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GLADMAN DEVELOPMENTS LIMITED

HILL FARM, GLOUCESTER

ODOUR ASSESSMENT UPDATE

JULY 2022

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GLADMAN DEVELOPMENTS LIMITED

HILL FARM, GLOUCESTER

ODOUR ASSESSMENT UPDATE

JULY 2022

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1 INTRODUCTION

1.1.1 Wardell Armstrong has been commissioned by Gladman Developments Ltd to undertake a detailed odour modelling assessment for a proposed residential development at Hill Farm, Gloucester.

1.1.2 The proposed development site is located to the south of Hempsted, a village part of the City of Gloucester. To the north of the site are existing residential dwellings, including those along Hempsted Lane. To the south east is the A430, the Gloucester Car Boot and Flea Market and the Gloucester and Sharpness Canal beyond. To the south are wetlands with a sewage treatment works beyond. To the west are open fields and the River Severn beyond. The Netheridge Waste water Treatment Works (WwTW) operated by Severn Trent (ST) is located approximately 540m to the south west of the proposed development site.

1.1.3 From the information provided, we understand that the proposals originally comprised a residential development comprising of up to 245 dwellings and associated infrastructure, however the number of proposed dwellings has been reduced to 215.

1.2 Project History

1.2.1 Wardell Armstrong have previously undertaken a qualitative odour impact assessment for the proposed development in January 2020 (REF: GM10710/006). As part of this assessment, four odour observation site visits were completed between August and September 2019.

1.2.2 Following this, a detailed odour modelling assessment was undertaken in June 2021 (REF: GM10710/006A – CD2.4) which used emission rate data agreed with ST, based on data used in the Cordon Sanitaire Evidence Study report produced in 2019 by Phlorum (REF: 8693.S).

1.2.3 Gloucester City Council employed Phlorum in April 2022 to review the June 2021 odour assessment produced by Wardell Armstrong. As part of this review, Phlorum recommended that olfactometric odour sampling was undertaken at Netheridge WwTW to provide robust emission data for the Primary Settlement Tanks (PST's), Final Settlement Tanks (FST's), the Gravity Belt Thickener (GBT) Odour Control Unit (OCU) and the Sludge and Blend Tank OCU.

1.2.4 This odour sampling work has been undertaken by Wardell Armstrong at Netheridge WwTW over the course of two visits during July 2022.

1.3 Current Assessment

1.3.1 This report sets out the results of a detailed odour assessment, comprising updated detailed odour dispersion modelling undertaken using emission rate data agreed with ST and data from the two odour sampling exercises undertaken at the Netheridge WwTW in July 2022.

1.3.2 This report should be read in conjunction with both the 2020 and 2021 reports written by Wardell Armstrong.

2 PLANNING POLICY CONTEXT

2.1.1 The Odour Planning Policy and Guidance documents considered within the current detailed assessment are listed in the July 2021 report undertaken by Wardell Armstrong.

2.1.2 These documents are unchanged and have therefore also been used for this current assessment.

3 ASSESSMENT METHODOLOGY

3.1 Previous Consultation

3.1.1 Extensive consultation was undertaken with Severn Trent as part of the previous detailed assessment works undertaken in June 2021. This consultation is described in the June 2021 report completed by Wardell Armstrong.

3.1.2 This previous consultation included agreeing the emission rates used in the June 2021 assessment with ST, specifically the agreement for the use of reduced odour emission rates for the PST's and FST's following upgrades to the Netheridge WwTW around 2015/2016 (i.e. after the odour sampling data used in the Phlorum report was collected in 2009). A copy of this consultation is included in **Appendix A** of this report.

3.2 Current Consultation and Odour Sampling

3.2.1 Following receipt of Phlorum's April 2022 peer review comments in response to Wardell Armstrong's June 2021 odour assessment report, detailed consultation was undertaken with ST between 6th May and 27th July 2022 to arrange an odour sampling exercise at the Netheridge WwTW. A summary of this consultation is provided below:

- It was proposed to ST via email on 6th May 2022 that odour samples would be collected in triplicates at four sources at the WwTW:
    - Primary Settlement Tank
    - Final Settlement Tank
    - The new Odour Control Unit for the Gravity Belt Thickeners (installed circa 2015/16)
    - The existing Odour Control Unit for the Sludge and Blend Tank
- A provisional sampling date of 27th June was suggested to ST via email on 30th May 2022;
- ST confirmed this date as acceptable via phone call on 19th June 2022. However, a subsequent phone call from ST on the 24th June identified that the Sludge and Blend tank OCU had a technical fault, and it would not be possible to undertake odour sampling at the works on the 27th June;
- A new sampling date of 18th July 2002 was suggested by Wardell Armstrong to ST via email on 6th July 2022,
- ST agreed this date as suitable for sampling to take place via telephone call on 15th July. However, ST highlighted that whilst the technical fault on the Sludge and Blend tank OCU had been repaired, one of the fans used in the OCU was

out of use and so it would not be possible to sample this location.

- In an attempt to avoid further delays to the sampling exercise, it was agreed that sampling would still take place on the 18th July at the PST's, FST's and the GBT OCU, with the samples for the Sludge and Blend tank OCU taken on another date when the OCU was fully operational.
- ST confirmed that the Sludge and Blend tank OCU was once again operational and suitable for sampling via email on 22nd July. A sampling date of 27th July was suggested to ST which was agreed via email on 26th July 2022.

3.3 Odour Sampling

3.3.1 The first odour sampling visit at Netheridge WwTW took place on 18th July 2022. As discussed above, one of the odour sources to be sampled, the Sludge and Blend tank OCU, was non-operational during this visit and so samples were collected in triplicate at the PST's, the FST's and the GBT OCU on 18th July 2022. The Sludge and Blend Tank was sampled on the 27th July 2022.

3.3.2 The odour sampling undertaken on the 18th July, occurred during a heatwave which saw extreme heat and unprecedented high temperatures not seen in this country before. The Met Office issued a 'Red Warning' for extreme heat across the majority of England for the 18th and 19th July.

3.3.3 The Met Office Statistics for the Cheltenham climate station (approximately 4 miles from Gloucester) show average maximum temperatures of 23.16°C during July (based on average temperatures between 1991 and 2020)[1]. During the sampling exercise at Netheridge WwTW on the 18th July 2022, temperatures reached 35°C.

3.3.4 Therefore, it is considered that odour emission rates captured during the odour sampling exercise on the 18th July are representative of extreme worst-case weather conditions (highest ever recorded), that are not likely to occur during the course of a normal year.

3.3.5 Given this, when sampling was undertaken at the WwTW on 27th July to collect samples from the Sludge and Blend Tank OCU, additional samples were also taken at the PST's in order to capture emission rates from this odour source during more 'typical' summer time temperatures.

[1] Available at https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/gcnx0z9e5

4 PREDICTIVE ASSESSMENT – ODOUR DISPERSION MODELLING

4.1.1 Emissions to atmosphere from the Netheridge WwTW have been modelled using AERMOD (Lakes Environmental model version 10.2.1). This is a proprietary quantitative dispersion model that is based upon the Gaussian theory of plume dispersion. The model uses all input data, including the characteristics of the release (i.e. rate, temperature, velocity, height, location, etc.), meteorological data and the locations of the buildings adjacent to the proposed emission points (where appropriate), to predict the concentration of the substance of interest at a specified point.

4.1.2 The model uses sequential hourly meteorological data and the locations of the buildings, to predict the concentration of each substance at each point for each hour over the course of a year. This allows long-term mean and short-term peak ground level concentrations to be estimated over the modelled area, as required.

4.1.3 The odour dispersion modelling has been carried out in accordance with guidance included within the EA H4 Odour Management document.

Model Inputs

Proposed Sensitive Receptor Locations

4.1.4 The assessment focuses on proposed sensitive receptors, as it considers the potential for odour effects within the development site.

4.1.5 The results of the assessment will be used to inform the masterplan for the proposed development, and therefore a uniform Cartesian grid has been modelled, which covers the entire site. The parameters of the modelled Cartesian grid are included in Table 1.

Table 1: Uniform Cartesian Grid Parameters

Parameter	X	Y
South West Grid Coordinates	380111.83	215148.89
Number of Points	39	34
Spacing (m)	50	50
Length (m)	1900.00	1650.00
Total Number of Grid Receptors	1326	

Meteorology

4.1.6 Meteorological data has the greatest impact on the determination of the dispersion of odour from a given source. In modelling terms, the meteorological data input into the model will determine the dispersion characteristics of odour from Netheridge WwTW and therefore it will affect the distribution of contours of predicted odour levels across the development site.

4.1.7 It is considered that there is no representative meteorological station in the vicinity of the proposed development site. The nearest meteorological station to the site, the Gloucester meteorological station, has a high percentage of missing wind data for 2020 and 2021 and so was not considered suitable for use within the assessment. The next nearest stations are all over 37km away. Therefore, Numerical Weather Prediction (NWP) Meteorological data has been obtained from ADM Ltd for use in the model, and this is considered to be the most representative of on-site conditions.

4.1.8 Whilst still not fully representative of actual meteorological conditions experienced on site, the use of this data in the assessment is considered to be more robust than using data from the nearby meteorological stations.

4.1.9 Five years of hourly sequential data (i.e. 2017 to 2021) have been obtained from ADM Ltd, with each year of data being considered separately within the model.

Surface Characteristics

4.1.10 The predominant characteristics of land use in an area provide a measure of the vertical mixing and dilution that is likely to take place in the atmosphere due to factors such as surface roughness and albedo.

4.1.11 The met data used within the assessment has been processed using AERMET software which allows for the incorporation of the surface characteristics in the vicinity of Netheridge WwTW and the proposed development site.

4.1.12 Examination of the local setting shows a mix of urban and more open, cultivated land uses. The met data has been processed using AERMET software to account for these land uses.

Terrain

4.1.13 To consider the impact of terrain surrounding the site on the dispersion of pollutants, x.y.z format terrain data has been used in the model.

Emission Parameters for Odour Sources

4.1.14 Details of the sources to be included in the model have been taken from a mix of sources. These include emission rate data from within the Phlorum report (which includes previous odour sampling data collected at Netheridge WwTW), library values within the UKWIR document and emission rate data from two odour sampling exercises undertaken by Wardell Armstrong in July 2022.

4.1.15 All emission rates have been agreed as suitable for use within the assessment with ST. The majority of the sources considered are area sources in nature, and details have been provided of their area and heights. There are also several point source emission sources included in the model.

4.1.16 The area sources and odour emission rates considered in the model are included in Table 2, whilst the point source odour emission rates are shown in Table 3. The locations of these sources are shown in **Appendix B**.

Table 2: Sources and Odour Emission Rates – Area Sources

Odour Source Model Reference	Odour Source Description	SW Corner / Centre Grid Reference		Emission Rate (OU/m²/s)	Area (m²)	Height (m)	Base Elevation (m)
		X	Y				
Polygon Sources							
PAREA1	Rag Skips (x4)	381088	215794	50†	22.1	1.5	12
PAREA2	Grit Skip	381084	215820	50†	2.9	1	12
PAREA3	Storm Channel	381011	215958	4.8^	74.3	2.5	12.43
PAREA4	Rag Skip (Storm x2)	381089	215900	50†	13.1	1.5	12.11
PAREA5	Inlet Channel	381094	215851	6.2†	89.6	2	12.07
PAREA6	Rag Skip (permitted)	380801	215841	50†	92.0	0	15.85
PAREA7	Aged Cake	380716	215808	1.8^	5942.2	0	17.4
PAREA8	Fresh Cake	380812	215745	62†	194.1	0	14
PAREA9	Aerobic Zone 1	380901	215833	0.4^	3942.8	1.5	13
PAREA10	Aerobic Zone 2	380841	215808	0.4^	1997.9	1.5	13.81
PAREA11	Anoxic Zone	380872	215730	8.5^	240.5	1.5	13.7
PAREA12	SAS and RAS channel	380870	215857	0.4^	40.1	0	13.89

