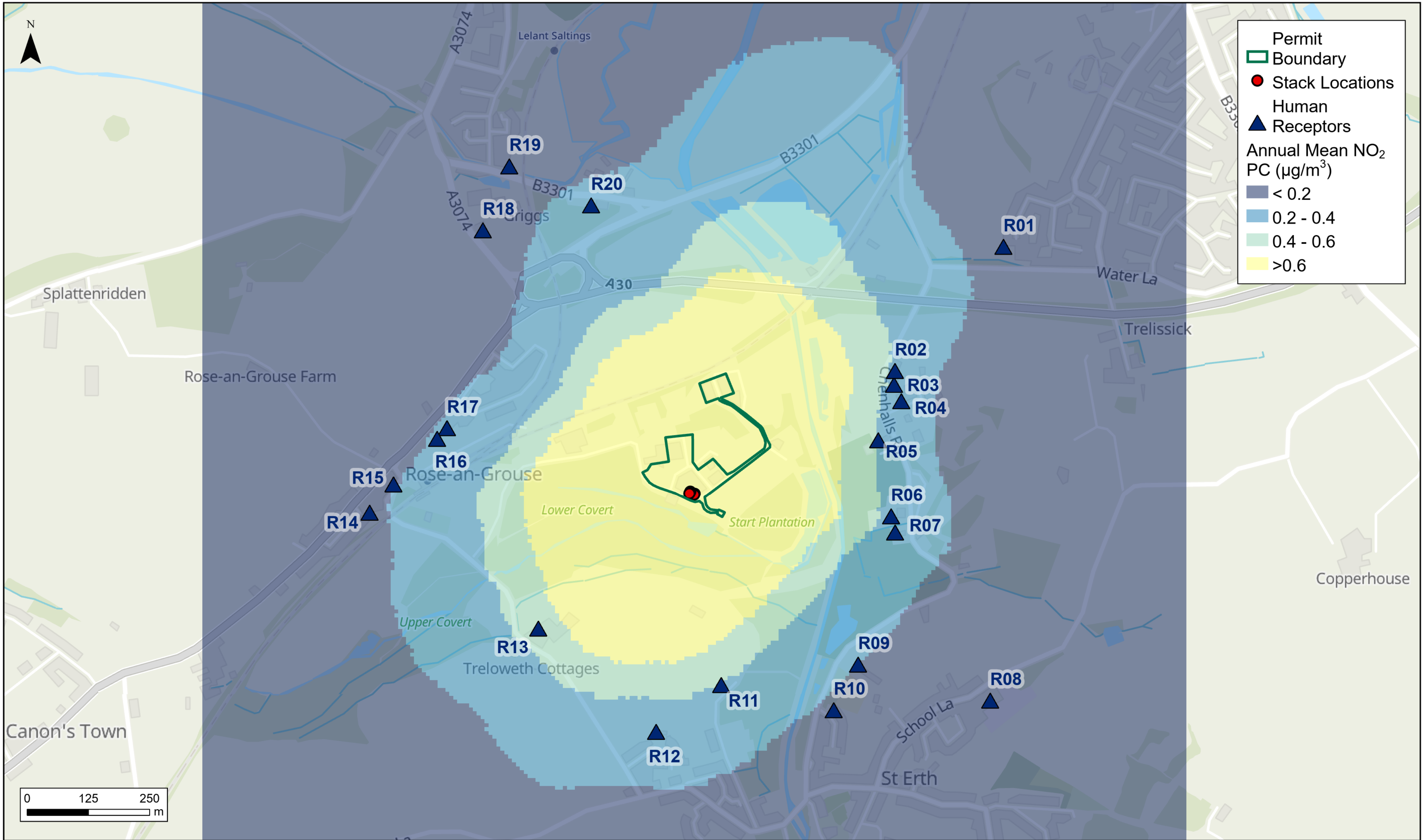

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2018 Predicted Annual Mean NO_2 Process Contribution (PC) Contours