Table 2: Sources and Odour Emission Rates – Area Sources							
Odour Source Model Reference	Odour Source Description	SW Corner / Centre Grid Reference		Emission Rate (OU/m²/s)	Area (m²)	Height (m)	Base Elevation (m)
		X	Y				
PAREA13	Anoxic Zone 2	380932	215752	8.5^	241.0	1.5	12.72
Circular Sources							
CAREA1	FST 1	380839	215884	0.3*	845.0	0.5	14
CAREA2	FST 2	380877	215898	0.3*	845.0	0.5	14
CAREA3	FST 3	380914	215913	0.3*	845.0	0.5	13.84
CAREA4	FST 4	380929	215875	0.3*	845.0	0.5	13.83
CAREA5	FST 5	380891	215860	0.3*	845.0	0.5	13.5
CAREA6	FST 6	380854	215847	0.3*	845.0	0.5	13.95
CAREA7	PST 1	380990	215861	6.9*	494.0	0.5	13
CAREA8	PST 2	381020	215872	6.9*	494.0	0.5	13
CAREA9	PST 3	381002	215830	6.9*	494.0	0.5	12.43
CAREA10	PST 4	381031	215841	6.9*	494.0	0.5	12.8
CAREA11	Storm Tank 1	381047	215961	4.8^	576.8	0.5	12
CAREA12	Storm Tank 2 (20% size)	381079	215973	2.5^	115.4	0.5	11.69
CAREA13	Storm Tank 3 (20% size)	381060	215928	2.5^	115.4	0.5	12.15
CAREA14	Storm Tank 4 (20% size)	381092	215940	2.5^	115.4	0.5	11.93
CAREA15	Pathogen Kill Tank 1	380930	215719	0.6^	224.3	7	12.86
CAREA16	Pathogen Kill Tank 2	380949	215727	0.6^	224.3	7	12.17
CAREA17	Pathogen Kill Tank 3	380969	215734	0.6^	224.3	7	12
CAREA18	Pathogen Kill Tank 4	380937	215699	0.6^	224.3	7	12.99
CAREA19	Pathogen Kill Tank 5	380957	215707	0.6^	224.3	7	12.61
CAREA20	SAS Buffer Tank	380985	215814	1^	89.9	5.6	12

* Value obtained from odour sampling by Wardell Armstrong in July 2022
^ Value obtained from odour sampling (contained with Phlorum Report)
† Value obtained from UKWIR library values (contained within Phlorum Report)

Table 3: Sources and Odour Emission Rates – Point Sources								
Odour Source Model Reference	Odour Source Description	SW Corner / Centre Grid Reference		Emission Rate (OU/s)	Diameter (m)	Exit Velocity (m/s)	Height (m)	Base Elevation (m)
		X	Y					
Polygon Sources								
STCK1	Sludge and Blend Tank OCU	381058	215829	3.0*	0.1	0.05	4	12.26
STCK6	Inlet Well OCU	381124	215714	502^	0.1**	15	4	11
STCK7	GBT/Import OCU	381074	215869	5376*	0.3	5.66	13	12.79

* Value obtained from odour sampling by Wardell Armstrong in July 2022
^ Value obtained from odour sampling (contained with Phlorum Report)
† Value obtained from UKWIR library values (contained within Phlorum Report)
** Assumed Value

4.1.17 Two odour sampling exercises were undertaken by Wardell Armstrong in July 2022 to obtain representative emission rate values for the PST's, FST's, the GBT OCU and the Sludge and Blend Tank OCU. As discussed earlier in this report, sampling was undertaken on two separate dates (18th and 27th July) as the Sludge and Blend Tank OCU was not operational on the 18th July.

4.1.18 Sampling undertaken on 18th July occurred during extreme heat conditions when a 'Red Warning' was issued by the Met Office. Temperatures at the Netheridge WwTW reached 35°C during sampling (the average maximum temperature during July is 23.16°C).

4.1.19 It is considered that the PST emissions obtained from sampling on the 18th July were elevated due to this extreme heat, and so the PST was also re-sampled on the 27th July under conditions more typical of summertime. Both the elevated and typical PST sampling emission rates have been used in the assessment, with the results of the emissions captured during the extreme heat detailed in the sensitivity analysis in **Appendix C** of this report.

4.1.20 It was previously understood that the odorous air from the GBT's were treated in a new OCU system before release to air. However, once on site at the WwTW, it was discovered that the odorous air from the GBT's is sent to an existing OCU system already in use on site which also treats odorous air from the import sludge tanks. This is important to note, as it means the current modelling assessment does not include an additional OCU source for the GBT's, but rather the Import Sludge OCU emission

source already within the model has been amended to reflect the odour emissions sampled from the GBT/Import Sludge OCU (reflective of emissions from both odour sources).

4.1.21 The previous June 2021 report produced by Wardell Armstrong included emission rates for the 'Sludge Thickening Building Vents' as a proxy for the GBT emissions, which at the time were not available. Given this current assessment uses emission rates obtained for the GBT/Import sludge OCU through odour sampling, the 'Sludge Thickening Building Vents' emission rates, have been removed from the assessment. It is important to note that this emission source is associated with an older treatment method no longer in use at the works (but was in use at the time of the sampling data used within the Phlorum report).

4.1.22 The Storm Tanks (CAREA11 – CAREA14) are likely to be used only during heavy storm events, usually during the winter months, when increased rainfall increases the flow of water into the WwTW, thereby diluting odour rates within this source. It is understood that following a storm event, insufficient drainage within the tanks results in some level of odorous sludge left in the bottom of each tank. Therefore, in order to replicate this within the model, 3 of the four storm tanks have been modelled as a smaller odour source (20% of each tank size to represent the remaining sludge) at 100% of the specified emission rate for the whole year. The remaining storm tank has been modelled as full of storm water (100% tank size and constant emission rate) for 100% of the specified emission rate for 6 months of the year.

4.1.23 It is considered that modelling the storm tanks in this way represents an overly robust approach, as it not likely the storm tanks would be full constantly for 6 months as storm events do not tend to happen so frequently. This approach has been agreed with ST.

Treatment of Buildings

4.1.24 Building downwash occurs when the aerodynamic turbulence induced by nearby buildings cause a pollutant, emitted from an elevated point source, to be mixed rapidly toward the ground (downwash), resulting in higher ground-level concentrations.

4.1.25 If buildings are present within a distance of 5 times the height of the point source stack, they can be modelled in AERMOD to assess the impact of building downwash on the odour/pollutant concentrations.

4.1.26 As there are elevated point sources included within the model, several buildings within the Netheridge WwTW have been modelled. These are shown in Table 4 below.

Table 4: Buildings

Source	Type	Height (m)	Length (m)/ Diameter (m)	Width	Angle
Office Building 1	Rectangular	9	62	24	290.1
Main Office (office area 2)	Polygonal	4	-	-	-
Inlet Pumping Station	Rectangular	8	18	24	20.1
SAS Thickening Building	Rectangular	4	12	11	19.8
Emergency holding tank	Circular	12	9	-	0
Digestor tank 1	Circular	12	9	-	0
Digestor tank 2	Circular	12	9	-	0
Digestor tank 3	Circular	12	9	-	0
Gas Holder	Circular	14	7	-	0
Sludge handling tank 1	Circular	6	6	-	0
Sludge handling tank 2	Circular	6	6	-	0
Sludge handling tank 3	Circular	4	4	-	0
Sludge handling tank 4	Circular	5	4	-	0

Modelling Uncertainties

4.1.27 The odour assessment has adopted a conservative approach to try to address the uncertainties involved with dispersion modelling.

4.1.28 The assessment has assumed that the emission rates for the various sources will be constant throughout the year apart from the storm tanks emissions, which have been modelled using variable emissions to reflect real world conditions.

4.1.29 All emission rates and the modelling approach have been agreed with ST. Odour sampling emission rates have been used for the majority of the odour sources considered within the model, either from the sampling exercise undertaken by Wardell Armstrong in July 2022 or from the odour sampling data used within the Phlorum report.

4.1.30 Odour sampling data obtained on 18th July 2022, during extreme heat conditions, are considered to have resulted in elevated emissions from the PST's. The results of the modelling assessment using these elevated PST emission rates have been included in a sensitivity analysis included in **Appendix C** of this report. This is considered to be the complete worst-case scenario for potential odour impact at the proposed development.

4.1.31 In order to address uncertainties within the meteorological data, the model has included five years' worth of NWP meteorological data, in accordance with the EA H4 odour guidance. NWP data allows for the use of predicted modelled meteorological conditions at the proposed development site within the AERMOD model, as opposed to meteorological data from a less representative met station. Whilst still not fully representative of conditions at the proposed development site, this provides a much more robust set of met data in the model. Each individual year of met data has been run separately, and also a composite drawing showing the maximum extent of the 3OU contour over the full 5 year assessment period.

4.1.32 Terrain data has been included in .xyz format in order to address uncertainties relating to the dispersion of odour in the vicinity of the WwTW and proposed development.

4.1.33 The installation of GBT's at the works means the final sludge cake produced at the works has reduced in quantity and odour. As it has not been possible to undertake odour sampling of the sludge cake following the installation of the GBT's, the previous higher emission rates used within the Phlorum report have been used within this assessment. This is considered to be a very robust approach as the sludge cake currently produced at the site will be of smaller quantities, higher quality (i.e. more efficiently treated containing less volatile material) and therefore less odorous than the previous sludge cake.

4.1.34 As outlined in paragraph 4.1.22, the four storm tanks included in the assessment have been modelled using time variable emissions to reflect their intermittent use throughout the year. Even with time variable emissions applied, this is still considered to be a highly robust approach as it is unlikely the storm tanks would contain either 20% sludge for the whole year or be full of storm water constantly for six months of the year.

4.1.35 As a result of these conservative inputs, it is considered the model is more likely to provide an overestimation of the potential odour effects of the WwTW than an underestimation.

4.1.36 Given the nature of the odour source, a level of $C_{98,\ 1\text{-hour}}$ $3ou_E/m^3$ has been adopted for the assessment (98th percentile of 1-hour mean concentration). This criterion applies at the site boundary but has been assessed across a receptor grid which covers the proposed development site.

5 SITE VISITS

5.1.1 Extensive details of the site visits undertaken (odour observation 'sniff tests') are provided in the 2020 and 2021 odour assessment reports produced by Wardell Armstrong.

6 PREDICTED EFFECTS AND THEIR SIGNIFICANCE

6.1 Odour Dispersion Modelling Results

6.1.1 Odour concentrations, as a result of the operation of Netheridge WwTW, have been modelled across a receptor grid which covers the proposed development site and surrounding area (see Table 1). Concentrations have been predicted for each of the last five years of available NWP meteorological data (i.e. 2017 to 2021).

6.1.2 Modelling odour concentrations across a receptor grid allows odour contour plots to be produced, which show the extent of the area across which the benchmark level of $C_{98,\ 1\text{-hour}}$ $3ou_E/m^3$ is exceeded. These plots, which have been created for each year of meteorological data considered in the assessment, are included in **Appendix D**.

6.1.3 As the proposed development is for residential use, the assessment should consider the $C_{98,\ 1\text{-hour}}$ $3ou_E/m^3$ as the benchmark criteria. Any area of site predicted to experience odour concentrations above this criterion would not usually be considered suitable for residential development.

6.1.4 The results of the assessment show that in all of the years assessed (2017 to 2021), the eastern area of the development site is predicted to be affected by the $C_{98,\ 1\text{-hour}}$ $1.5ou_E/m^3$ odour contours.

6.1.5 It should be noted however that as part of the assessment, in all five years assessed, the site remains outside of the $C_{98,\ 1\text{-hour}}$ $3ou_E/m^3$ odour contours.

6.1.6 The whole of the development site is also not predicted to be affected by the $C_{98,\ 1\text{-hour}}$ 5 or $10ou_E/m^3$ contours.

6.2 Odour Observations

6.2.1 Odour observations were undertaken on four separate site visits on 29th and 30th August and 6th and 12th September 2019, as part of the previous qualitative odour assessment undertaken by Wardell Armstrong (REF: GM10710/006).

6.2.2 Across all four visits, maximum odour intensities recorded across the monitoring locations ranged from 0 ‘no odour’ to 4 ‘strong’ with a corresponding average odour intensity ranging from 0 ’not perceptible’ to 2 ‘slight/weak’.

6.2.3 A total of 84 observation periods were conducted over the six site visits. No odour was detected at 53 of these (63.10%). Of the 31 observation periods that experienced odour, five of these related to odour from the surrounding agricultural fields.

6.2.4 Therefore, odour originating from the WwTW was not detected at 58 of the 84 locations (69.05%).

6.2.5 Odour effects were calculated as 'negligible' at 80 of the 84 observation periods (95.24%) undertaken during all four site visits. Slight adverse effects were calculated at 4 observation periods, across three monitoring locations (locations 8, 12 and 13). One of these resulted from odour originating from a source other than the Netheridge WwTW (location 8) and monitoring locations 12 and 13 are both located adjacent to the southern boundary of the site. It is understood that no residential dwellings are proposed within or in close proximity to these locations.

6.2.6 It is considered that the results of the odour observations during 2019 are still valid for the current assessment, as it is understood that no operational changes or upgrades have taken place at the WwTW since the visits were undertaken. It is considered very likely that similar results would be obtained were the visits to be undertaken again.

6.2.7 In accordance with IAQM guidance, based on the odour observations undertaken across the four site visits, the odour effects of Netheridge WwTW on the proposed development site as a whole, correlate to a **'not significant'** overall odour impact.

6.3 Odour Complaint History

6.3.1 As part of the previous qualitative odour assessment undertaken by Wardell Armstrong (REF: GM10710/006) it was confirmed by GCC that the council have record of 12 odour complaints relating to the WwTW in the last five years (since 2020). Eleven of these are located to the south of the WwTW, with the remaining one complaint, logged in 2016, located to the north east of the proposed development site. The proposed development site is located towards the north east of the WwTW, and so this shows there is potential for greater odour impact to the south of the WwTW.

6.4 Discussion of Results and Recommendations for Mitigation

6.4.1 IAQM guidance states that considerable weight should be given to those assessment tools based on real world observations, such as odour observation site visits and odour complaint histories.

6.4.2 Steps have been taken during the modelling process to improve the perceived reliability of the model, as outlined in Section 4 of this report. These steps are also summarised below:

- All emission rates have been agreed with ST in advance of the modelling assessment. The majority of emission rates used in the assessment have been taken from the Phlorum report which are mostly based on a previous odour sampling undertaken at Netheridge WwTW.
- This update assessment has also included robust emission rate data based on odour sampling undertaken at the WwTW in July 2022 for the PST's, FST's, the GBT/Import OCU and the Sludge and Blend Tank OCU.
- A sensitivity analysis has been undertaken which includes the higher PST emissions captured during the sampling exercise on 18th July 2022, during extreme heat conditions. This is considered to be the complete worst-case scenario for potential odour impact at the proposed development and not representative of conditions during a typical year.
- Four odour observation site visits were undertaken within the proposed development site, (above the minimum of three visits recommended in the IAQM guidance).
- There is no representative meteorological station in close proximity to the proposed development site. Therefore, to obtain more representative meteorological data for use within the assessment, Numerical Weather Prediction models were obtained from the Met Office.
- The NWP data used within the assessment has been processed using AERMET software. The predominant characteristics of land use in an area provide a measure of the vertical mixing and dilution that is likely to take place in the atmosphere due to factors such as surface roughness and albedo. Examination of the local setting shows a mix of urban and more open, cultivated land uses. The met data has been processed using AERMET software to account for these land uses.
- In order to improve accuracy, detailed terrain data has been included in the model.

6.4.3 The above steps led to an increase in the perceived reliability of the model and the results can be considered to be much more representative than if these steps had not been taken.

6.4.4 When reaching an overall conclusion on the significance of likely odour effects, the IAQM guidance states that the findings of the different odour assessment tools should be drawn together. This includes community-based tools, such as odour complaint histories, and empirical tools, such as sniff tests. The guidance states that both of these should normally be given *"considerable weight"* when drawing conclusions in an assessment.

6.4.5 The results of the modelling assessment show that in all years considered as part of the assessment (2017 -2021), the eastern area of the development site is predicted to be affected by the $C_{98, 1\text{-hour}}$ $1.5ou_E/m^3$ odour contours.

6.4.6 It should be noted however that as part of the assessment, in all five years assessed, the site as a whole remains outside of the $C_{98, 1\text{-hour}}$ $3ou_E/m^3$ odour contours. Additionally, the development framework plan for the site shows a set back from the southern and south eastern boundary where no sensitive residential uses are proposed, as shown in **Appendix D.**

6.4.7 The proposed residential areas in the northern half of the development site are not predicted to be impacted by the $C_{98, 1\text{-hour}}$ $3ou_E/m^3$ odour benchmark criteria in any of the five years assessed, as shown in Composite Drawing GM10710-120.

6.4.8 Out of a total of 84 odour observations undertaken within the proposed development during four site visits, only 26 of these detected odours from Netheridge WwTW (30.95%).

6.4.9 All monitoring locations within the proposed residential areas of the development site correlate to a negligible odour impact across all four site visits, in accordance with the IAQM guidance.

6.4.10 The results of the sensitivity analysis, which use the higher PST emission rates obtained during extreme heat conditions (included in **Appendix C**) show that the $C_{98, 1\text{-hour}}$ $3ou_E/m^3$ odour contours impact a strip along the eastern section of the development site and the majority of the site remains outside of the benchmark criteria. The whole of the development site is not predicted to be affected by the $C_{98, 1\text{-hour}}$ 5 or $10ou_E/m^3$ contours.

6.4.11 The odour contours produced for each of the five years included in the sensitivity analysis are shown in **Appendix E**. An odour composite drawing showing the $C_{98, 1\text{-hour}}$ $3ou_E/m^3$ contours from each of the five years is shown in Drawing GM10710-121.

6.4.12 Given the results of the assessment and sensitivity analysis, it is not considered likely that the proposed development would place constraints on future development at the WwTW. Any new assets or treatment methods brought in to use at the works must be built to ensure that they will not significantly increase the risk of local odour impacts.

6.4.13 Combining the results of the assessment together and taking into consideration the development framework plan included in **Appendix F**, the effect of odour from Netheridge WwTW on the proposed development site is considered to be negligible, which correlates to an overall **'not significant'** effect, in accordance with IAQM guidance.

7 CONCLUSIONS

7.1 Odour Dispersion Modelling

7.1.1 Odour dispersion modelling has been undertaken using AERMOD software to consider the potential for odour effects from Netheridge WwTW at the proposed development site.

7.1.2 Steps were taken to increase the perceived reliability of the model in an attempt to ensure the results of the model are as representative of actual current conditions as possible, as discussed in Section 4 and 6.4 of this report.

7.1.3 Odour concentrations have been predicted across a receptor grid, which incorporates the entire proposed development site and surrounding area. This has allowed odour contour plots to be created for each of the five years of meteorological data considered. The predicted odour concentrations have been compared against a benchmark level of $C_{98,\ 1\text{-hour}}\ 3ou_E/m^3$.

7.1.4 The results of the modelling assessment show that the $C_{98,\ 1\text{-hour}}\ 3ou_E/m^3$ odour benchmark criteria contours do not encroach into the development site boundary in any of the five years assessed, as shown in Drawing GM10710 – 120.

7.1.5 The results of the sensitivity analysis predict a strip along the eastern boundary of the site will be impacted by the $C_{98,\ 1\text{-hour}}\ 3ou_E/m^3$ odour benchmark criteria contours, however the majority of the proposed residential areas are predicted to remain outside of this area, as shown in Drawing GM10710-121.

7.2 Odour Observations

7.2.1 In accordance with IAQM guidance, based on the results of the odour observation site visits, the effects of Netheridge WwTW on the proposed development site as a whole, correlate to a **'not significant'** overall odour impact.

Odour Complaint History

7.2.2 GCC have confirmed that the council have record of 12 odour complaints relating to the WwTW in the last five years. Eleven of these are located to the south of the WwTW, with the remaining one complaint, logged in 2016, located to the north east of the proposed development site. The proposed development site is located towards the north east of the WwTW, and so this shows there is potential for greater odour impact to the south of the WwTW.

7.3 Summary

7.3.1 The framework plan for the proposed development, included in **Appendix F**, incorporates a setback distance from Netheridge WwTW, with no residential development proposed in the southern areas of the proposed development site. This correlates well with the results of both the odour observation site visits, which predict a negligible odour impact in the northern half of the development site where residential uses are proposed, and the results of the odour modelling assessment, which predict the proposed residential areas will not be impacted by the $C_{98,\ 1\text{-hour}}$ $3ou_E/m^3$ odour benchmark criteria in any of the five years assessed.

7.3.2 The results of the sensitivity analysis predict a strip along the eastern boundary of the site will be impacted by the $C_{98,\ 1\text{-hour}}$ $3ou_E/m^3$ odour benchmark criteria contours, however the majority of the proposed residential areas are predicted to remain outside of this area.

7.3.3 Given the results of the assessment and sensitivity analysis, it is not considered likely that the proposed development would place constraints on future development at the WwTW. Any new assets or treatment methods brought in to use at the works must be built to ensure that they will not significantly increase the risk of local odour impacts.

7.3.4 Taking the results of the modelling assessment, together with the odour observation results and odour complaint history, it is considered that the effects of odour from Netheridge WwTW on the proposed development site as a whole is negligible, which correlates to an overall **'not significant'** effect.

APPENDICES

Appendix A
Consultation with Severn Trent

Walton, Malcolm

From: Lopes, Bruno [redacted]
Sent: 05 May 2021 10:30
To: Threlfall, Paul; Digby, Ben
Subject: RE: Proposed Odour Assessment methodology

ST Classification: OFFICIAL PERSONAL

Hi Paul
We have no objections to the new proposed values as per your table.

Best regards
Bruno

[redacted]

From: Threlfall, Paul <[redacted]>
Sent: 30 April 2021 09:55
To: Digby, Ben [redacted] Lopes, Bruno [redacted]
Subject: RE: Proposed Odour Assessment methodology

Hi both,

Many thanks for your emails and confirmation of the changes at the works.

Given these changes I propose to reduce the odour emission rates for the following sources. I have listed their previous emission rate assigned as part of the Phlorum assessment for reference:

Odour Source	Phlorum emission rate (ouE/m2/s)	Proposed emission rate following changes to the works (ouE/m2/s)
PST's	7.5 (UKWIR 'high' library value)	1.9 (UKWIR 'typical' library value)
FST's	1.7 (UKWIR 'high' library value)	0.7 (UKWIR 'typical' library value)

The PST emissions will have improved given what we have previously discussed, and the FST's are also likely to be less odorous due to the upgraded treatment methods and improved operational practices at the works.

I have also amended the way the storm tanks have been modelled in the assessment. We are aware that these tanks are likely to have some level of odorous sludge left in the bottom due to insufficient drainage following a storm event. Therefore, I have modelled 3 of the 4 of these tanks as a constant emission rate to reflect this sludge (as 20% of the size of the tank) and the other tank is modelled as full of storm water for 6 months of the year. We consider these changes to still be overly robust as it not likely the storm tanks would be full constantly for 6 months as storm events do not tend to happen so frequently.

It is understood that given the improvements to the sludge treatment process, the final sludge cake that is produced will be in smaller quantities, of higher quality and less odorous than the previous sludge cake produced. This is based on information within the Phlorum report and is taken from a quote from a 'strategic asset planner at Severn Trent. This means that the odour emission rates used in the Phlorum report for this source is likely to also have

reduced. However, given the difficulty in obtaining a more representative emission rate for this (there are no representative emission rates in the UKWIR guidance) we propose to keep the overly conservative emission rates from the Phlorum report in our updated model.

Could you please review the above and let me know if you have any comments or thoughts. I can then use this information to produce an updated model of the works.

Many thanks

Paul

[redacted]

wardell armstrong

From: Digby, Ben [redacted]
Sent: 28 April 2021 14:37
To: Lopes, Bruno [redacted]; Threlfall, Paul [redacted]
Subject: RE: Proposed Odour Assessment methodology

ST Classification: OFFICIAL PERSONAL

I'll also add that the Primary sludge GBTs are have odour management installed.

Ben Digby BEng (Hons) CEng MIChemE

Senior Process Design Engineer,
Asset Health and Performance

[redacted]

From: Lopes, Bruno [redacted]
Sent: 28 April 2021 14:31
To: Threlfall, Paul [redacted]
Cc: Sugden, Peter [redacted] Went, Charlotte [redacted]
Wroe, Jonathon [redacted] Lees, Steven [redacted] Digby, Ben [redacted]
Subject: RE: Proposed Odour Assessment methodology

ST Classification: OFFICIAL PERSONAL

Hi Paul

Yes we did manage to have a word with the site manager.
According to the information we got, there was indeed a change in the operational procedure for the PST desludging, which has occurred circa 2015/2016.
In a nutshell, you are correct when you previously mentioned the PSTs are no longer being used for thickening of sludge. That role is now fulfilled by a set of gravity belt thickeners which are fed raw sludge from the primaries.
It is my understanding that this change, has indeed reduced the occurrence of rising sludges in the primary tanks and associated emissions from that source.

Best regards
Bruno

[redacted]

From: Threlfall, Paul [redacted]
Sent: 27 April 2021 15:28
To: Lopes, Bruno [redacted]
Cc: Sugden, Peter [redacted] Went, Charlotte [redacted]
Wroe, Jonathon [redacted] Lees, Steven [redacted] Digby, Ben
[redacted]
Subject: RE: Proposed Odour Assessment methodology

Hi Bruno,

I am just emailing for a quick update on the below – did you manage to speak to the site manager?

Many thanks

Paul

[redacted]

wardell armstrong

From: Threlfall, Paul
Sent: 20 April 2021 15:15
To: Lopes, Bruno [redacted]
Cc: Sugden, Peter [redacted]; Went, Charlotte [redacted]
Wroe, Jonathon [redacted] Lees, Steven [redacted] Digby, Ben
[redacted]
Subject: RE: Proposed Odour Assessment methodology

Hi Bruno,

This would be very much appreciated, thank you. Please let me know when you have spoken to the site manager and hopefully we can get some further information.