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Figure 06	Rev A

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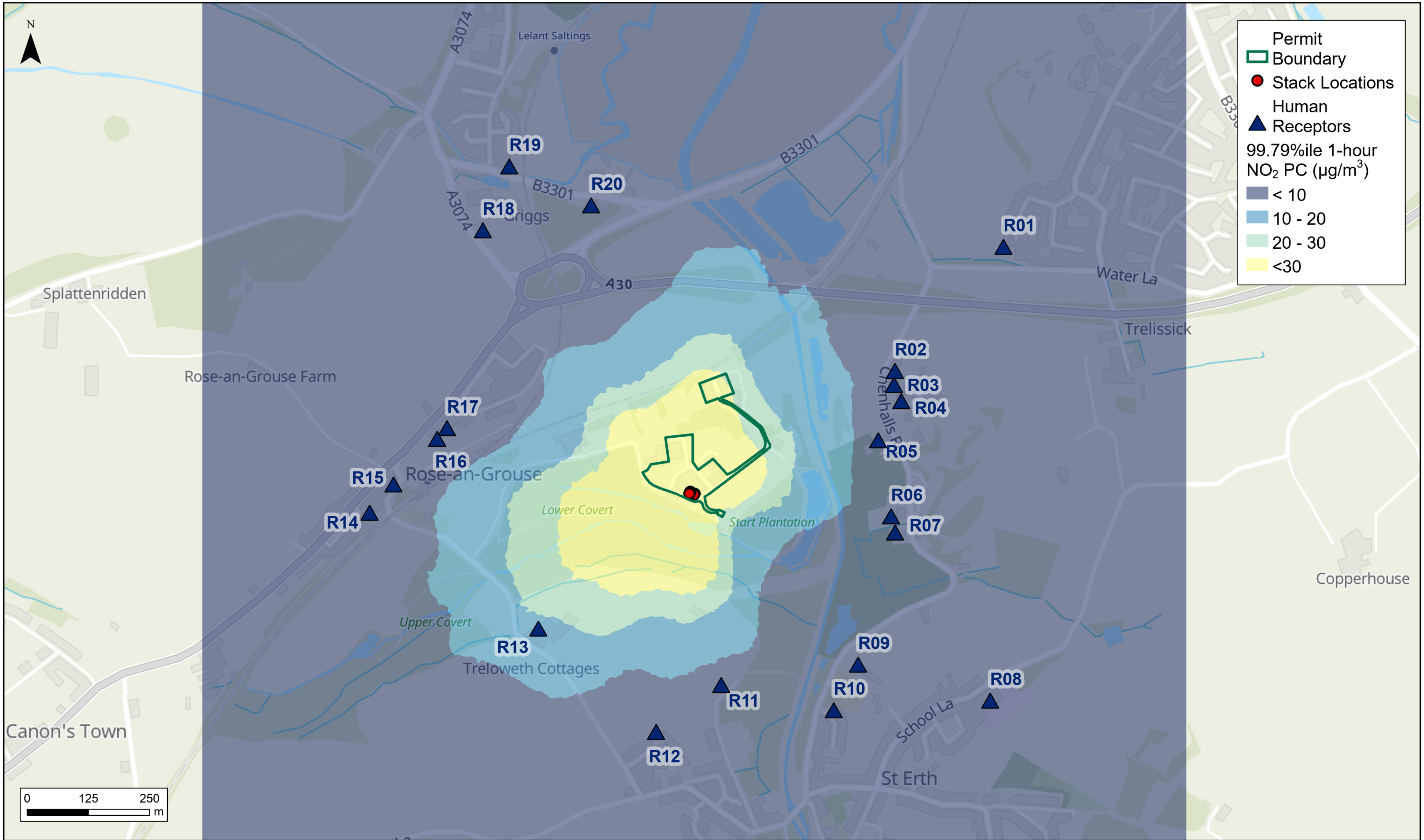

Stantec	South West Water	**Hayle Sludge Treatment Centre** 2020 Predicted 1-hour Mean NO_2 (99.79%ile) Process Contribution (PC)	GB Topographic: Contains OS data © Crown Copyright and database right 2020 Contains data from OS Zoomstack	1:10,000 @ A4 Drawn: LS Figure 07	Date: 18/11/2021 Checked: KH Rev A