Many thanks

Paul

[redacted]

From: Lopes, Bruno [redacted]
Sent: 20 April 2021 13:44
To: Threlfall, Paul [redacted]
Cc: Sugden, Peter [redacted] Went, Charlotte [redacted]
Wroe, Jonathon [redacted] Lees, Steven [redacted] Digby, Ben [redacted]
Subject: RE: Proposed Odour Assessment methodology

ST Classification: OFFICIAL PERSONAL

Hi Paul
I am not familiar with the history of the site (way before my time). The site manager will be the best person to provide detail about any upgrades/changes on site. We will try to gather any relevant information regarding this matter and get back to you.

Best regards
Bruno

[redacted]

From: Threlfall, Paul [redacted]
Sent: 12 April 2021 11:36
To: Lopes, Bruno [redacted]
Cc: Sugden, Peter [redacted] Went, Charlotte [redacted]
Wroe, Jonathon [redacted] Lees, Steven [redacted] Digby, Ben [redacted]
Subject: RE: Proposed Odour Assessment methodology

Hi Bruno,

Many thanks for your reply and apologies for the lateness of my response – I was out of the office the second half of last week so did not have access to my emails.

We acknowledge that ST does not hold any odour emission rates on file. However, given there have been some improvements to the works as well as changes to operational practices since the previous emission rate data was collected/ UKWIR library values were assigned to various odour sources in 2008, we believe that the odour contours produced in the previous Phlorum report (which have helped define the current Cordon Sanitaire around the works) are overly conservative and inaccurate.

Therefore, we are trying to ascertain what impact these improvements/changes in operational practices may have had on the odour emission rates from certain sources at the works. As discussed, we understand that since the 2008

odour survey, upgrades have been made to the sludge treatment and handling processes and there have been operational changes to sources such as the PST's (it is understood that sludge was previously thickened within the PST's which led to rising sludge and resulting high odour emissions, but this practice no longer takes place due to the sludge treatment/handling upgrades). Therefore, it is considered very likely that the odour of sources such as the PST's and certain aspects of the sludge handling/treatment areas will have now improved.

We are undertaking indicative odour modelling to see if the application of new reduced odour emission rates to these sources will make a discernible difference to the odour contours and predicted areas of odour impact. Therefore, it is our aim to try to agree more representative emission rates with ST – we are aware you hold no emission rate data on file, but we would like to open a dialogue to discuss the application of reduced odour emission rates - for example, the use of a 'typical' UKWIR library value instead of a previously used 'high' value given the likelihood of odour reduction at a particular source.

We would be grateful if you could advise what upgrade works have taken place across the works since 2008 (i.e. such as the refurbishment of the sludge handling/treatment areas in 2016) and we can then look at the emission rates previously applied to these to ascertain if it is realistic and representative to apply a reduced odour emission rate to these sources to more accurately reflect current odour conditions at the works.

Many thanks

Paul

[redacted]

wardell armstrong

From: Lopes, Bruno [redacted]
Sent: 08 April 2021 10:36
To: Threlfall, Paul [redacted]
Cc: Sugden, Peter [redacted] Went, Charlotte [redacted]
Wroe, Jonathon [redacted] Lees, Steven [redacted] Digby, Ben [redacted]
Subject: RE: Proposed Odour Assessment methodology

ST Classification: OFFICIAL PERSONAL

Hi Paul
I have spoken to Ben Digby about this matter and as mentioned before by Charlotte, ST does not have a database of odour emission factors and we rely on the previous sampling data included in the Odournet report and/or UKWIR standard values.
Regarding the improvements you mention in your email (PST desludging and sludge route), as far as I know, they are being planned/discussed (as part of an upcoming project) but have not been implemented yet.

Best regards
Bruno Lopes

[redacted]

From: Threlfall, Paul [redacted]
Sent: 06 April 2021 13:54
To: Digby, Ben [redacted]
Cc: Sugden, Peter [redacted] Lopes, Bruno [redacted] Went, Charlotte [redacted] Wroe, Jonathon [redacted] Lees, Steven [redacted]
Subject: RE: Proposed Odour Assessment methodology

Good Afternoon Ben,

I am just emailing to see if you have had time to review my email below and have any advice on the likely updated emission rates we can use in our assessment?

Many thanks

Paul

[redacted]

wardell armstrong

From: Threlfall, Paul
Sent: 24 March 2021 09:09
To: Went, Charlotte [redacted] Digby, Ben [redacted]
Cc: Sugden, Peter [redacted] Lopes, Bruno [redacted] Wroe, Jonathon [redacted] Lees, Steven [redacted]
Subject: RE: Proposed Odour Assessment methodology

Thanks for your reply Charlotte.

It is our understanding that, since the odour sampling survey was undertaken in 2009,m there have been improvements to the sludge handling and treatment methods at the sewage works which will have led to an improvement in emission rates at the associated treatment process.

For example, we are aware there have been improvements to the PST's following on from the provision on site of raw sludge thickening and the necessary change in operational practice of withdrawing a thin sludge on a frequent basis. These have been assigned a 'high' odour emission rate within the Phlorum report but now, it is considered these would now be classed as a 'low' odour source.

We are also aware that there have been improvements to the sludge route through the works and new dewatering processes are now used on site which will result in less odour during the treatment process (as many are now covered) and will help to produce a cleaner, less odorous sludge cake.

Ben – could you please give me your views on the above and perhaps we could have some discussions regarding more appropriate emission rates to use in the assessment? If no further sampling works has been undertaken since the Odournet visit in 2009, perhaps we could begin by using more appropriate library value emission rates from within the UKWIR document.

I am also concerned the storm tanks may have been modelled very conservatively which may have also had an impact on the contours predicted within the Phlorum report. It would be great if we could also discuss this as well

Looking forward to hearing from you

Many thanks

Paul

[redacted]

From: Went, Charlotte [redacted]
Sent: 23 March 2021 12:42
To: Threlfall, Paul [redacted] Lopes, Bruno [redacted] Wroe, Jonathon [redacted] Digby, Ben [redacted]
Cc: Lees, Steven [redacted] Sugden, Peter [redacted]
Subject: RE: Proposed Odour Assessment methodology

ST Classification: OFFICIAL PERSONAL

Hi Paul

Sorry for late reply.

As far as Netheridge goes we haven't closed Hayden or changed anything regarding the digestion process at Netheridge it is still conventional mesophilic (minimum 16 days digestion and minimum of 7 days batch storage post digestion). There are discussions to look at advanced digestion at Netheridge but nothing has been decided at this current time.

With respect to odour emissions rates, I don't have any data to share or aware of any other surveys taken. So would have to go on the previous report. I have copied in Ben Digby (senior process design who may also have a view on odours if required).

Not sure if that is very helpful or not, but feel free to call if we need to provide emissions rates and ill try and raise this further.

Thank you

Charlotte

From: Threlfall, Paul [redacted]
Sent: 23 March 2021 08:49
To: Went, Charlotte [redacted] Lopes, Bruno [redacted] Wroe, Jonathon [redacted]
Cc: Lees, Steven [redacted] Sugden, Peter [redacted]
Subject: RE: Proposed Odour Assessment methodology

Hi Charlotte,

I hope you are well.

Im just emailing to see if you have any update for me regarding the new odour emission rates for the upgraded parts of the Netheridge STW, as opposed to the overly conservative figures that have been used in the Phlorum report?

Many thanks

Paul

[redacted]

From: Threlfall, Paul
Sent: 15 March 2021 08:45
To: Went, Charlotte [redacted] Lopes, Bruno [redacted] Wroe, Jonathon [redacted]
Cc: Lees, Steven [redacted]; Sugden, Peter [redacted]
Subject: RE: Proposed Odour Assessment methodology

Good morning Charlotte,

Yes, the report was written in September 2019 but used odour emission rate data collected from an odour sampling exercise undertaken at the sewage works during 2009.

I have attached a copy of the report for your reference if you need it

Many thanks

Paul

[redacted]

From: Went, Charlotte [redacted]
Sent: 12 March 2021 16:11
To: Threlfall, Paul [redacted] Lopes, Bruno [redacted] Wroe, Jonathon [redacted]
Cc: Lees, Steven [redacted] Sugden, Peter [redacted]
Subject: RE: Proposed Odour Assessment methodology

ST Classification: OFFICIAL PERSONAL

Hello

Apologies for the late reply.

Do you have the date for the odour assessment report undertaken by Phlorum on behalf of Gloucester Council please?

Thank you

Charlotte

From: Threlfall, Paul [redacted]
Sent: 11 March 2021 08:41
To: Lopes, Bruno [redacted] Went, Charlotte [redacted] Wroe, Jonathon [redacted]
Cc: Lees, Steven [redacted] Sugden, Peter [redacted]
Subject: RE: Proposed Odour Assessment methodology

Good Morning Bruno/Charlotte/Jonathan

I hope you are all well.

I am just emailing to see if you have had time to have a look over my initial email, forwarded to you by Peter Sugden on 4th March, with regards to the odour assessment methodology of the Netheridge STW as well as the availability of some indicartive emission ates from the works following on from the fairly recent upgrade works that have taken place.

I would be very grateful if you could review the email and provide me with a response

Many thanks

Paul

[redacted]

wardell armstrong

From: Threlfall, Paul
Sent: 04 March 2021 09:28
To: Sugden, Peter [redacted]
Cc: Lees, Steven [redacted] Lopes, Bruno [redacted] Wroe, Jonathon [redacted] Went, Charlotte [redacted]
Subject: RE: Proposed Odour Assessment methodology

Good Morning Peter/All,

Many thanks for your reply and for passing the email on to the correct people!

I will keep an eye out for any comments from Bruno, Jonathan and Charlotte as we would appreciate any input/information you may have to help with our assessment.

Many thanks

Paul

[redacted]

From: Sugden, Peter [redacted]
Sent: 04 March 2021 08:51
To: Threlfall, Paul [redacted]
Cc: Lees, Steven [redacted] Lopes, Bruno [redacted] Wroe, Jonathon [redacted] Went, Charlotte [redacted]
Subject: RE: Proposed Odour Assessment methodology

ST Classification: OFFICIAL PERSONAL

Paul,

Please accept my apologies for not replying earlier to your email. I have copied in Bruno Lopes of our Process Design team who may be able to comment on the proposed methodology (I do not have expertise in this area). I do not believe we have actual emissions data of the current treatment processes and arrangements on site, but I have also copied in our Bioresources process optimisation lead, Charlette Went, and Bioresources Operations Manager, Jonathon Wroe, both of whom may have emissions information on the most recent developments at Netheridge STW, which were concerned with Bioresources (sludge treatment) processes.

Regards,
Peter Sugden
[redacted]

From: Threlfall, Paul [redacted]
Sent: 03 March 2021 18:27
To: Sugden, Peter [redacted]
Cc: Lees, Steven <[redacted]
Subject: Re: Proposed Odour Assessment methodology

Hi Peter,

I am just emailing to ensure you received my previous email, dated 18th February, regarding an odour assessment methodology.

I can send the email again should you wish, but could you please review the email and let me know of any comments you may have please?

Many thanks

Paul

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From: Threlfall, Paul
Sent: Thursday, February 18, 2021 2:56:20 PM
To [redacted]
Cc: Lees, Steven [redacted]
Subject: Proposed Odour Assessment methodology

Dear Peter,

I hope you are well.

Wardell Armstrong have been instructed to undertake an odour assessment for a proposed residential development on land off Hempsted Lane, Gloucester. The Gloucester (Netheridge) Waste water Treatment Works (WwTW) is located approximately 550m to the south west of the proposed development site, which we understand is operated by Severn Trent.

With regard to potential odour issues associated with the nearby WwTW, we are aware of an existing odour assessment report of the Netheridge WwTW undertaken by Phlorum on behalf of Gloucester Council to establish a cordon sanitaire. It is understood that the data used within this report is based on information and odour emission rates from before a number of recent upgrades took place at the WwTW. Therefore we would consider the odour contours predicted within that report to be overly robust.

Our client is keen for us to undertake some indicative odour modelling to assess if the changes/upgrades that have already taken place at the works are likely to have reduced the size of the odour contours predicted in the Phlorum report.

With this in mind, we propose to undertake a detailed odour assessment using dispersion modelling and the following methodology:

- The odour dispersion modelling will be undertaken using AERMOD (Lakes Environmental, Version 9.8) and will be carried out in accordance with Environment Agency (EA) modelling guidance and the EA Technical Guidance Note 'H4 – Odour Management' (March 2011), using 5 years of sequential hourly wind data. We propose to use NWP met data within the assessment.

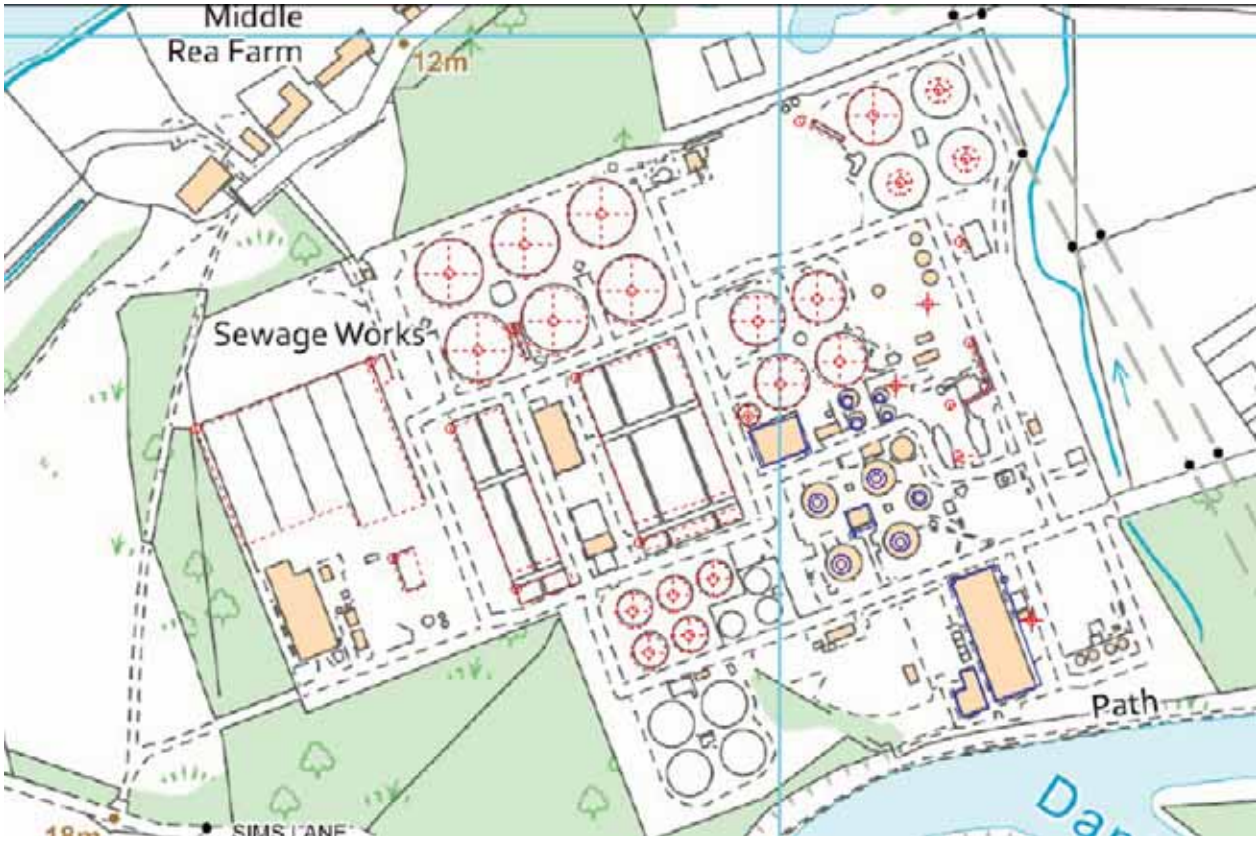
- We will build a base model of the works using the odour emission rate data and information within the Phlorum report. Following this, we would want to agree more representative emission rates for those sources at the works that have recently been upgraded to ascertain if these will make a difference to the predicted odour impact from the works. Ideally, we would like to obtain this information directly from Severn Trent if the information is available. **Can you confirm if this information would be available?** If this is not possible, we would look to use library emission values from the UKWIR 'Odour control in wastewater treatment' document in the assessment, and agree more representative emission rates with Severn Trent using this data.

Please can you provide me with any comments you may have on the above odour methodology. Apologies if you are not the right person to contact regarding this – if not, I would be very grateful if you could forward my email to the appropriate person

Many thanks,

Paul Threlfall

Appendix B
Odour Sources at Netheridge WwTW


Middle
Rea Farm
12m
Sewage Works
Path
SIMS LANE

Appendix C
Sensitivity Analysis

SENSITIVITY ANALYSIS

1.1 Odour Dispersion Modelling Results – Sensitivity Analysis

1.1.1 The Sensitivity analysis uses the emission rates obtained during the sampling exercise undertaken on 18th July 2022, which includes the higher PST emission rates. For reference, Table C1 below shows the higher PST emission rate used in the sensitivity analysis.

Table C1: Higher PST Emission Rate used in the Sensitivity Analysis							
Odour Source Model Reference	Odour Source Description	SW Corner / Centre Grid Reference		Emission Rate (OU/m²/s)	Area (m²)	Height (m)	Base Elevation (m)
		X	Y				
Polygon Sources							
CAREA7	PST 1	380990	215861	15.3	494.0	0.5	13
CAREA8	PST 2	381020	215872	15.3	494.0	0.5	13
CAREA9	PST 3	381002	215830	15.3	494.0	0.5	12.43
CAREA10	PST 4	381031	215841	15.3	494.0	0.5	12.8

1.1.2 Sampling undertaken on 18th July occurred during extreme heat conditions when a 'Red Warning' was issued by the Met Office. Temperatures at the Netheridge WwTW reached 35°C during sampling (the average maximum temperature during July is 23.16°C).

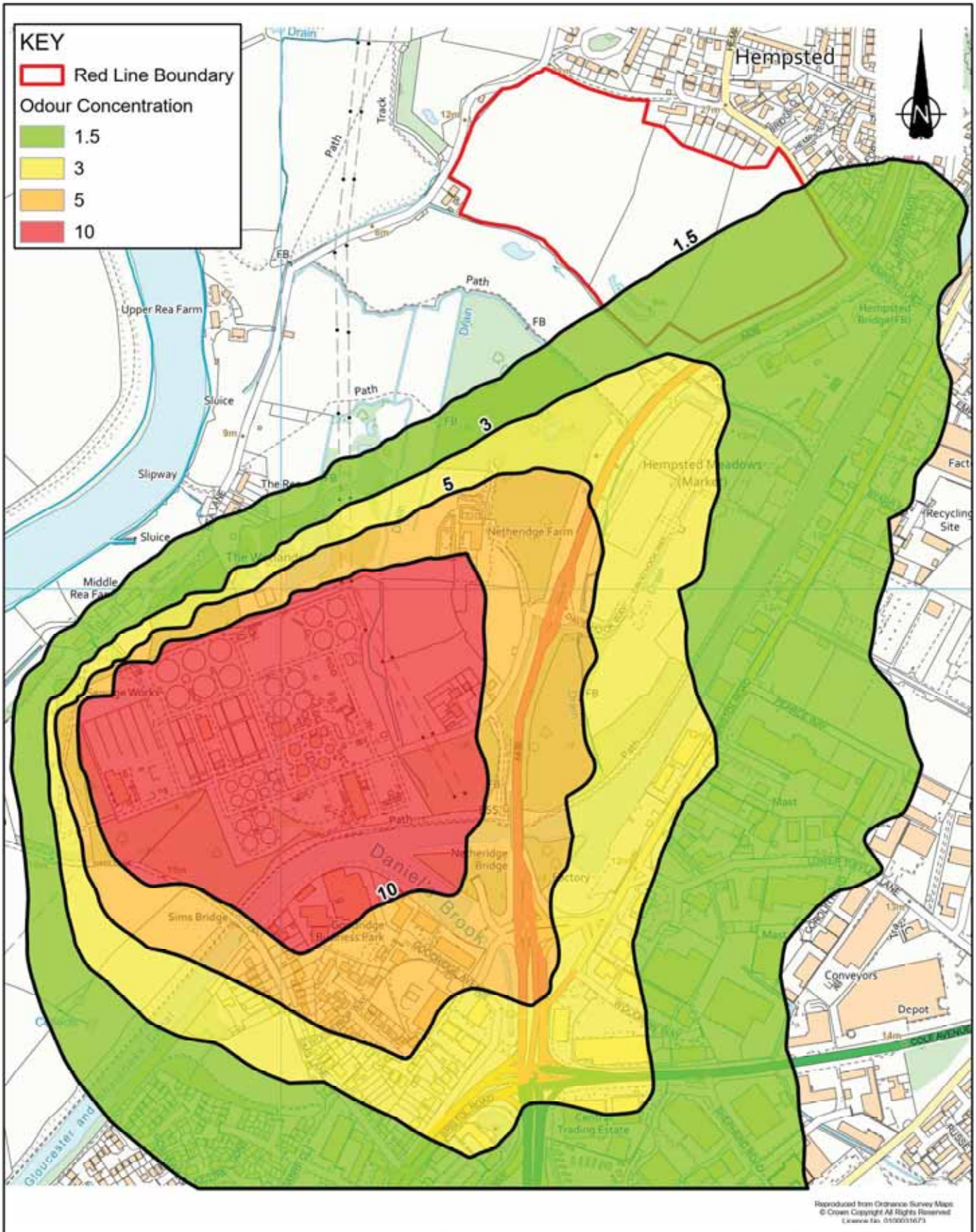
1.1.3 Therefore, it is considered that these emission rates are representative of complete worst case odour conditions and not representative of conditions during a typical year.

1.1.4 The results of the sensitivity analysis show that in all of the years assessed (2017 to 2021), the development site is predicted to be affected by the $C_{98,\ 1\text{-hour}}$ $1.5ou_E/m^3$ and $C_{98,\ 1\text{-hour}}$ $3ou_E/m^3$ and odour contours.

1.1.5 The $C_{98,\ 1\text{-hour}}$ $3ou_E/m^3$ odour contours impact a strip along the eastern section of the development site and the majority of the site remains outside of the benchmark criteria.

1.1.6 Although there is some similarity between three of the five years of meteorological data considered, 2017 can be considered to be a worst case, as the $C_{98,\ 1\text{-hour}}$ $3ou_E/m^3$ odour contours are predicted to affect a greater area of the eastern section of proposed development site. The whole of the development site is not predicted to be affected by the $C_{98,\ 1\text{-hour}}$ 5 or $10ou_E/m^3$ contours.

Appendix D
Odour Concentration Maps



CLIENT: GLADMAN DEVELOPMENTS LTD	DRG No: GM10710-044		REV: A
	SIZE: A4	SCALE: 1:7,500	DATE: 01/08/2022
PROJECT: HEMPSTED LANE, GLOUCESTER	DRAWN BY: CT	CHECKED BY: MTW	APPROVED BY: MTW
DRAWING TITLE: 2017 ODOUR CONTOUR PLOT			

wardell armstrong

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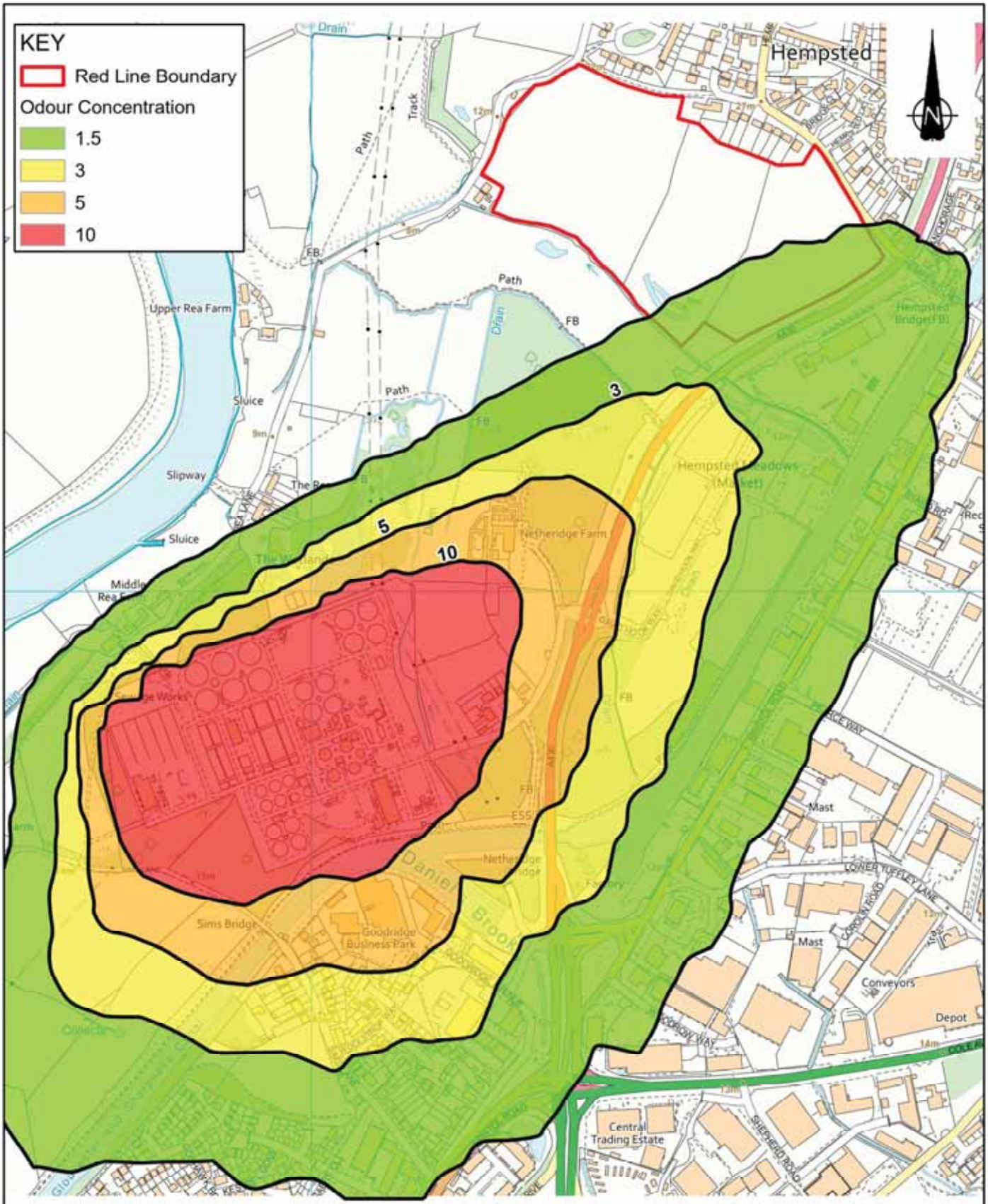