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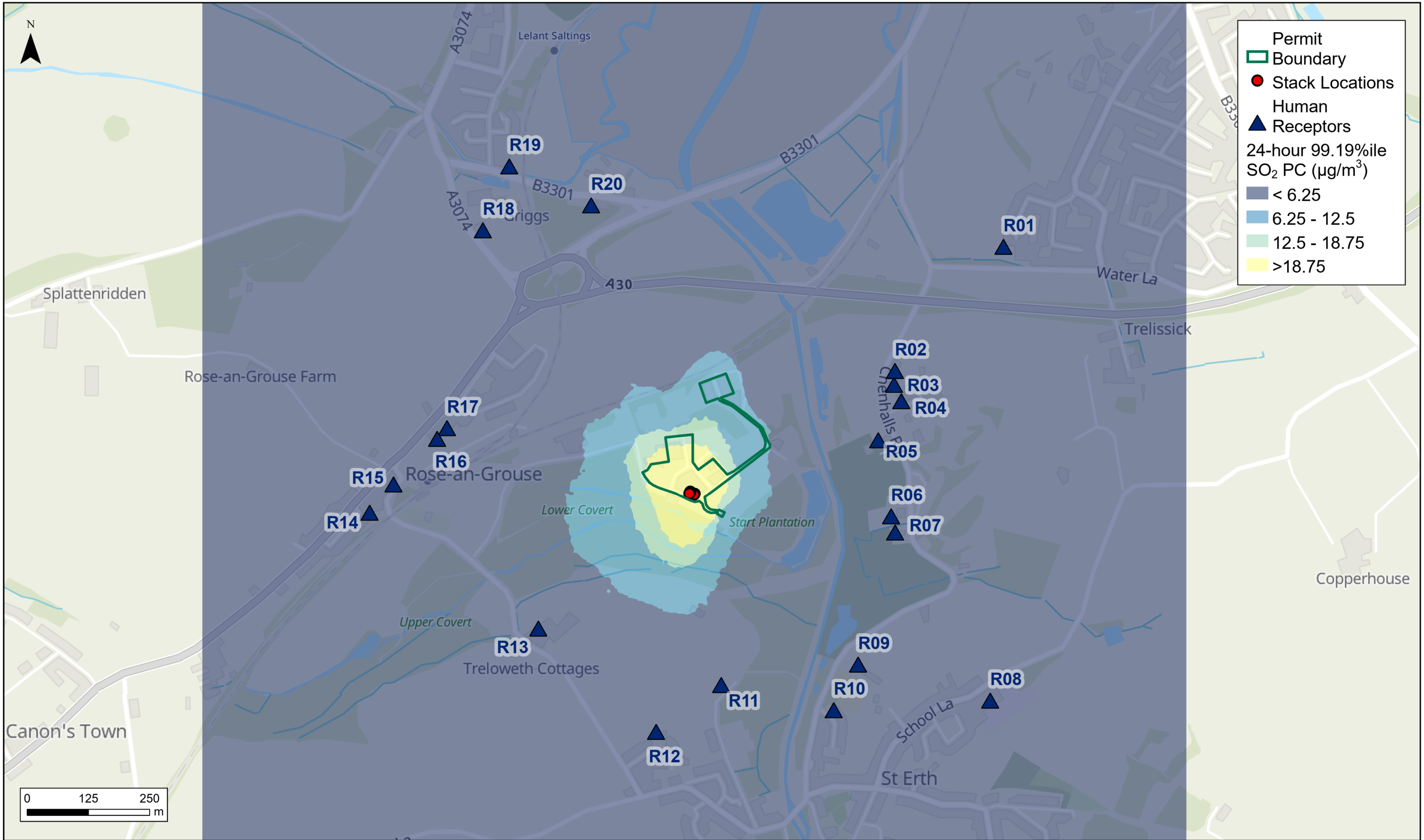

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Hayle Sludge Treatment Centre