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PROJECT: HEMPSTED LANE, GLOUCESTER	DRAWN BY: CT	CHECKED BY: MTW	APPROVED BY: MTW
DRAWING TITLE: 2018 ODOUR CONTOUR PLOT			

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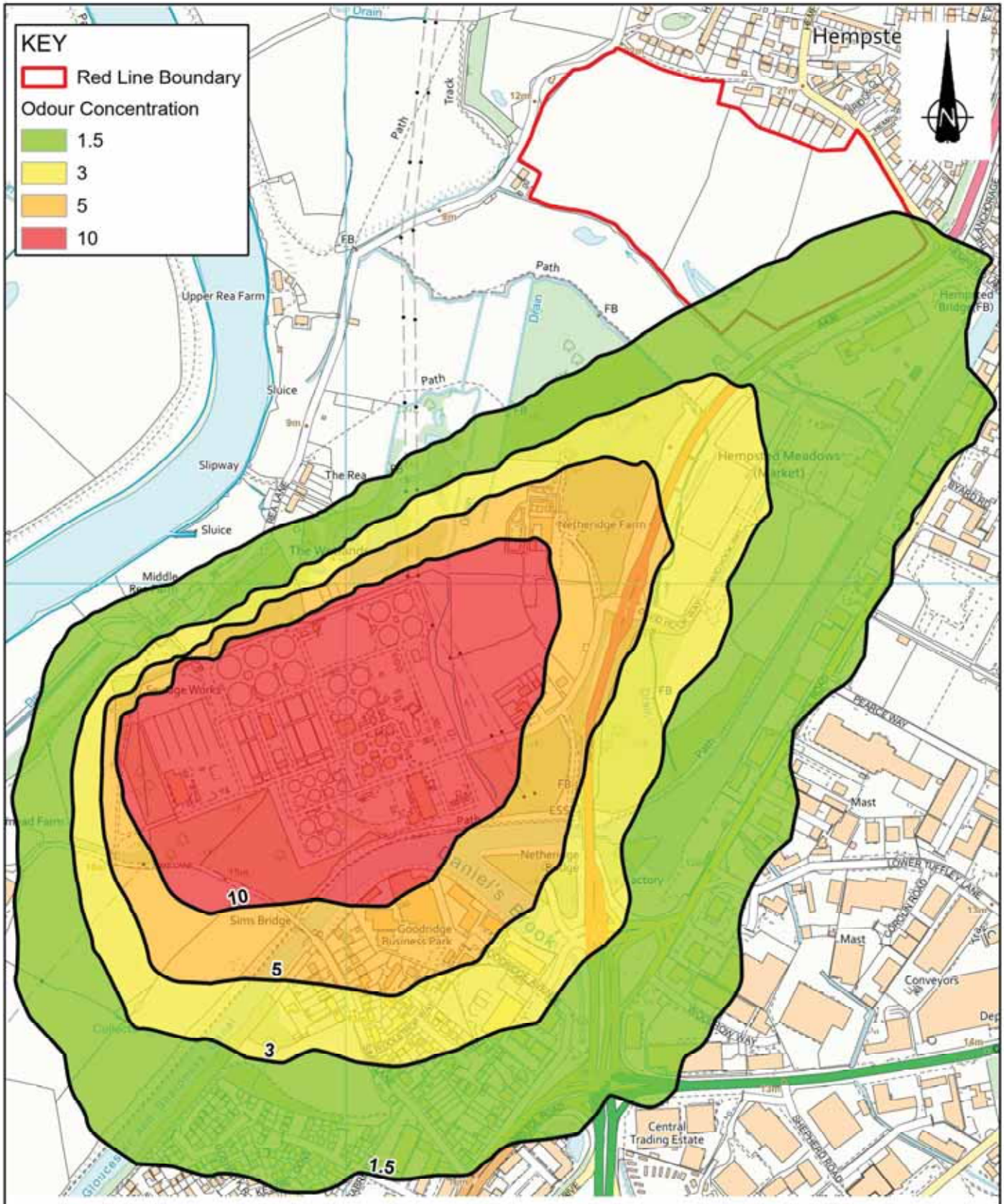

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PROJECT: HEMPSTED LANE, GLOUCESTER	DRAWN BY: CT	CHECKED BY: MTW	APPROVED BY: MTW
DRAWING TITLE: 2020 ODOUR CONTOUR PLOT			

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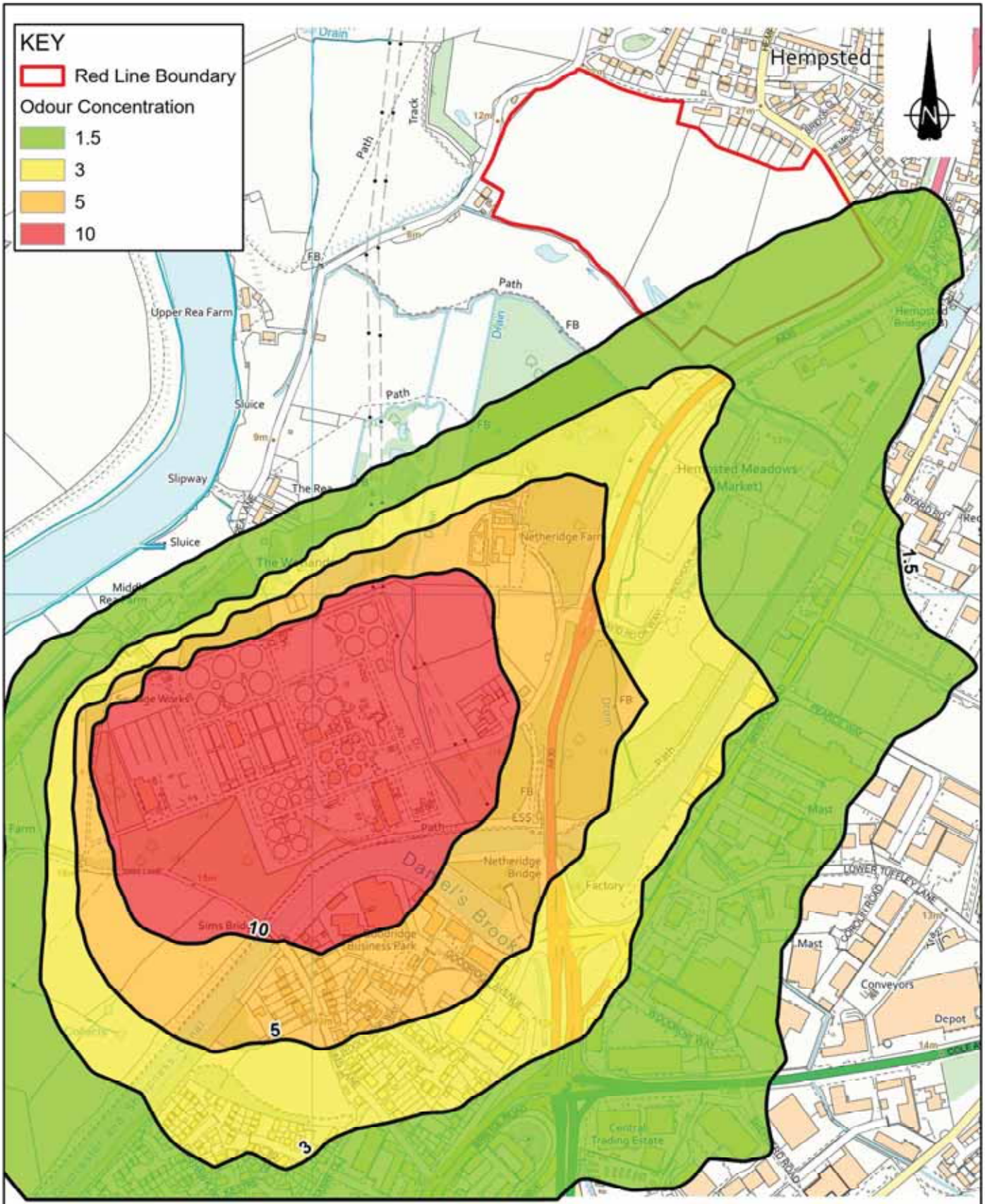

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PROJECT: HEMPSTED LANE, GLOUCESTER	DRAWN BY: CT	CHECKED BY: MTW	APPROVED BY: MTW
DRAWING TITLE: 2021 ODOUR CONTOUR PLOT			

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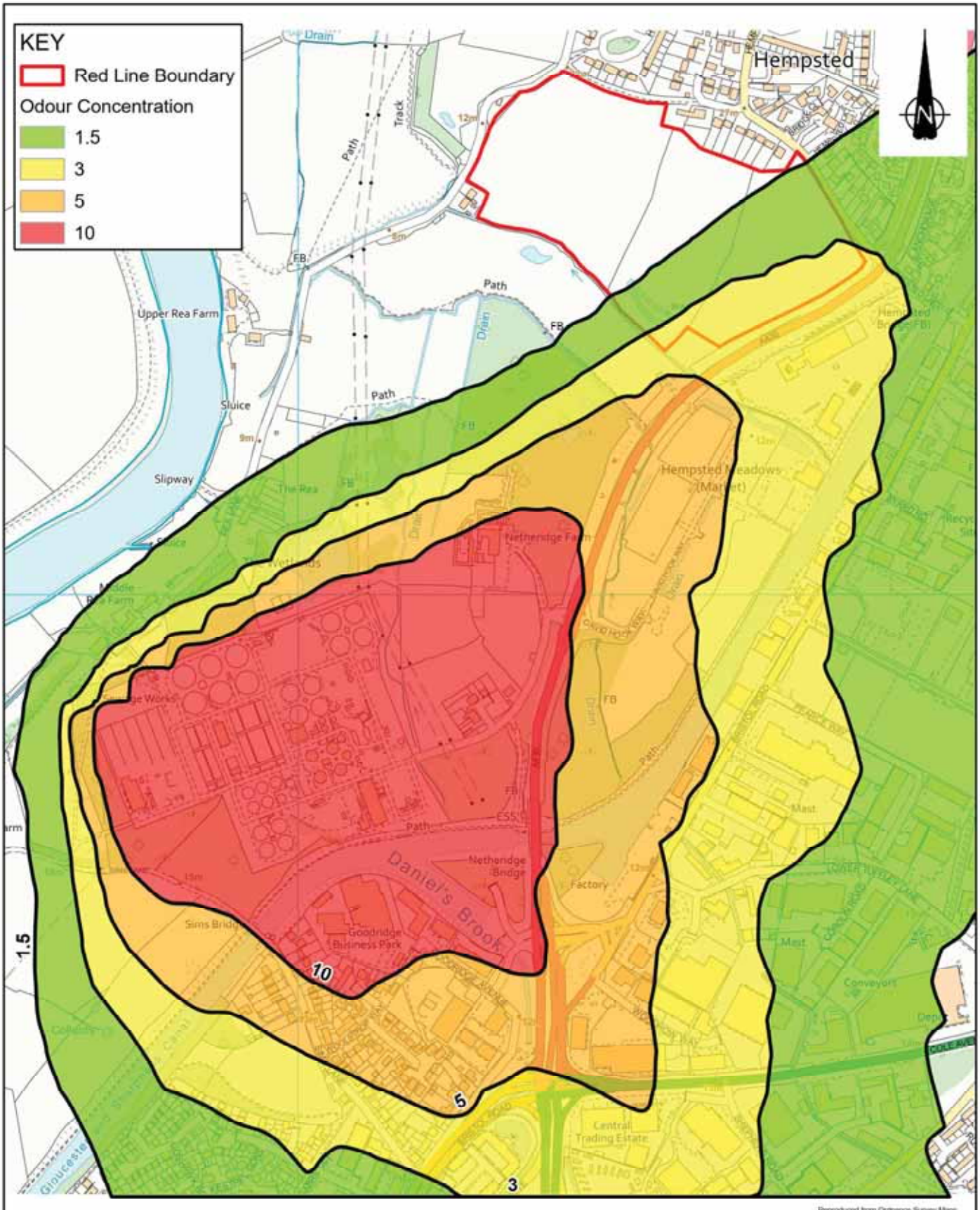
Appendix E
Odour Concentration Maps – Sensitivity Analysis



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PROJECT: HEMPSTED LANE, GLOUCESTER	DRAWN BY: CT	CHECKED BY: MTW	APPROVED BY: MTW
DRAWING TITLE: 2017 SENSITIVITY ANALYSIS			

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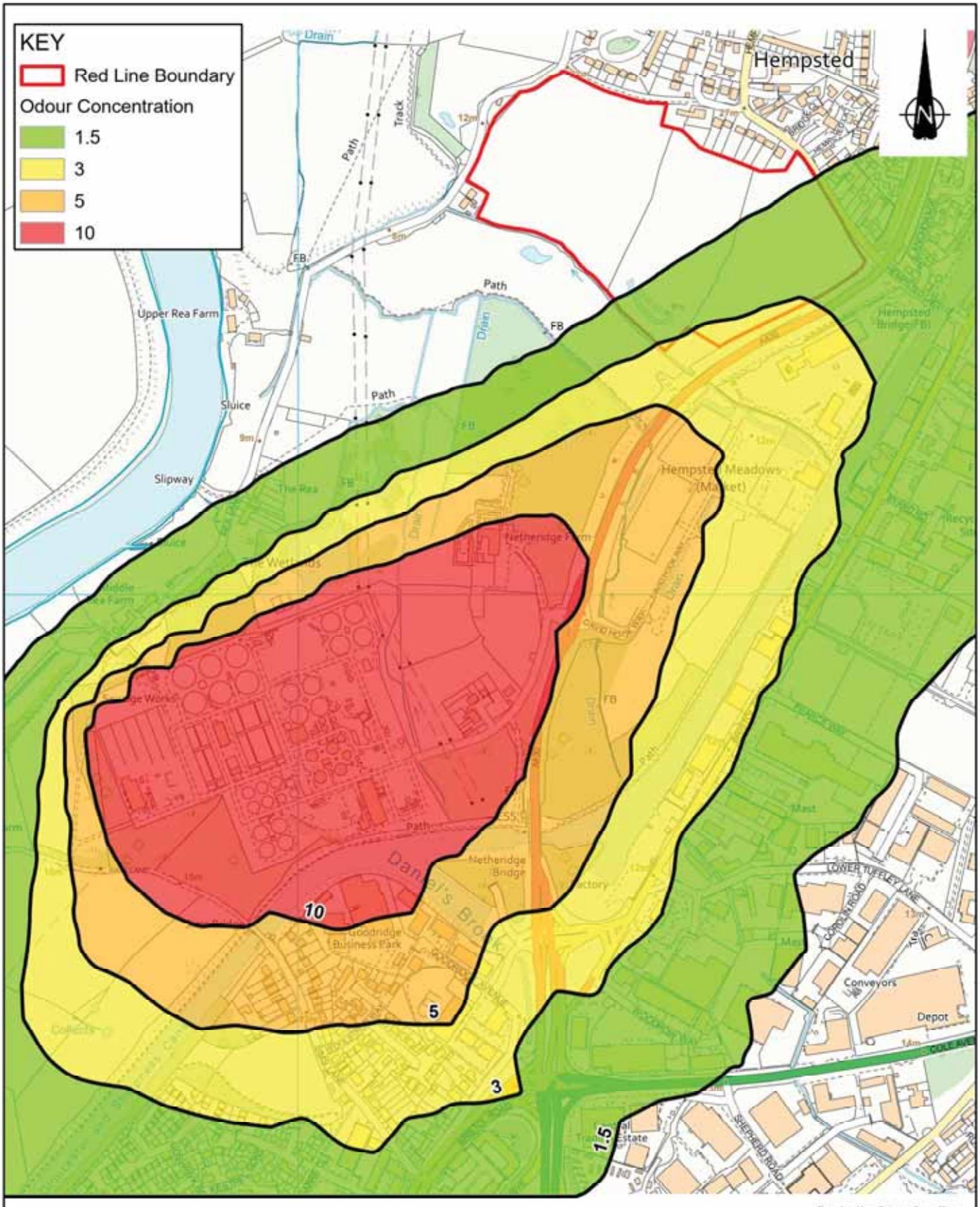

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PROJECT: HEMPSTED LANE, GLOUCESTER	DRAWN BY: CT	CHECKED BY: MTW	APPROVED BY: MTW
DRAWING TITLE: 2018 SENSITIVITY ANALYSIS			

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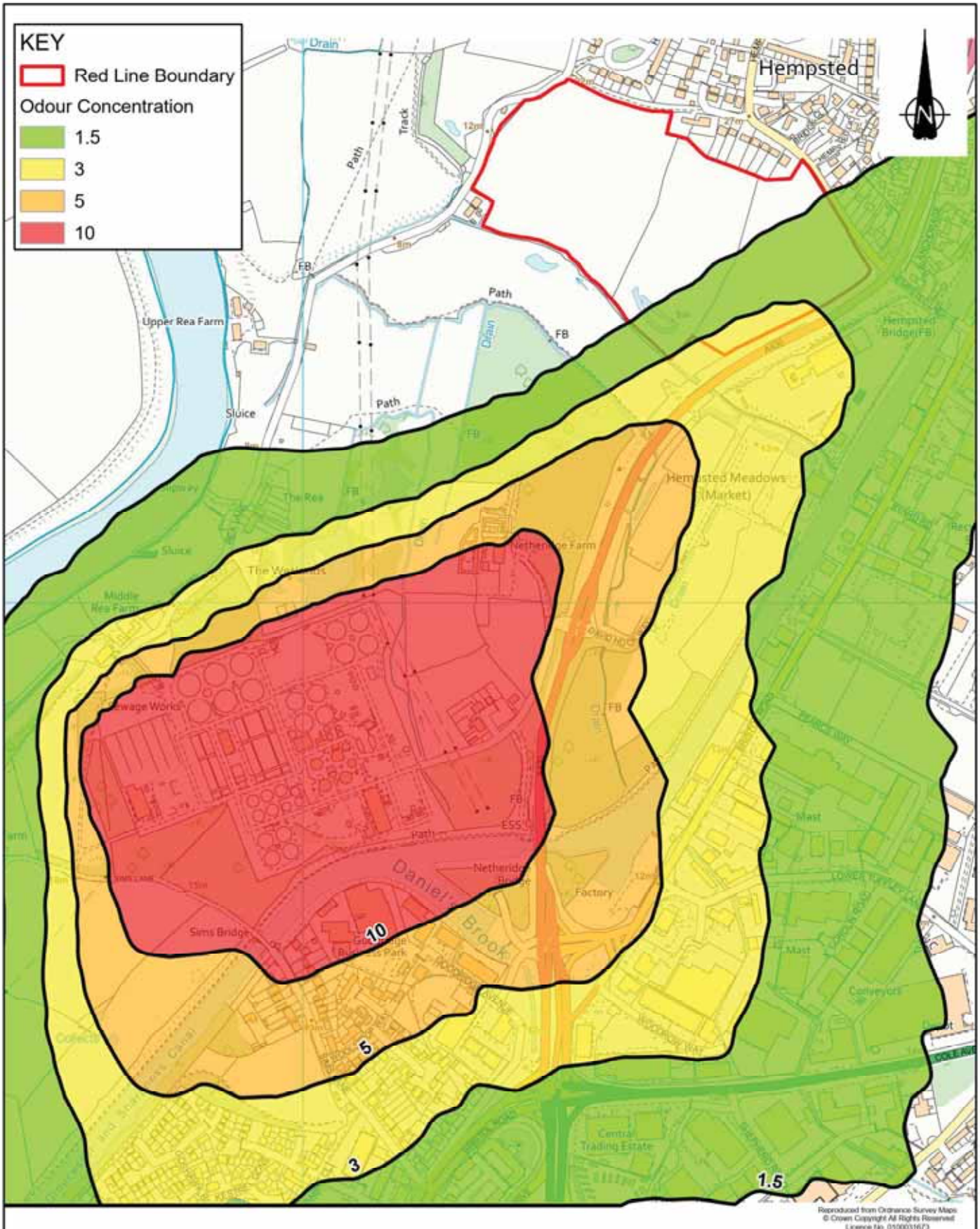

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PROJECT: HEMPSTED LANE, GLOUCESTER	DRAWN BY: CT	CHECKED BY: MTW	APPROVED BY: MTW
DRAWING TITLE: 2019 SENSITIVITY ANALYSIS			

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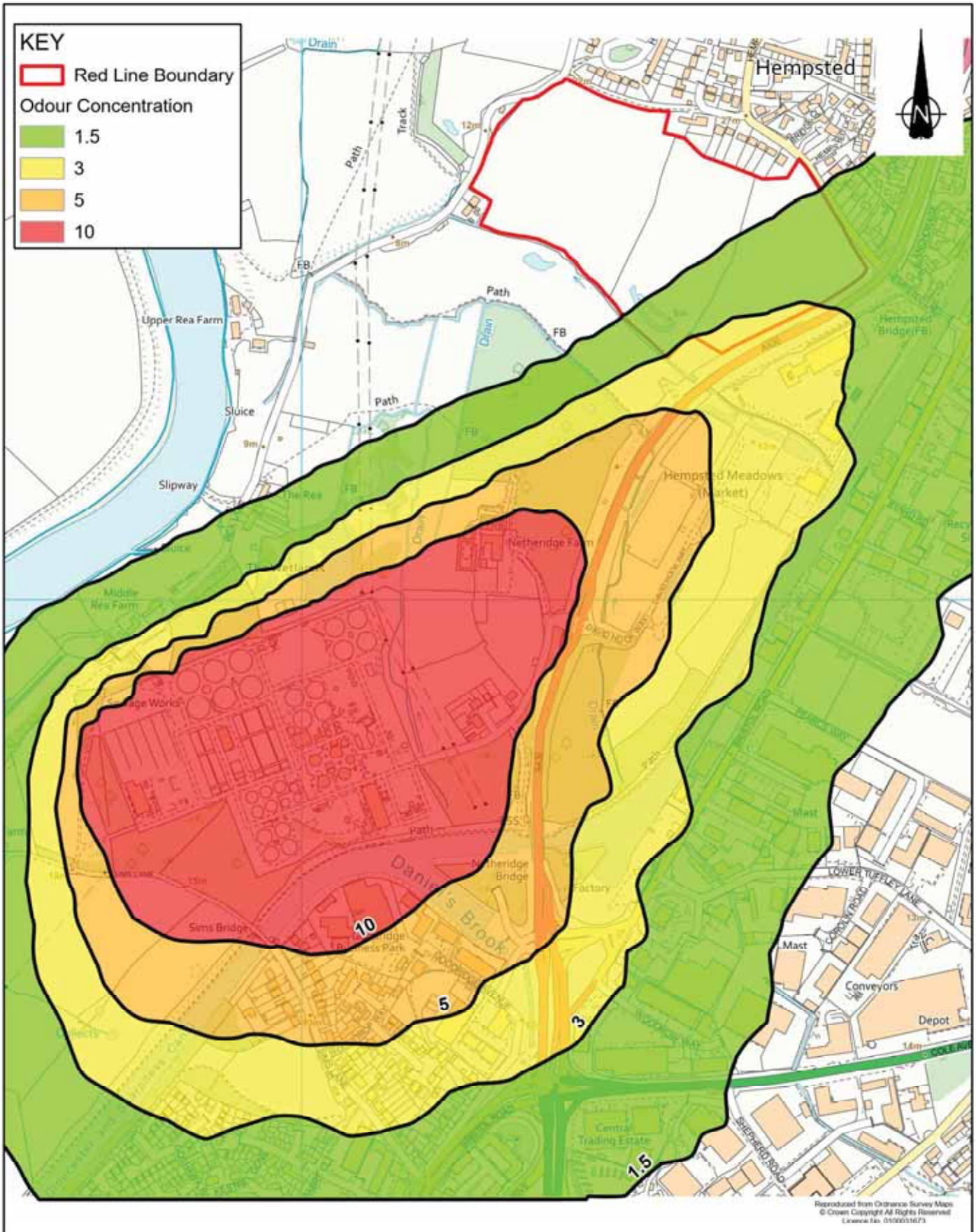