2019 Predicted 24-hour Mean (99.19%ile) SO_2 Process Contribution (PC) Contours

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Figure 08	Rev A

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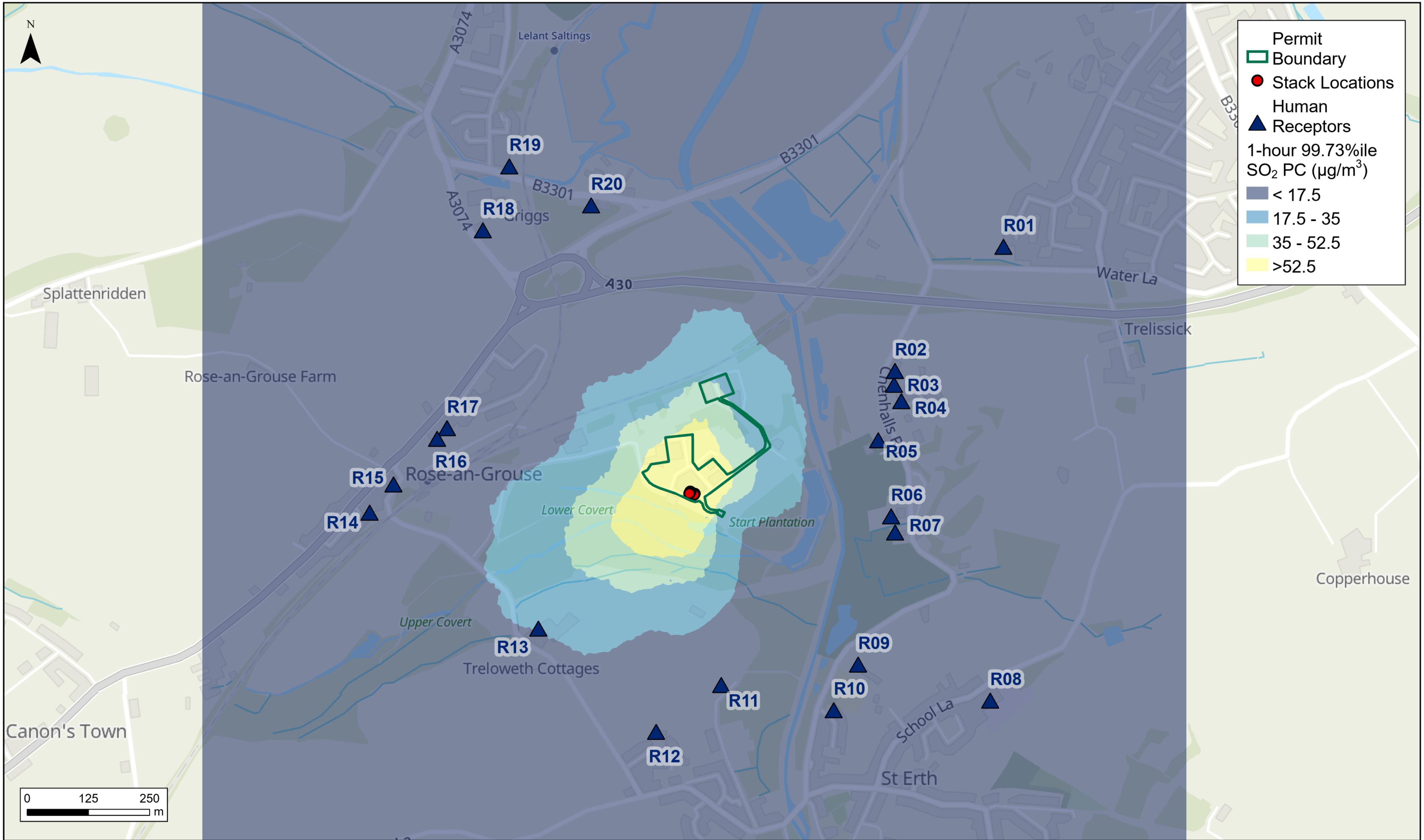

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2020 Predicted 1-hour Mean (99.73%ile) SO_2 Process Contribution (PC) Contours