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PROJECT: HEMPSTED LANE, GLOUCESTER	DRAWN BY: CT	CHECKED BY: MTW	APPROVED BY: MTW
DRAWING TITLE: 2020 SENSITIVITY ANALYSIS			

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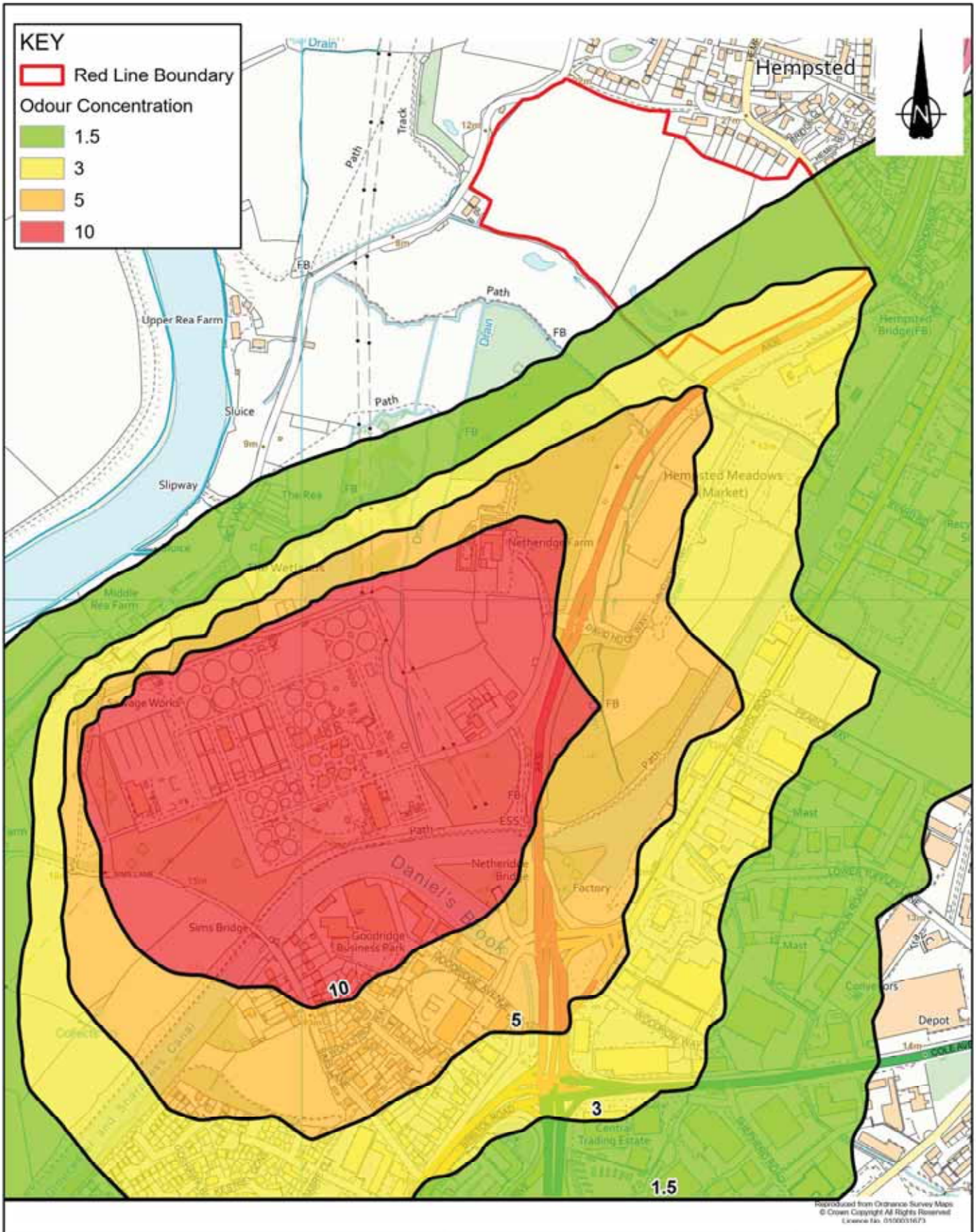

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PROJECT: HEMPSTED LANE, GLOUCESTER	DRAWN BY: CT	CHECKED BY: MTW	APPROVED BY: MTW
DRAWING TITLE: 2021 SENSITIVITY ANALYSIS			

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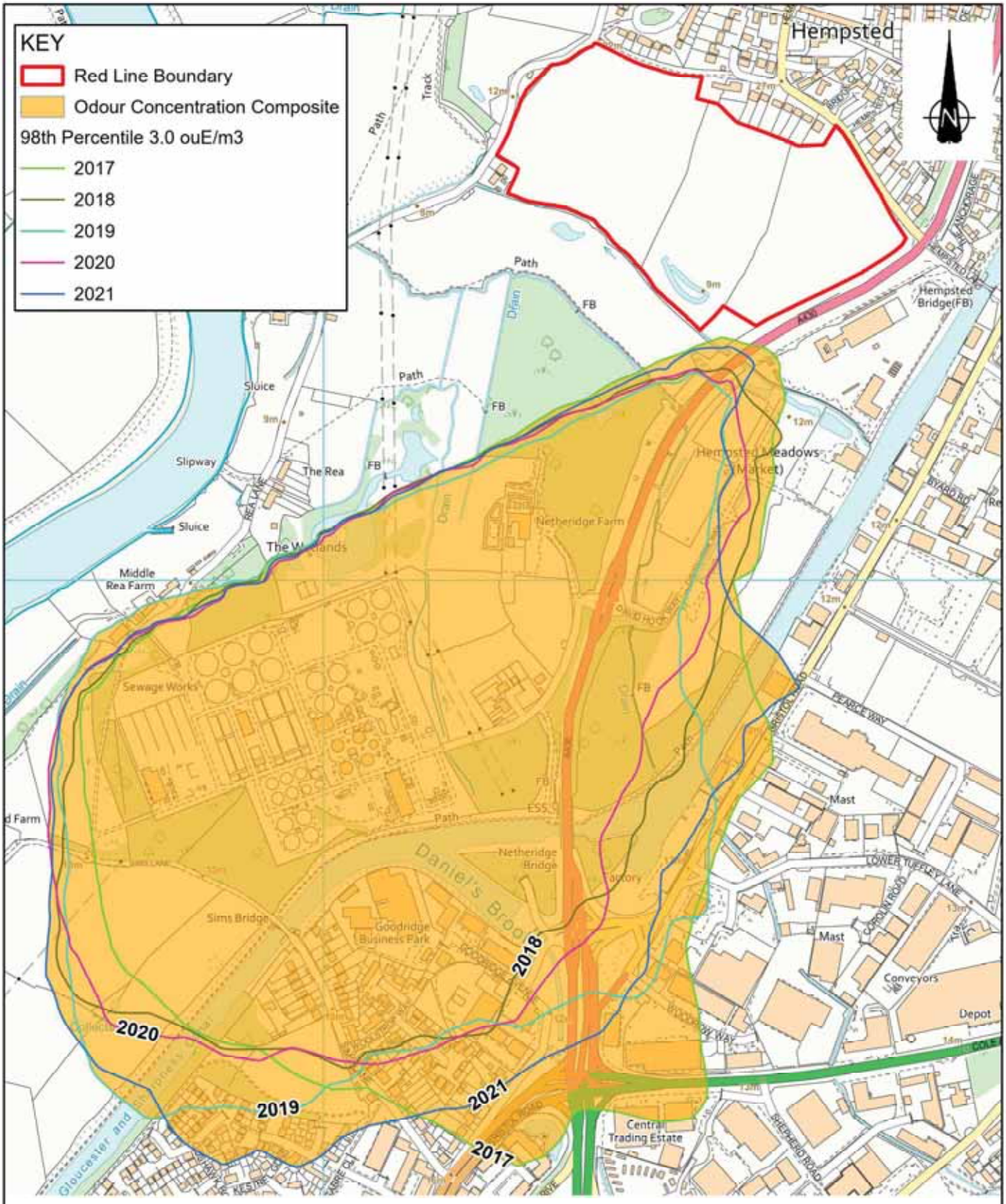
Appendix F
Development Framework Plan

CD6.10

DRAWINGS



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PROJECT: HEMPSTED LANE, GLOUCESTER	DRAWN BY: CT	CHECKED BY: MTW	APPROVED BY: MTW
DRAWING TITLE: ODOUR CONCENTRATION COMPOSITE			

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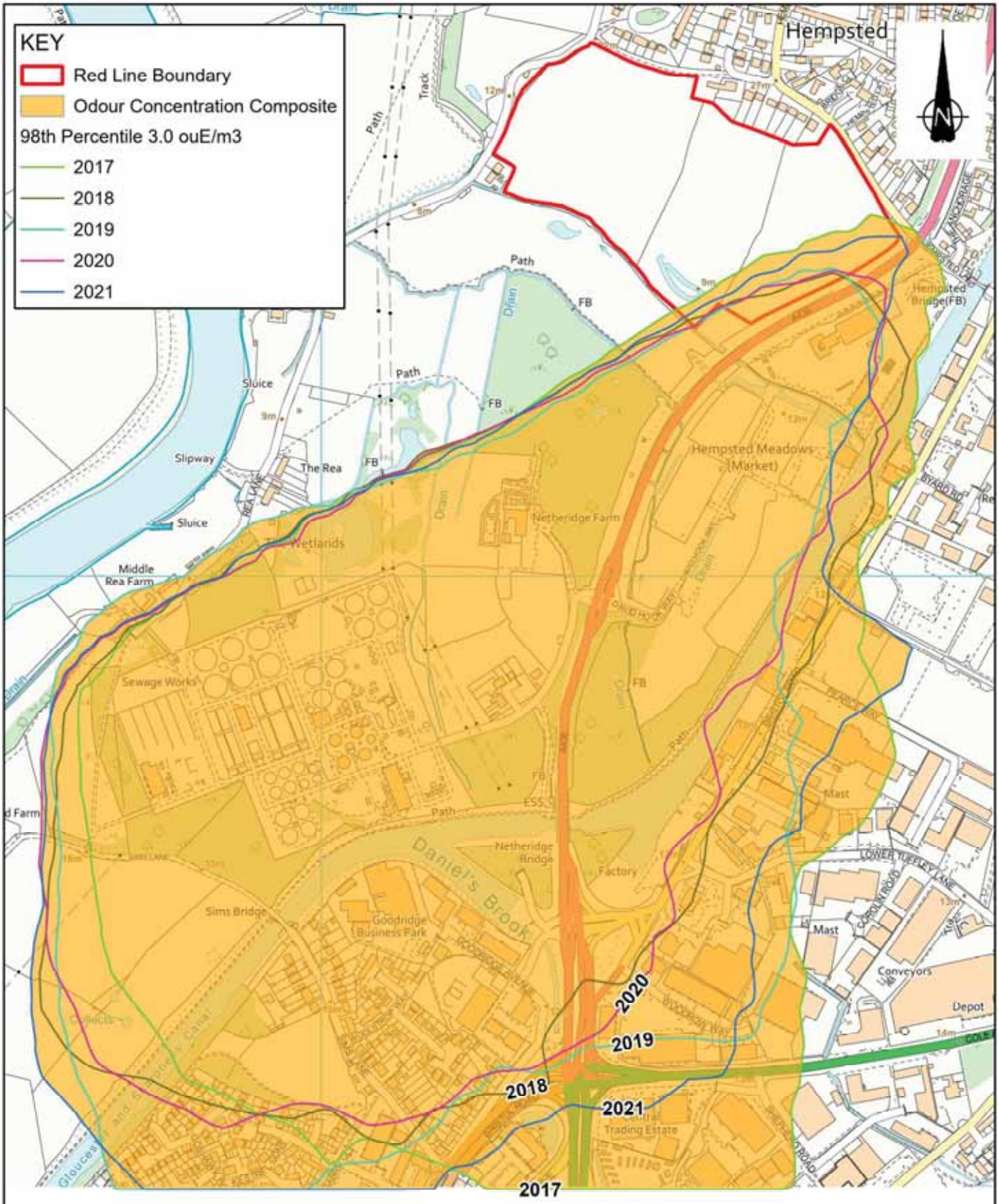

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DRAWING TITLE: ODOUR CONCENTRATION COMPOSITE SENSITIVITY ANALYSIS			

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