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Figure 09	Rev A

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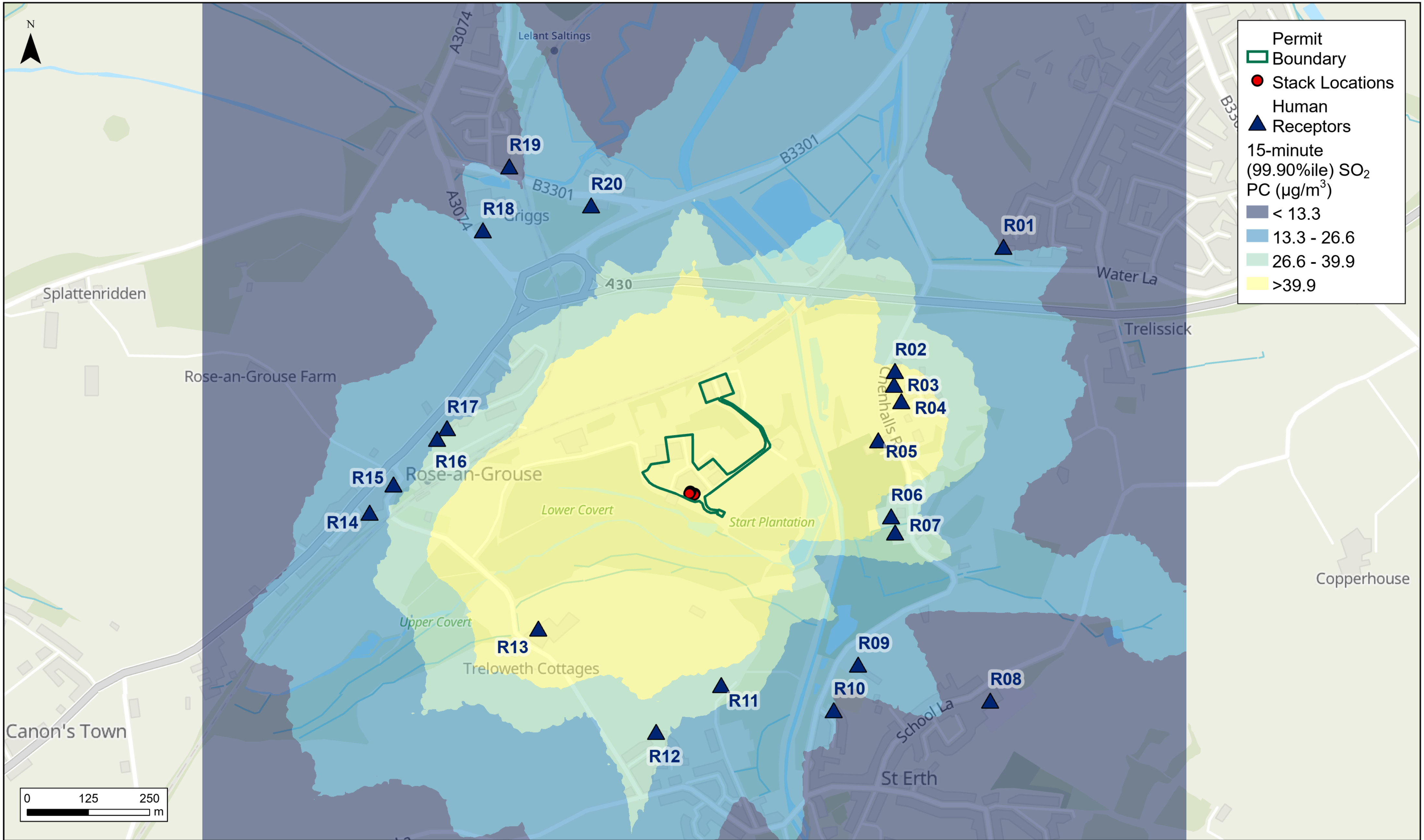

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Hayle Sludge Treatment Centre

2016 Predicted 15-minute Mean (99.9%ile) SO_2 Process Contribution (PC) Contours

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Drawn: LS	Checked: KH
Figure 10	Rev A